Appendix C: Willimantic South Variations

C.1: Description and Analysis

C.2: Aerial Segment Mapsheets: 1”=400’

Appendix C.1:

Description and Analysis of

Willimantic South Variations

(Section 15.5 of the Connecticut Light & Power Company's December, 2011 Application to the Connecticut Siting Council for the Interstate Reliability Project)

15.5 WILLIMANTIC SOUTH VARIATIONS

15.5.1 Introduction and Summary

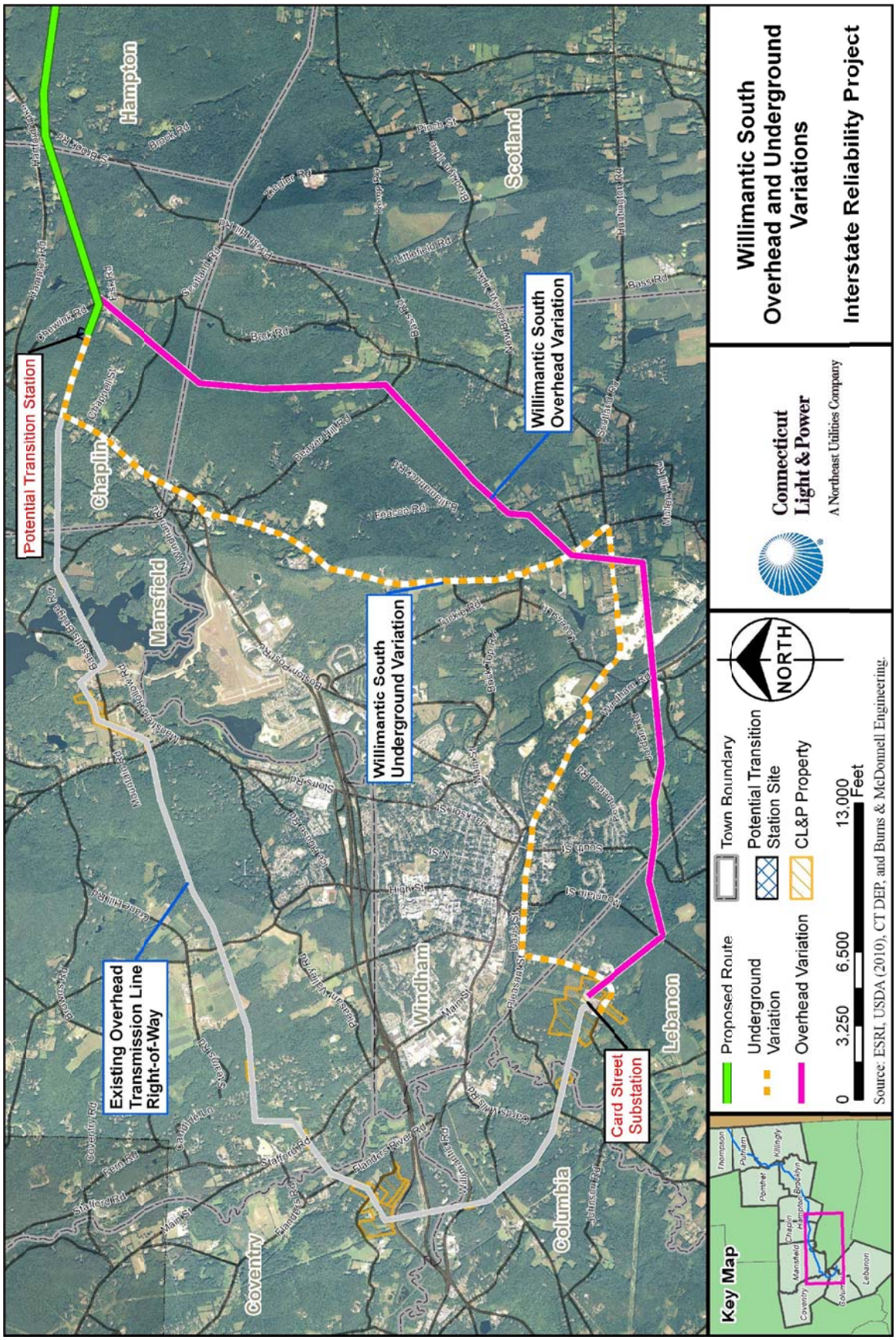
15.5.1.1 Purpose of the Variations

The Willimantic South Overhead and Underground Variations provide potential routing and transmission line configuration alternatives to the western 11.6 to 11.9 miles of the proposed Project (i.e., the 345-kV overhead transmission line located adjacent to CL&P's existing 330 Line through portions of the towns of Lebanon, Columbia, Coventry, Mansfield, and Chaplin). The two route variations were identified as alternatives for consideration to avoid aligning the new 345-kV transmission line across the approximately 1.4 miles of federally-owned properties through Mansfield Hollow State Park (including Mansfield Hollow Lake) and the Mansfield Hollow WMA in the towns of Mansfield and Chaplin. As described in Volume 1, to develop the Project as proposed along these ROW segments, CL&P plans to obtain additional easements (totaling approximately 11 acres) from the federal government. The additional easements would allow CL&P to expand the existing 150-foot-wide ROW to construct and operate the new 345-kV line adjacent to the 330 Line in a matching configuration. In addition to this proposed configuration, CL&P has identified two other configuration options for aligning the new 345-kV line through the Mansfield Hollow federal lands, using either no ROW expansion or a minimum ROW expansion (refer to Section 10, Volume 1 for further discussion of these configuration options). The Willimantic South Variations would not traverse these federally-owned properties.

Figure 15-10 illustrates the locations of the Willimantic South Variations in relation to the Proposed Route[20]. As Figure 15-10 shows, both of the Willimantic South Variations would extend east from CL&P's Card Street Substation in the Town of Lebanon, passing south of the City of Willimantic before turning north-northeast to interconnect to CL&P's existing 345-kV transmission line ROW, east of U.S. Route 6, in the Town of Chaplin.

[20] Note that the Proposed Route is illustrated on Figure 15-10 as a gray line.

Figure 15-10: Willimantic South Variations



The Willimantic South Overhead Variation would replace approximately 11.9 miles of the proposed Project, whereas the Willimantic South Underground Variation would replace approximately 11.6 miles of the proposed Project. The portions of the proposed 345-kV overhead line route that would be replaced are depicted on XS-1 to XS-6, including XS-2 BMP (these cross-sections are included in Volume 1, Section 3 [Appendix 3A], Volume 9, and Volume 10).

15.5.1.2 Summary Comparison of the Willimantic South Variations to the Segments of the Proposed Project that would be Replaced

The Project on the route proposed in Volume 1 (i.e., the 345-kV overhead transmission line aligned along CL&P's existing ROWs) is preferred over either of the Willimantic South Variations. As summarized below and in Table 15-32, and as discussed in detail in Sections 15.5.2 and 15.5.3, compared to the portions of the proposed overhead 345-kV transmission line route that would be replaced, the development of the new 345-kV line along either of the Willimantic South Variations would result in greater impacts to environmental resources or would be more costly. These adverse effects would significantly outweigh any benefits that would be achieved by avoiding the alignment of the new 345-kV transmission line through the approximately 1.4 miles of the federally-owned Mansfield Hollow properties.

Willimantic South Overhead Variation

Except for a 1-mile segment directly southeast of Card Street Substation, the 9.6-mile Willimantic South Overhead Variation would require a new "greenfield" utility corridor for the western portion of the proposed overhead 345-kV line. The development of the 345-kV line along this variation would add an estimated $17 million to the cost of the Project, including new ROW acquisition costs.

Table 15-32: Comparison of Willimantic South Variations to the Portions of the Proposed Route that Each Would Replace

Characteristic	Willimantic South – Overhead		Willimantic South – Underground	
	Proposed Route Segment to be Replaced	Overhead Variation	Proposed Route Segment to be Replaced	Underground Variation
Town(s) Traversed	Lebanon, Columbia, Coventry, Mansfield, Chaplin	Lebanon, Windham, Chaplin	Lebanon, Columbia, Coventry, Mansfield, Chaplin	Lebanon, Windham, Chaplin
Route Length (miles)	11.9	9.6	11.6	10.7
Route Location	CL&P ROW except for proposed ROW expansion in Mansfield, Chaplin	0.3 mile of CL&P Card Street Substation property, 0.7 mile of CL&P ROW; greenfield corridor for 8.6 miles	CL&P ROW except for proposed ROW expansion in Mansfield, Chaplin	10.1 miles along road ROWs; 0.6 mile along CL&P ROW
Overhead Line Structures (est. no.)	111	80	108	-
Splice Vaults (est. no.)	-	-	-	35 location (105 vaults)
New ROW or Other Land Acquisition (approximate acres)	11 acres (ROW expansion: Mansfield Hollow State Park and WMA)	156 acres (15-foot ROW expansion along 0.7-mile segment; all new ROW for 8.6 miles)	11 acres (ROW expansion: Mansfield Hollow State Park and WMA)	8.2 acres (Line transition station and off-ROW Splice Vaults)
Upland Forest Clearing (est. acres)	60.0 acres	111.6 acres	61.4 acres	6.7 acres
Forested Wetland Clearing (est. acres)	10.5 acres	16.1 acres	10.2 acres	0.2 acre
Scrub-Shrub Clearing (est. acres)	9.6 acres (upland) 0.7 acre (wetland)	19.1 acres (upland) 5.5 acres (wetland)	8.8 acres (upland) 0.5 acre (wetland)	2.7 acres (upland) 0.9 acre(wetland)
Watercourse Crossings (number)*	27	15	25	3
Wetlands, Permanent Effects (fill, est. acres)	0.4 acre (access roads)	0 [2] (access roads)	0.4 acre (access roads)	1.1 acres (duct bank/access roads)
Wetlands, Temporary Effects (est. acres)	1.1 acres (access roads)	3.2 acres [1] (access roads)	1.1 acres (access roads)	0.1 acres (access roads)
Cost ($) million[2]	$62.3	$79.3	$60.8	$325.9
Cost ($) million to CT Consumers, assuming localization of excess UG Cost	$18.8	$35.8	$18.4	$283.6
Life-cycle Cost ($) million	$106.3	$126.4	$103.7	$467.8

* Streams and wetlands were field-delineated only along the Proposed Route. For the route variations, streams and wetlands were identified based on the review of aerial photography, published water resource maps, and GIS data.

1. For the overhead route variation, specific structure locations have not been defined. However, for this impact evaluation, it is assumed that all structures could be located outside of wetlands and that all access roads across wetlands and streams would be temporary (removed after construction).

2. Cost comparisons assume that the Proposed Route and overhead line configurations would be as proposed by CL&P and that the Mansfield Underground Variation and the Mount Hope Underground Variation would not be used. Estimates for the Proposed Route segment similarly assume that the new 345-kV line through the Mansfield Hollow federally-owned lands would be built as proposed by CL&P and not according to one of the configuration options.

To develop the new 345-kV line along the Willimantic South Overhead Variation, CL&P would have to acquire 156 acres of new ROW (including a 15-foot expansion of the existing 0.7-mile ROW and a 150-foot-wide "greenfield" corridor along 8.6 miles of the route). Approximately 4 acres of forest land also would have to be removed on CL&P's Card Street Substation property to connect the new 345-kV line into the substation.

Compared to the portion of the Proposed Route replaced, the route variation would require 145 more acres of new ROW, approximately 52 more acres of forest clearing, and new on-ROW access roads, and would create a new 8.6-mile linear utility corridor across wetlands and streams. In addition, the region traversed by the new corridor is considered highly sensitive for the location of as-yet unrecorded archaeological sites and, as a result, extensive cultural resource field investigations would be required to assess potential effects on such resources.

Whereas the route variation would avoid the Mansfield Hollow area, it would create a new corridor across Pomeroy State Park in the Town of Lebanon, the Shetucket River in Windham, and the Airline State Park Trail in Chaplin. The new ROW would also abut portions of Beaver Brook State Park in the towns of Windham and Chaplin. Furthermore, the new overhead transmission line ROW would create a new linear corridor through the Quinebaug – Shetucket Rivers Valley National Heritage Corridor and would not be consistent with the general goals for resource protection in the towns encompassed by the Heritage Corridor.

Overall, the Willimantic South Overhead Variation was determined to be decisively inferior to the proposed overhead 345-kV line aligned along CL&P's existing ROW. The variation would not be consistent with federal and state policies for the collocation of linear corridors and would require a new "greenfield" ROW for which CL&P would have to acquire new utility easements across privately and publicly owned properties. The use of the variation would result in comparatively significant long-term

environmental impacts associated with the creation of a new ROW (e.g., forest clearing, wetland and stream crossings).

In addition, the use of the Willimantic South Overhead Variation would result in magnetic fields along two separate ROWs, and the opportunity for reducing magnetic fields along at least one edge of the existing ROW by cancellation through best circuit phasings with a new 345-kV line adjacent to the existing 330 circuit within the existing CL&P ROW would be lost. Further, compared to the proposed Project segment that would be replaced, the variation would not present a clear magnetic field reduction advantage and would be significantly more costly. (Refer to Volume 1, Section 7 for a discussion of MF along the Proposed Route.)

Willimantic South Underground Variation

The 10.7-mile Willimantic South Underground Variation would be aligned predominantly along road ROWs, with a short (0.6-mile) segment of underground cable aligned within the existing CL&P transmission ROW in the Town of Chaplin. Like the Willimantic South Overhead Variation, this underground variation also would avoid the federally-owned lands in the Mansfield Hollow area. If the "along road" portions of the underground variation could be installed primarily within paved road ROWs (which is not certain), potential environmental effects associated with vegetation clearing would be minimized.

On the other hand, the variation would involve continuous trenching and excavation for the cable system's duct bank and splice vaults. This would result in extensive soil disturbance and potential direct effects to water resources, including small streams and wetlands. The installation of the cable system beneath larger watercourses (the Shetucket River) and railroads would require the use of special construction techniques (e.g., jack and bore or HDD). In addition, the construction and operation of a new 345-kV line transition station on the eastern end of the cable system would require the acquisition

and conversion to utility use of up to 4 acres of property. On the western end of the underground cable system, the line transition facilities could be accommodated within the fenced area at CL&P's Card Street Substation.

Like the Willimantic South Overhead Variation, the Willimantic South Underground Variation also would be more costly, requiring estimated capital expenditures of $265.1 million more than those of an overhead line configuration along the Proposed Route. As described in Section 14.3.1.3, these increased costs would not likely qualify for inclusion in New England regional transmission rates. As a result, in addition to paying 27% of the cost of building the base-case overhead line, Connecticut consumers would likely be responsible to pay 100% of any costs that exceed the cost of building the base-case overhead line, including extra costs for constructing underground cables and EMF BMP line designs..[21] Because this variation would be constructed for 10.1 miles along or adjacent to road ROWs, it would provide an additional linear source of magnetic fields for this length, and would pass by several Statutory Facilities. However, while magnetic fields would be elevated directly over and near to the cables and splice vaults, they would drop off quickly to background levels laterally.

Along the 0.6-mile segment in Chaplin where the cable system would be aligned within CL&P's existing ROW, implementing this variation would result in lower magnetic field levels along the northern edge of the existing ROW, but higher magnetic field levels on the southern edge of the ROW, compared to the situation where the new proposed overhead transmission line was built within the ROW. The magnetic fields on the northern edge of the ROW could be reduced by the use of a different overhead line design. (For information concerning projected magnetic fields along sections of the ROW that would be replaced

[21] Connecticut consumers would likely bear all of these extra costs, in addition to the 27% share of the cost of the base-case overhead line construction that the variation would replace. Since the Willimantic South Underground Variation would cost approximately six times more than the comparable segment of proposed overhead transmission line (constructed pursuant to standard good utility practice), the cost to Connecticut consumers for the 10.7-mile underground segment would be approximately 15 times more than that of the overhead line, as further detailed in Section 15.5.3.7.

by the Willimantic South Variations, refer to the information concerning "Focus Areas" A, B, and C in Volume 1, Section 7, Appendix 7B.)

Based on the substantial additional costs of constructing the Willimantic South Underground Variation and its lack of any significant advantage in reducing magnetic field levels or exposures, the proposed overhead 345-kV line configuration, aligned along the Proposed Route, was selected over the variation.

15.5.2 Willimantic South Overhead Variation

15.5.2.1 Location of the Route Variation

The approximately 9.6-mile Willimantic South Overhead Variation would replace the western-most 11.9 miles of the Proposed Route, along which the new 345-kV line would be developed in an overhead configuration adjacent to the 330 Line within CL&P's existing ROWs. The variation would involve the development of the new overhead 345-kV transmission line for approximately 0.3 mile on CL&P's Card Street Substation property, 0.7-mile along CL&P's existing 115-kV line ROW (with a small expansion) near Card Street Substation, and then for approximately 8.6 miles along a new "greenfield" corridor (refer to Figure 15-10).

From Card Street Substation, the route variation would traverse generally southeast through the Town of Lebanon and then east – northeast through portions of the towns of Windham and Chaplin, before re-connecting to CL&P's existing 330 Line ROW near U.S. Route 6. Table 15-33 identifies the towns that would be traversed along the variation, compared to the Proposed Route. To develop a 345-kV overhead transmission line along this variation, CL&P would have to acquire new utility easements from private landowners, as well as from the state (for the crossing of Pomeroy State Park, the Airline State Park Trail, and possibly Beaver Brook State Park).

Table 15-33: Towns Traversed along the Willimantic South Overhead Variation vs. the Proposed Route

Municipality	Proposed Overhead Transmission Line Segment on Existing CL&P ROW to be Replaced (Miles)	Willimantic South Overhead Variation (Miles)
Lebanon	0.6	1.7
Columbia	1.7	-
Coventry	1.2	-
Mansfield	6.4	-
Chaplin	2.0	1.0
Windham	-	6.9
Total Miles	**11.9**	**9.6**

15.5.2.2 Technical Description (Design, Appearance, Land Requirements, Cost)

The Willimantic South Overhead Variation would extend for approximately 9.6 miles through the towns of Lebanon, Windham, and Chaplin. Along 8.6 miles of the variation, CL&P would have to acquire easements, predominantly from private landowners, to develop a new 150-foot-wide ROW for the overhead 345-kV line. Along approximately 1 mile of the variation (extending south-southeast from Card Street Substation), the variation would be aligned along an existing 125-foot-wide CL&P ROW that would need widening. This ROW is presently occupied by two existing 115-kV transmission lines (the 1080/1490 circuits), supported on H-frame structures. A 23-kV distribution line shares the ROW from the substation to Card Street.

Along the 0.7-mile segment of existing CL&P ROW in Lebanon, the line route variation would be constructed with a vertical configuration of the conductors on steel-monopole structures (refer to Appendix 15B). Along the 8.6-mile “greenfields” portion of the variation, the base design of the new overhead transmission line would be H-frame structures with a typical height of 85 to 90 feet (refer to Appendix 15B).

To accommodate the new 345-kV overhead line along the 0.7-mile segment, the existing ROW would have to be expanded by 15 feet along the eastern side of the ROW. Because residences are located along Card Street near the existing 1080/1490 Line ROW, options for widening the ROW to accommodate a

new 345-kV overhead line are limited; specifically, the new line could not be developed on H-frame structures (which require more widening of the ROW) without affecting the residences. In order to accommodate the new 345-kV overhead transmission line along this existing ROW segment while minimizing the amount of new ROW and without purchasing and removing the residences in the vicinity of Card Street, the existing double-circuit 115-kV line would have to be re-built using vertical conductor configurations on double-circuit steel-monopole structures, and the new 345-kV line would also be constructed with a vertical conductor configuration on single-circuit steel-monopole structures. The existing distribution line would be relocated to one edge of the ROW (refer to Appendix 15B).

The Willimantic South Overhead Variation would be approximately 2.3 miles shorter than the portion of the Proposed Route that it would replace. However, in order to construct and operate the new 345-kV overhead transmission line along this route variation, CL&P would have to acquire permanent easement rights, over approximately 156 acres of land, principally from private landowners.

In the Town of Lebanon, the overhead line-route variation would extend east-southeast from Card Street Substation for a distance of approximately 1.5 miles, 0.3 mile of which would be adjacent to Card Street Substation, 0.7 mile of which would be along CL&P's existing 115-kV transmission line ROW, and 0.5 mile of which would be new ROW. The route variation would traverse a mix of woodlands and scrub-shrub lands, passing near residential areas along Card Street and would then cross approximately 0.5 mile of Pomeroy State Park, 0.3 mile of which would be along CL&P's existing 115-kV transmission line ROW. Along this 0.3-mile segment, the existing CL&P ROW would have to be expanded by 15 feet to accommodate the new 345-kV line. Along the remaining 0.2-mile route through the park, CL&P would have to acquire a new 150-foot wide ROW.

In the Town of Windham, the line-route variation would extend east for approximately 2.4 miles before turning north-northeast and traversing approximately 4.5 miles, crossing into the Town of Chaplin near

Beaver Brook State Park. CL&P would have to acquire a new 150-foot wide ROW over the entire 6.9 miles. The overhead line-route variation would create a new utility crossing of the Shetucket River and would traverse combinations of mature mixed and wetland forested areas. The overhead variation would pass near residential areas in the vicinity of Plains Road and North Road.

In the Town of Chaplin, CL&P would have to acquire a 1.0 mile long new 150-foot wide ROW. The overhead variation route would traverse approximately 0.3 mile adjacent to the Beaver Brook State Park and would cross the Airline State Park Trail (North Section). The line route then continues across the Fin, Fur & Feather Club, Inc. property before joining the Proposed Route along CL&P's existing 345-kV transmission line ROW near Chewink Road, approximately 1 mile east of U.S. Route 6. Lands along the line-route variation in Chaplin consist primarily of mature mixed forest with some open fields and residential areas near Chewink Road.

The estimated cost of this overhead line-route variation is $79.3 million. This cost is $17 million higher than the cost for the replaced overhead 345-kV line segment along the Proposed Route built as proposed by CL&P.

15.5.2.3 Construction and Operation/Maintenance Considerations

The construction of an overhead 345-kV transmission line along the Willimantic South Overhead Variation would involve the same general techniques as described for the overhead 345-kV line on the Proposed Route (refer to Volume 1, Section 4). However, because the line-route variation would involve the use of a new (greenfield) ROW, additional work would be required to clear vegetation within the corridor and to develop new access roads along the ROW. In addition, to accommodate the new 345-kV line along the 0.7 miles of existing ROW in Lebanon, the existing 115-kV line structures along this segment would have to be removed and rebuilt, and an existing distribution line would have to be relocated to the edge of the ROW.

After the installation of an overhead line along the route variation, the entire 150-foot ROW width would have to be managed in low-growth vegetation, pursuant to CL&P policies and regulatory standards. In addition, permanent on-ROW roads would likely be required to access structure sites for operation and maintenance purposes.

15.5.2.4 Existing Environmental Features

15.5.2.4.1 Topography, Geology, and Soils

Elevations along the Willimantic South Overhead Variation range from approximately 200 feet NGVD to 590 feet NGVD. Bedrock geology in the area includes the Quinebaug and Tatnic Hill formations, whereas surficial geology consists primarily of floodplain alluvium (sand, gravel, silt and some organic matter of variable thickness), overlying sand and fines. Like the Proposed Route, the variation traverses some soils classified as Prime Farmland or Farmland Soils of Statewide Importance (refer to Table 15-34).

15.5.2.4.2 Water Resources

The Willimantic South Overhead Variation is located within the Thames River drainage basin, and would extend through regional drainage basins associated with the Natchaug, Shetucket, and Willimantic rivers. As summarized in Table 15-35, the route variation would traverse 15 watercourses (as identified based on aerial photographs and GIS data), the largest of which are Jordan Brook and the Shetucket River. All of these surface waters have water quality classifications of AA, A, or B. The route variation traverses FEMA-designated 100-year floodplains associated with Jordan Brook and the Shetucket River. The variation does not traverse any SCELs (the designated SCEL along the Shetucket River ends at Plains Road, north of the line route variation).

Table 15-34: Soils and Soil Characteristics along the Willimantic South Overhead Variation

Soil Map Unit Name and Symbol	Parent Material	Hydric Soil	Erosion Factor[1]	Depth to Bedrock (inches)	Depth to Water Table (feet)
3 Ridgebury, Leicester, Whitman	Coarse-loamy lodgment till derived from granite and/or schist and/or gneiss	Yes	0.15	--	0.0-1.5
13* Walpole sandy loam	Sandy and gravelly glaciofluvial deposits derived from granite and/or schist and/or gneiss	Yes	--	--	0.0-1.0
17 Timakwa and Natchaug	Woody organic material over sandy and gravelly glaciofluvial deposits, and woody organic material over loamy alluvium and/or loamy glaciofluvial deposits and/or loamy till	Yes	--	--	0.0-1.0
21A** Ninigret and Tisbury, 0 to 5 % slopes	Coarse-loamy aeolian deposits over sandy and gravelly glaciofluvial deposits derived from granite and/or schist and/or gneiss	No	0.43	--	1.5-2.5
23A** Sudbury sandy loam, 0 to 5 % slopes	Sandy and gravelly glaciofluvial deposits derived from granite and/or schist and/or gneiss, and coarse-loamy eolian deposits over sandy and gravelly glaciofluvial deposits derived from granite and/or schist and/or gneiss	No	--	--	1.5-3.0
29A** Agawam fine sandy loam, 0 to 3 % slopes	Coarse-loamy eolian deposits over sandy and gravelly glaciofluvial deposits derived from granite and/or schist and/or gneiss	No	0.28	--	--
29B** Agawam fine sandy loam, 3 to 8 % slopes	Coarse-loamy eolian deposits over sandy and gravelly glaciofluvial deposits derived from granite and/or schist and/or gneiss	No	0.29	--	--
34A** Merrimac sandy loam, 0 to 3 % slopes	Sandy and gravelly glaciofluvial deposits derived from granite and/or schist and/or gneiss	No	0.24	--	--
34B** Merrimac sandy loam, 3 to 8 % slopes	Sandy and gravelly glaciofluvial deposits derived from granite and/or schist and/or gneiss	No	0.24	--	--
36B* Windsor loamy sand, 3 to 8 % slopes	Eolian sands over sandy glaciofluvial deposits derived from granite and/or schist and/or gneiss	No	--	--	--
38C* Hinckley gravelly sandy loam, 3 to 15 % slopes	Sandy and gravelly glaciofluvial deposits derived from granite and/or schist and/or gneiss	No	0.15	--	--
38E Hinckley gravelly sandy loam, 15 to 45 % slopes	Sandy and gravelly glaciofluvial deposits derived from granite and/or schist and/or gneiss	No	0.15	--	--
46B Woodbridge fine sandy loam, 2 to 8 % slopes, very stony	Coarse-loamy lodgment till derived from granite and/or schist and/or gneiss	No	0.15	--	1.5-2.5
47C Woodbridge fine sandy loam, 2 to 15 % slopes, extremely stony	Coarse-loamy lodgment till derived from granite and/or schist and/or gneiss	No	0.10	--	1.5-2.5
50B** Sutton fine sandy loam, 3 to 8 % slopes	Coarse-loamy melt-out till derived from granite and/or schist and/or gneiss	No	0.15	--	1.5-2.5
51B Sutton sandy loam, 2 to 8 % slopes, very stony	Coarse-loamy melt-out till derived from granite and/or schist and/or gneiss	No	0.15	--	1.5-2.5

Soil Map Unit Name and Symbol	Parent Material	Hydric Soil	Erosion Factor[1]	Depth to Bedrock (inches)	Depth to Water Table (feet)
52C Sutton fine sandy loam, 2 to 15 % slopes, extremely stony	Coarse-loamy melt-out till derived from granite and/or schist and/or gneiss	No	0.15	--	1.5-2.5
60B** Canton and Charlton, 3 to 8 % slopes	Coarse-loamy over sandy and gravelly melt-out till derived from granite and/or schist and/or gneiss	No	0.17	--	--
61B Canton and Charlton, 3 to 8 % slopes, very stony	Coarse-loamy over sandy and gravelly melt-out till derived from granite and/or schist and/or gneiss	No	0.17	--	--
61C Canton and Charlton, 8 to 15 % slopes, very stony	Coarse-loamy over sandy and gravelly melt-out till derived from granite and/or schist and/or gneiss	No	0.17	--	--
62C Canton and Charlton, 3 to 15 % slopes, extremely stony	Coarse-loamy over sandy and gravelly melt-out till derived from granite and/or schist and/or gneiss	No	0.17	--	--
62D Canton and Charlton, 15 to 35 % slopes, extremely stony	Coarse-loamy over sandy and gravelly melt-out till derived from granite and/or schist and/or gneiss	No	0.17	--	--
73C Charlton-Chatfield complex, 3 to 15 % slopes, very rocky	Coarse-loamy melt-out till derived from granite and/or schist and/or gneiss	No	0.17	20-40	--
73E Charlton-Chatfield complex, 15 to 45 % slopes, very rocky	Coarse-loamy melt-out till derived from granite and/or schist and/or gneiss	No	0.17	20-40	--
84B** Paxton and Montauk fine sandy loam, 3 to 8 % slopes	Coarse-loamy lodgment till derived from granite and/or coarse-loamy lodgment till derived from gneiss and/or coarse-loamy lodgment till derived from gneiss and/or coarse-loamy lodgment till derived from granite	No	0.20	--	1.5-2.5
85B Paxton and Montauk fine sandy loam, 3 to 8 % slopes, very stony	Coarse-loamy lodgment till derived from granite and/or coarse-loamy lodgment till derived from gneiss and/or coarse-loamy lodgment till derived from gneiss and/or coarse-loamy lodgment till derived from granite	No	0.20	--	1.5-2.5
86C Paxton and Montauk fine sandy loam, 3 to 15 % slopes, extremely stony	Coarse-loamy lodgment till derived from granite and/or coarse-loamy lodgment till derived from gneiss and/or coarse-loamy lodgment till derived from gneiss and/or coarse-loamy lodgment till derived from granite	No	0.20	--	1.5-2.5
86D Paxton and Montauk fine sandy loam, 15 to 35 % slopes, extremely stony	Coarse-loamy lodgment till derived from granite and/or coarse-loamy lodgment till derived from gneiss and/or coarse-loamy lodgment till derived from gneiss and/or coarse-loamy lodgment till derived from granite	No	0.20	--	1.5-2.5
102** Pootatuck fine sandy loam	Coarse-loamy alluvium	No	0.24	--	1.5-2.5
103* Rippowam fine sandy loam	Coarse-loamy alluvium	Yes	0.15	--	0.0-1.5

Soil Map Unit Name and Symbol	Parent Material	Hydric Soil	Erosion Factor[1]	Depth to Bedrock (inches)	Depth to Water Table (feet)
307 Urban land	This is a miscellaneous area ***				

Source: USDA Natural Resources Conservation Service, Online Soil Surveys and Geographic Data of New London, Tolland, and Windham counties, 2009.
* Soils classified as Farmland Soils of Statewide Importance
** Soils classified as Prime Farmland Soils
*** Miscellaneous areas are those instances where soils have been altered or obscured by urban works and structures (buildings, paved areas, industrial areas) or standing water.
1. Erosion Factor (K (dimensionless)): Indicates the erodability of the whole soil, the higher the value, the more susceptible the soil to erosion.
-- No Data Available. No bedrock or water encountered to survey depth.

Table 15-35: Watercourses Traversed by the Willimantic South Overhead Variation

Municipality	Watercourse Series Number[1] and Name (Where Applicable)	Water Quality[2] / Fisheries Classification[3] (where applicable)	Watercourse Frequency Type (P or I) [4]
Lebanon			
	S23-1/Jordan Brook	A/coldwater	P
Windham			
	S23-2/Intermittent Tributary to Jordan Brook	A/coldwater	I
	S23-3/Intermittent Tributary to Jordan Brook	A/coldwater	I
	S23-4/Intermittent Tributary to Jordan Brook	A	I
	S23-5/Intermittent Tributary to Jordan Brook	A/coldwater	I
	S23-6/Intermittent Tributary to Jordan Brook	A/coldwater	I
	S23-7/Shetucket River	B/coldwater	P
	S23-8/Intermittent Watercourse	A	I
	S23-9/Pottens Brook	A	I
	S23-10/Chestnut Hill Brook	A/coldwater	P
	S23-11/Ballymahack Brook	A/coldwater	P
	S23-12Intermittent Tributary to Beaver Brook	A	I
	S23-13/Intermittent Tributary to Beaver Brook Pond	A/coldwater	I
Chaplin			
	S23-14/Ames Brook	AA/coldwater	P
	S23-15/Intermittent Tributary to Ames Brook	A/coldwater	I

1. Series No. refers to waterbody numbers on the aerial photographs in Volume 9.
2. Table 5-2 in Volume 1 defines the water classifications as defined by the Connecticut Water Quality Standards:
3. Fishery Classification (where applicable) was obtained by personnel communication with Don Gonyea and Neal Hagstrom at CT DEEP.
4. P = Perennial; I = Intermittent.

Based on reviews of published wetland (NWI) maps, soils maps, state GIS data, and aerial photography, the Willimantic South Overhead Variation would traverse 22 wetlands. Table 15-36 summarizes the characteristics of these wetlands.

A review of aerial photography and NWI mapping indicates that a total of approximately 29 acres of wetlands would be located along the line route variation[22]. These wetlands consist of the following cover types: approximately 17 acres of palustrine forested (PFO), 6.2 acres of palustrine scrub-shrub (PSS), 3.2 acres of palustrine emergent (PEM), and 2.4 acres of open water (PUB) or riverine (R2).

Groundwater resources along the Willimantic South Overhead Variation are classified by CT DEEP as "GA" within the Town of Lebanon; "GA", "GB", "GC", or "GA/GAA" within the Town of Windham; and "GA/GAA/GAA" within the Town of Chaplin. No public wells, or Connecticut Aquifer Protection Areas are crossed by or within the vicinity of the variation. Potable water is obtained from a combination of private groundwater wells and from surface water drawn from the Willimantic Reservoir, which is located more than 2 miles northwest of the variation, near the Windham Airport.

[22] Acreage of wetlands was calculated using the area of the ROW across the wetland type.

Table 15-36: Wetlands along the Willimantic South Overhead Variation

Municipality Vol. 9 Mapsheet Nos.	Wetland Series Number[1]	Wetland Classification[2]
Lebanon		
1 of 11	W21-16	PFO
1 of 11	W21-14	PFO/PSS
1 of 11	W22-1	PFO/PSS
1 of 11	W23-1	PFO/POW/PSS/PFO
2 of 11	W23-2	PFO
Lebanon/Windham		
2 of 11	W23-3	PFO
Windham		
3 of 11	W23-5	PFO/POW/PSS
3 of 11	W23-6	PFO/PEM/PSS
4 of 11	W23-7	PFO
4 of 113	W23-8	PFO/POW/PEM
4 of 11	W23-9	PEM/PFO/POW/PSS
5 of 11	W22-5	PSS
5 of 113	W23-10	PFO
5-6 of 11	W23-11	PFO
6 of 11	W23-12	PSS
6 of 11	W23-13	PFO
7 of 11	W23-14	PSS
7 of 11	W23-15	PSS
7 of 11	W23-16	PFO
7 of 11	W23-17	PFO
7-8 of 11	W23-18	PSS/PFO
8 of 11	W23-19	PFO
9-10 of 11	W23-20	PFO
Chaplin		
11 of 113	W23-21	PFO

NOTES:

1. Series No. refers to wetland number illustrated on the maps for the route variation in Volume 9.
2. Wetlands classification according to Cowardin et al 1979; PEM = Palustrine Emergent Wetland; PFO = Palustrine Forested Wetland; PSS = Palustrine Scrub-Shrub Wetland; POW = Palustrine Open Water; PUB = Palustrine Unconsolidated Bottom.

15.5.2.4.3 Biological Resources

Vegetative Communities

Most of the Willimantic South Overhead Variation would traverse along a new ROW, along which vegetative communities are dominated by forest habitat, intermixed with areas of open fields, wooded floodplains along the Shetucket River, and wetlands. Based on a 150-foot-wide width for the new ROW and the expansion of the existing 115-kV ROW, the footprint of the Willimantic South Overhead Variation would encompass approximately 172.5 acres, of which approximately 127.7 acres are presently forested (upland and wetland). These acreages include the 0.3 miles of line that would be construction adjacent to Card Street Substation on a 150-foot wide ROW located on land owned by CL&P, 0.7 miles of line constructed on existing ROW to be slightly expanded (including impacts along the 140-foot-wide ROW) and 8.6 miles of new ROW.

Approximately 26.8 acres of wetlands would be located within the construction footprint of the route variation. These include approximately 3.2 acres of emergent marsh, 16.1 acres of forested wetlands, 2 acres of open water / riverine areas, and 5.5 acres of scrub-shrub wetlands.

Fish and Wildlife Resources

The wildlife resources associated with the habitat types found along the Willimantic South Overhead Variation can be expected to be similar to those identified for the same habitats for the Proposed Route (refer to Section 5.3, Volume 1).

Based on consultations with the CT DEEP, the perennial watercourses traversed by the Willimantic South Overhead Variation provide fishery habitat, principally for cold-water fish species. Each fall, the CT DEEP stocks the Shetucket River with large (2 to 15 pound) Atlantic salmon below the Scotland Dam, which is 3 miles south of the route variation. The Shetucket River is also a proposed Trophy Trout Water.

Amphibians

Due to the lack of survey rights to the privately-owned properties, no field surveys to determine amphibian breeding habitat or potential areas of vernal pools were conducted along the Willimantic South Overhead Variation.

Listed Species

CL&P consulted with both federal and state agencies regarding the known or potential occurrence of federally- or state-listed species in the vicinity of the route variation (copies of correspondence from these agencies are included in Volume 4). Although the variation does not encompass the known habitat of any federally-listed species, the New England cottontail (*Sylvilagus transitionalis*), which the USFWS lists as a candidate species for federal protection, is reported to occur in the Town of Lebanon.

Based on a review of CT NDDB, the route variation does not traverse any areas of known habitat for state-listed species, except near the intersection with the Proposed Route in the Town of Chaplin. In addition, the variation is located directly south of, but does not traverse, CT NDDB designated areas along the Shetucket River and near Lake Marie, both in the Town of Windham.

WMAs and Other Wildlife Management Areas

The Willimantic South Overhead Variation would not cross any state- or federally-designated WMAs. However, the route variation would traverse approximately 0.5 mile across Pomeroy State Park in the Town of Lebanon and would traverse approximately 0.3 mile adjacent to Beaver Brook State Park in the Towns of Windham and Chaplin. Although not designated as WMAs, both of these parks include areas where bow hunting is allowed.

Immediately to the north of Beaver Brook State Park, the overhead route variation would traverse approximately 0.6 mile of property owned by the Fin, Fur and Feather Club, Inc. in the Town of Chaplin.

The Fin, Fur, and Feather Club, Inc. property is a privately-owned sportsman's area that offers archery, black powder, hunting, fishing, rifle, pistol, and shotgun sports activities.

15.5.2.4.4 Land Uses

The Willimantic South Overhead Variation would traverse the northeastern portion of the Town of Lebanon, central and northern portions of the Town of Windham, and the southern portion of the Town of Chaplin. Land-use plans for these towns were reviewed, and land uses along and adjacent to this line route variation were characterized.

Land uses in the vicinity of the Overhead Variation consist primarily of forested lands, interspersed with residential and commercial development, scrub-shrub lands, and agricultural areas. As illustrated on the Volume 9 maps, extending south and then east from Card Street Substation to the Lebanon/Windham town border, the Willimantic South Overhead Variation would traverse primarily scrub-shrub and forested areas, including lands managed in low-growth vegetation along CL&P's existing ROW. In this area, the line-route variation would cross approximately 0.5 mile through Pomeroy State Park.

In the Town of Windham, the route variation would cross a mix of land uses, including forested, commercial, residential, and agricultural areas. Within the Town of Chaplin, the majority of the route variation would be aligned across forested areas, although some residential areas would be located near the ROW along Chewink Road. The line-route variation then crosses several recreational-use areas, including the Airline State Park Trail and the Fin. Fur, and Feather Club, Inc. property.

Overall, the overhead line-route variation would encompass approximately 26.8 acres of wetlands, 19.2 acres of open field / shrubland uses, 2.1 acres of ROWs, 111.6 acres of mature mixed forest, 3.3 acres of agricultural lands, 2.2 acres of house/yard uses, and 7.5 acres of commercial / industrial uses. Except for the state-owned parklands, the route variation would be located on privately-owned property, across which CL&P would have to acquire new easements for the 345-kV overhead transmission line; along the

0.7-mile segment of ROW near Card Street Substation, CL&P would have to acquire additional rights for an easement expansion.

As illustrated on the Volume 9 and 11 maps, lands along and in the vicinity of the Willimantic South Overhead Variation are zoned primarily for residential use. Zoning classifications include Residential Agricultural (RA) uses in the Town of Lebanon; Residential (R-1, R-2, R-3, R-4) and industrial (M-1, M-2) uses in the Town of Windham; and Rural Agriculture Residence District (RAR) and Light Industry (L) uses in the Town of Chaplin.

No Statutory Facilities are located along the Willimantic South Overhead Variation. However, low-density rural residential developments are located near the route variation in the vicinity of Plains Road, North Road, and Ballamahack Road in the Town of Windham, and Chewink Road in the Town of Chaplin. In these areas, 22 homes would be located within 300 feet of the edge of the line-route variation ROW.

The three towns traversed by the Willimantic South Overhead Variation are all located within the designated Quinebaug-Shetucket Rivers Valley National Heritage Corridor. The variation also would traverse Pomeroy State Park a 286-acre state-designated area of preserved open space. The park is undeveloped and contains no public facilities, but is open to bow hunting. Along the Shetucket River in Windham, the variation would cross land designated for Shetucket River Water Access. In Windham and Chaplin, the variation abuts Beaver Brook State Park, which is an undeveloped park of approximately 400 acres (303 acres are open to bow hunting). Bordering Beaver Brook State Park to the north, the variation crosses the Airline State Park Trail (Northern Section), and then extends across land owned by the Fin, Fur, and Feather Club, Inc. before joining the Proposed Route along CL&P's existing transmission ROW.

The Windham *Plan of Conservation and Development* was last updated in 2007 and includes community goals of improving community image, maintaining existing town character, expanding, improving, and

diversifying the town's economic base, enhancing and developing quality of life, providing balanced growth, protecting natural and man-made resources, and promoting energy efficiency. Other applicable local land-use plans include those for the towns of Lebanon and Chaplin, which are discussed for the proposed Project in Volume 1, Section 5.4.

Applicable regional, state, and federal plans include those prepared by the Windham Region Council of Governments (WINCOG) and the NECCOG, and the Conservation and Development Plan for the State of Connecticut. These plans also are described in Volume 1, Section 5.4.

15.5.2.4.5 Transportation, Access, and Utility Crossings

The Willimantic South Overhead Variation would cross 14 roads (refer to Table 15-37). Of these, the primary highways are State Routes 289, 32, and 14/203. Portions of State Routes 14 and 203 are state-designated scenic highways. The Windham Airport is located approximately 2 miles west of the route variation, adjacent to the Willimantic Reservoir.

Table 15-37: Road Crossings along the Willimantic South Overhead Variation

Municipality	Road Name	Road Type
Lebanon	Card Street	Local Road
Lebanon	Beaumont Highway (Route 289)	Highway
Lebanon	Unnamed	Thoroughfare
Windham	South Street	Local Road
Windham	Jordan Road	Local Road
Windham	South Windham Road	Local Road
Windham	Windham Road (Route 32)	Highway
Windham	Plains Road	Local Road
Windham	North Road (Route 14/203)	Highway
Windham	Ballamahack Road	Local Road
Windham	Beaver Hill Road	Local Road
Chaplin	Lynch Road	Local Road
Chaplin	Unnamed	Thoroughfare
Chaplin	Chewink Road	Local Road

Source: US Dept of Commerce, US Census Bureau, and UCONN Center for Geographic Information and Analysis. Connecticut Street Network State Plane/TIGER Line 2000, 2002.

The route variation also would cross two active rail lines. The New England Central Railroad operates an active freight line on the west side of the Shetucket River adjacent to Windham Road. The Providence & Worcester Railroad provides freight service on a line east of the Shetucket River.

15.5.2.4.6 Cultural (Archaeological and Historic) Resources

Based on an analysis of published cultural resource data, four reported Native American archaeological sites are located within 1 mile of the Willimantic South Overhead Variation. However, none of the sites are adjacent to or within the route variation ROW. Approximately 72% of this route variation appears to be sensitive for possible Native American sites.

Similar to the Proposed Route (refer to Volume 1, Section 5 and to the *Cultural Resources Assessment* in Volume 3), this variation generally appears to have limited sensitivity for significant below-ground Euro-American archaeological sites. Three previously reported Euro-American sites were identified within 1 mile of this route variation. Of these three sites, two are 400 to 5,100 feet from the route variation, while one is traversed by the variation corridor. This NRHP archaeological site is the Fourth Camp of Rochambeau's Army, a 16-acre Revolutionary War encampment. The location of this archaeological site is restricted from public documents to protect its integrity.

The route variation extends across one former New York & New England Railroad track bed in the Town of Chaplin. No cultural resource studies have been conducted of this crossing.

Four significant historic resources (including 29 individual structures or sites) have been identified within approximately 0.25 mile of the Willimantic South Overhead Variation. These include the Dr. Chester Hunt Office and the Windham Center Historic District in Windham, and the Chewink and Old cemeteries in Chaplin. The Windham Center Historic District, which is located along Plains and North Roads (State Routes 14 and 203), was designated on the NRHP in 1979.

Additional information about these cultural resources is presented in the *Cultural Resources Assessment* (Volume 3). A number of other above-ground properties located within 0.25 mile of the Willimantic South Overhead Variation have been inventoried in surveys, but no determinations of NRHP eligibility have been made to date.

15.5.2.5 Potential Environmental Effects and Mitigation Measures

The construction and operation of the new 345-kV transmission line along the Willimantic South Overhead Variation would cause both temporary and long-term effects associated with the expansion of CL&P's existing ROW for 0.7 mile and the creation of a new, 8.6-mile utility corridor on presently undeveloped land. In addition, the connection of the 345-kV line to the Card Street Substation would require approximately 0.3 mile of ROW on CL&P's property. The development of the new "greenfield" ROW segment would not be consistent with state and federal policies that advocate the collocation of utility corridors to the extent possible.

Appendix 15A describes the typical environmental effects caused by the construction and operation of an overhead transmission line along a new corridor, and identifies the mitigation measures that CL&P would typically use to minimize adverse effects to the extent possible. Appendix 15B includes representative cross-sections of the ROW along the Willimantic South Overhead Variation.

In general, the development of the 345-kV line along the Willimantic South Overhead Variation would affect soils, water resources, biological resources, land use and visual resources, cultural resources, and transportation. In addition, the acquisition of 156 acres of new easement for utility purposes would affect land-use patterns. Table 15-38 reviews these potential environmental effects, and summarizes the mitigation measures that CL&P would typically use to minimize, to the extent practical, adverse effects from transmission line construction and operation.

Table 15-38: Summary of Primary Effects and Potential Mitigation for the Willimantic South Overhead Variation

Environmental Feature	Potential Environmental / Social Effects		Potential Mitigation
	Construction	Operation / Maintenance	
Topography and Soils	Grading / filling along ROW to create access roads for use during construction; soil disturbance at structure installation / crane pad sites and other on-ROW staging areas Soil disturbance associated with removal and reconstruction of existing 115-kV line structures and distribution line along 0.7-mile segment of existing ROW in Lebanon	Permanent access roads as needed	Use temporary soil erosion and sediment control measures during construction. Stabilize disturbed sites after construction. Allow ROW to permanently revegetate in scrub-shrub species.
Water Resources	Development of new ROW across 15 watercourses, with temporary access roads likely required across smaller streams. New ROW across Shetucket River, which is part of the federally-designated Quinebaug – Shetucket Rivers Valley National Heritage Corridor. Potential direct or indirect effects to approximately 26.8 acres of wetlands located along the line route variation. Access road crossings of wetlands and watercourses (temporary fill). Potential effects associated with dewatering if groundwater is encountered in structure foundation excavations. Wetland vegetation clearing.	Permanent, culverted access roads likely required along the new 150-foot-wide ROW at some stream crossings. Also, permanent access across some wetlands, if required, would result in a potential net loss wetland habitat. Conversion of forested wetlands to scrub-shrub for the life of the Project will result in indirect wetland effects. *(Note: For purposes of this analysis, it is assumed that all access roads across wetlands would be removed after transmission line construction, and that no structures would be located in wetlands. However, specific effects cannot be determined without more detail engineering design regarding structure locations.)*	Use temporary erosion and sediment controls to minimize off-ROW water resource impacts. Revegetate or otherwise stabilize disturbed soil areas to limit the potential for sedimentation into water resources. Restore wetlands as final phase of construction. Coordinate with USACE and CT DEEP regarding off-site compensation for permanent loss of wetlands.
Biological Resources	Removal of approximately 127.7 acres of forest lands (including 111.6 acres of mature mixed forest and 16.1 acres of forested wetland)	Permanent conversion of forested areas, including forested wetland to scrub-shrub vegetative communities ; net loss of wetland habitat as detailed above due to access roads and cable trench The 8.6 miles of new ROW through previously undisturbed forest lands could potentially "segment" forested tracts, affecting habitat use by wildlife.	Off-site compensation, in coordination with USACE and CT DEEP
Land Use, including Statutory Facilities and Designated Recreational Areas	Acquisition and long-term dedication to utility use of 156 acres of new electric transmission line easements. New ROW across Pomeroy State Park and Airline State Park Trail, as well as near Beaver Brook State Park	New ROW would not conform to policies regarding the collocation of linear corridors to the extent practical. Along the new corridor, the 345-kV transmission line would be within 300 feet of 22 homes.	

Environmental Feature	Potential Environmental / Social Effects		Potential Mitigation
	Construction	Operation / Maintenance	
Visual Resources	The construction of the new 345-kV line will alter the visual character of the 8.6 miles of the line route variation where no ROW currently exists. The New 345-kV H-frame line structures (the shortest of the transmission line structure options) could nonetheless be visible from designated recreational areas, historic sites, and residences. The visual character of the 0.7-mile segment along CL&P's existing ROW will be modified by the removal of the existing 115-kV H-frame line structures and their replacement with taller structures to support vertically-configured conductors.	Long-term change in visual resources as a result of views of the new, vegetatively managed ROW and overhead structures	The use of H-frame structures minimizes the potential for views of the transmission line above the tree line. CL&P would work with affected landowners and towns to manage vegetation along the ROW to minimize visual intrusion to the extent practical.
Transportation	Potential increase in traffic along roads leading to the ROW as a result of the movement of construction vehicles and equipment	Permanent access likely to be required along the new ROW	Implement traffic management plan during construction; coordinate with town officials
Cultural Resources	Area is sensitive for the location of archaeological sites, and one site is known to occur within the new ROW. For new structures located near the Windham Center Historic District, visual simulations could be required to evaluate potential indirect aesthetic effects.	Permanent adverse effects would occur to archaeological sites during construction and possible long-term indirect visual effects could occur to structures within the Windham Center Historic District as a result of possible views of the new 345-kV line structures	Conduct field investigations to identify archaeological sites and, if significant sites are found, to develop appropriate mitigation measures (e.g., data recovery), based on consultations with the SHPO. Conduct visual simulations of overhead line near historic structures and districts.

15.5.2.6 Electric and Magnetic Fields

The 9.6-mile Willimantic South Overhead Variation would entail the development of approximately 8.6 miles of new overhead 345-kV transmission line, along a new 150-foot-wide ROW, 0.7 mile within an existing and slightly expanded ROW, and 0.3 mile on CL&P's Card Street Substation property. Within the new ROW, the new 345-kV line would be centered within the ROW and would be supported on steel- or wood-pole H-frame structures (refer to Appendix 15B). Along the 0.7 mile of ROW that would be expanded by 15 feet, an existing double-circuit 115-kV line would be rebuilt on steel-monopole structures, and the new 345-kV line would be supported on steel-monopole structures.

Electric and magnetic fields were calculated for a base design (H-frame) configuration of the 345-kV transmission line along the Willimantic South Overhead Variation. Because the Willimantic South Variation would be generally comparable in length to the portion of the proposed overhead transmission line that it would replace (9.6 miles vs. 11.9 miles, respectively), the incorporation of the variation as part of the new Card Street substation to Lake Road 345-kV line would not significantly change the new circuit's impedance, and therefore the same circuit currents were used for these calculations as were used for the proposed overhead line configuration and route. Volume 1, Section 7 of the Application includes details on the system assumptions made in the power-flow modeling to determine these circuit currents.

Magnetic fields produced by the overhead variation line along the segments of the variation ROW at AAL were calculated and graphed as shown on Figures 15-11, 15-12 and 15-13. Following each figure, the calculated levels of magnetic and electric fields at the ROW edges of the Willimantic South Overhead Variation route after the completion of the Project at AAL are summarized in Table 15-39, Table 15-40, and Table 15-41.

Figure 15-11: Magnetic Field Profiles Under Pre Interstate (2015) and Post-NEEWS (2020) Conditions at AAL for the Willimantic South Overhead Variation: Card Street Substation to Existing Structure 7814 – XS-WS-OH-1

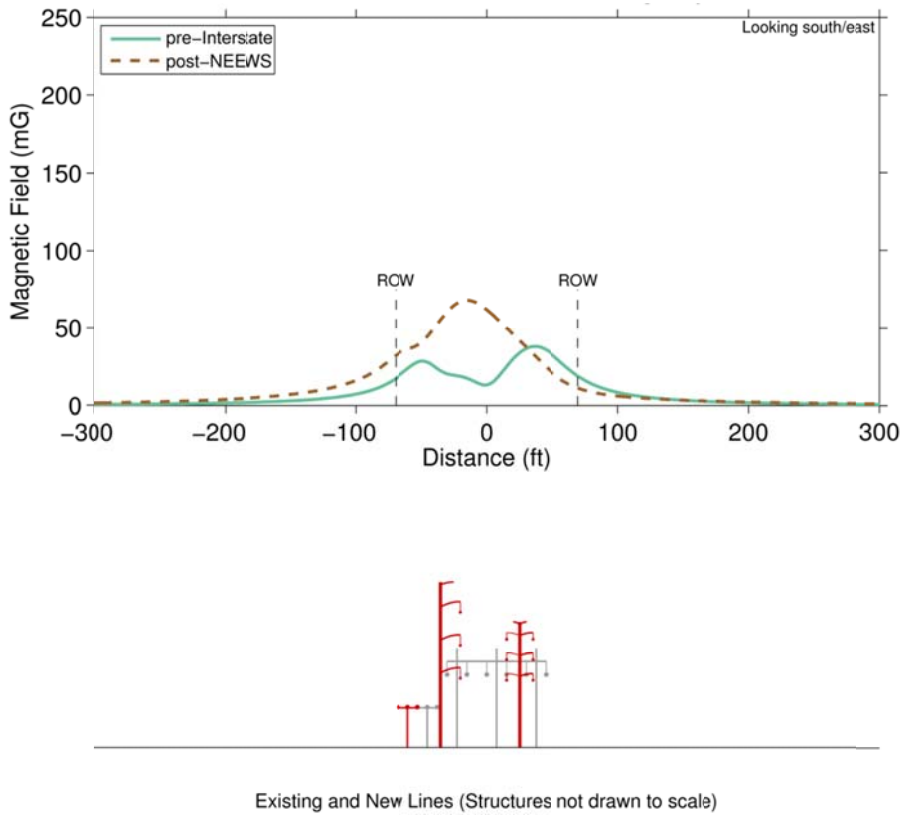


Table 15-39: Summary of Pre-Interstate(2015) and Post-NEEWS (2020) EMF Levels at the Edge of the ROW at AAL for the Willimantic South Overhead Variation: Card Street Substation to Existing Structure 7814 at Card Street – XS-WS-OH-1

	Magnetic Field (mG)		Electric Field (kV/m)	
Cross-Section	**West/North ROW Edge**	**East/South ROW Edge**	**West/North ROW Edge**	**East/South ROW Edge**
XS-OH-WS-1 – Pre-Interstate	17.4	19.1	0.33	0.86
XS-OH-WS-1 – Post-NEEWS	32.3	11.3	0.21	0.25

Figure 15-12: Magnetic Field Profiles Under Pre Interstate (2015) and Post-NEEWS (2020) Conditions at AAL for the Willimantic South Overhead Variation: Existing Structure 7814 at Card Street to Structure 7809 at Route 289 – XS-WS-OH-2

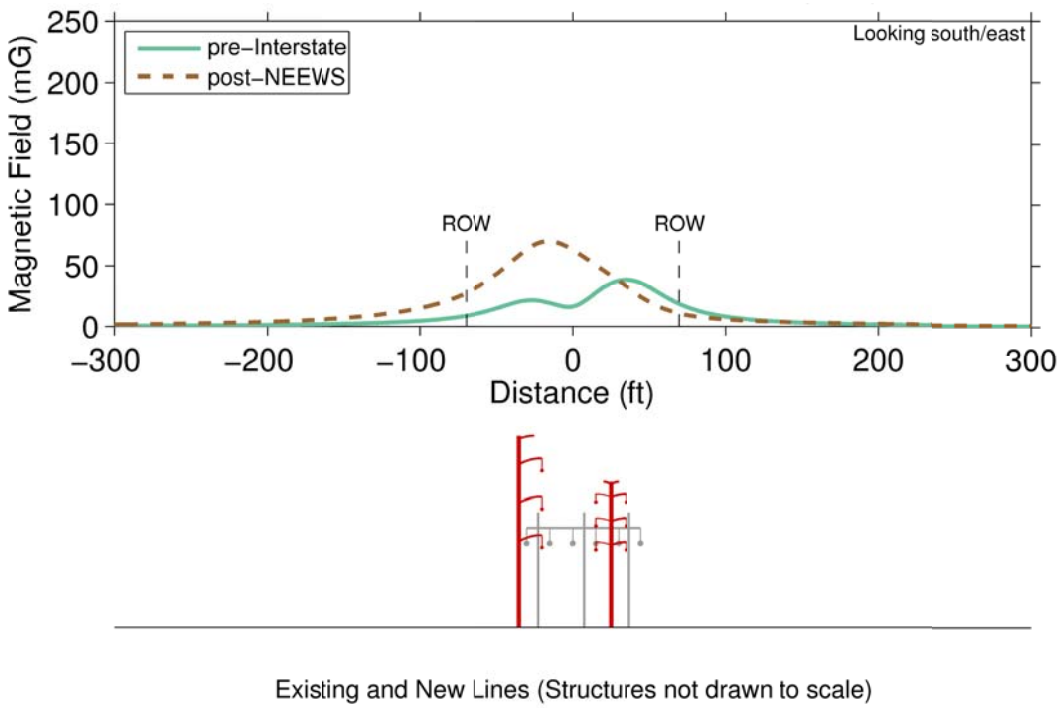


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Table 15-40: Summary of Pre-Interstate(2015) and Post-NEEWS (2020) EMF Levels at the Edge of the ROW at AAL for the Willimantic South Overhead Variation: Existing Structure 7814 at Card Street to Structure 7809 at Route 289 – XS-WS-OH-2

Cross-Section	Magnetic Field (mG)		Electric Field (kV/m)	
	West/North ROW Edge	East/South ROW Edge	West/North ROW Edge	East/South ROW Edge
XS-OH-WS-2 – Pre-Interstate	8.8	18.6	0.49	0.85
XS-OH-WS-2 – Post-NEEWS	27.5	10.8	0.54	0.25

Figure 15-13: Magnetic Field Profiles Post-NEEWS (2020) Conditions at AAL for the Willimantic South Overhead Variation: Route 289 in Lebanon to Chewink Road in Chaplin– XS-WS-OH-3

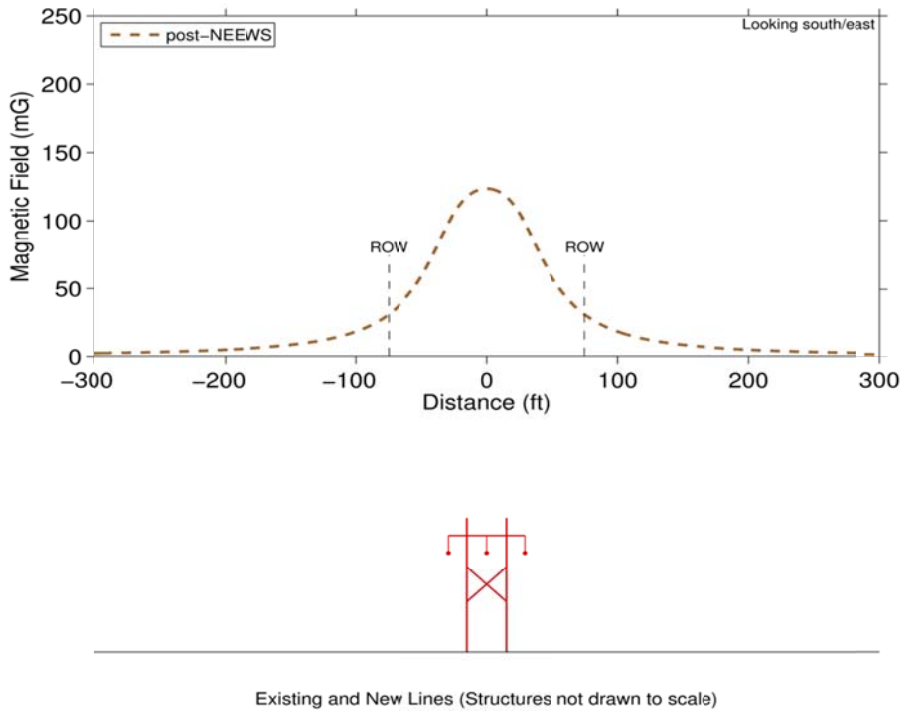


Table 15-41: Summary of Post-NEEWS (2020) EMF Levels at the Edge of the ROW at AAL for the Willimantic South Overhead Variation: Route 289 in Lebanon to Chewink Road in Chaplin – XS-WS-OH-3

Cross-Section	Magnetic Field (mG)		Electric Field (kV/m)	
	West/North ROW Edge	East/South ROW Edge	West/North ROW Edge	East/South ROW Edge
XS-WS-OH-3 – Post-NEEWS	30.9	30.9	1.67	1.67

If the Willimantic South Overhead Variation were incorporated into the new 345-kV line, the existing 330 Line would remain on the avoided segments of ROW, but would carry different currents. The calculated levels of electric and magnetic fields in 2020 along such existing ROW segments, compared to pre-Project levels in 2015, would be as shown in Table 15-42.

Table 15-42: Comparison of Pre-Interstate (2015) and Post-NEEWS (2020) EMF Levels at the Edges of the Existing CL&P Transmission ROW at AAL, With and Without Use of the Willimantic South Overhead Variation (WSOV)

Cross Section(s)	Magnetic Fields for Annual Average Load Case			
	South/West ROW Edge Level (mG)	North/East ROW Edge Level (mG)	North/West ROW Edge Level (mG)	South/East ROW Edge Level (mG)
XS-1 Pre-Interstate (2015)	7.6	28.2		
XS-1 Post-NEEWS (2020) With WSOV	7.2	24.2		
XS-1 Post-NEEWS (2020) Without WSOV	5.8	18.7		
XS-2, XS-4, & XS-6 Pre-Interstate (2015)			4.6	28.0
XS-2, XS-4, & XS-6 Post-NEEWS (2020) With WSOV			3.9	24.0
XS-2, XS-4, & XS-6 Post-NEEWS (2020) Without WSOV			7.2	18.4
XS-2 BMP Pre-Interstate (2015)			4.6	28.0
XS-2 BMP Post-NEEWS (2020) With WSOV			3.9	24.0
XS-2 BMP Post-NEEWS (2020) Without WSOV			5.2	20.6
XS-3 Pre-Interstate (2015)			8.8	24.7
XS-3 Post-NEEWS (2020) With WSOV			7.5	21.2
XS-3 Post-NEEWS (2020) Without WSOV			24.1	22.3
XS-5 Pre-Interstate (2015)			8.3	35.2
XS-5 Post-NEEWS (2020) With WSOV			7.1	30.1
XS-5 Post-NEEWS (2020) Without WSOV			25.1	24.1

Magnetic field levels in 2020 along both edges of the avoided 330 Line ROW segment included in Table 15-41 would be slightly reduced from the 2015 pre-Project levels by constructing the new overhead line

section on a different ROW (see rows in table labeled as "With WSOV"). These reductions would result from changes in circuit currents after the new 345-kV line is constructed and placed in service on the Willimantic South Overhead Variation ROW. However, the use of the Willimantic South Overhead Variation would result in magnetic fields along two separate ROWs, and the opportunity for reducing magnetic fields along at least one edge of the existing ROW by cancellation through best circuit phasings with a new 345-kV line adjacent to the existing 330 circuit within the existing CL&P ROW would be lost.

To show this effect, Table 15-42 also includes data representing the post-Project projections for magnetic field levels with the proposed line constructed using the proposed new transmission line configurations along the existing CL&P transmission ROW (see rows in table labeled "Without WSOV"). As this data shows, for most cross-sections, the proposed overhead transmission line designs would produce the lowest magnetic field levels along the south or east ROW edges, but would do so at the expense of higher magnetic field levels along the north or west ROW edge (not including XS-1) when compared to pre-Interstate levels or to the post-NEEWS levels with the Willimantic South Overhead Variation 345-kV line in service. However, the projected magnetic field levels in 2020 on the CL&P ROW following the construction of the proposed overhead transmission line in Cross-Sections 1 through 6 are all lower than the levels at the south or east ROW edge under pre-Interstate conditions.

15.5.2.7 Comparison of the Willimantic South Overhead Variation to the Segments of the Proposed Route that Would be Replaced

As summarized in Table 15-43, compared to the development of the new proposed 345-kV overhead transmission line along the Proposed Route within CL&P's existing ROWs, the use of the Willimantic South Overhead Variation would cause greater overall impacts to environmental resources, visual resources, and privately-owned properties, and would increase Project costs.

The route variation would avoid recreational use areas in the Towns of Mansfield and Chaplin (i.e., Mansfield Hollow State Park and WMA). In addition, the variation would avoid aligning the new

345-kV overhead transmission line, adjacent to the existing 330 Line within CL&P's ROWs near certain groups of homes (which may or may not qualify as Statutory Facilities), two residential child day cares, and the Mount Hope Montessori School in the Town of Mansfield.

However, the Willimantic South Overhead Variation would expand or create a new utility corridor across other recreational areas (i.e., Pomeroy State Park and the Airline State Park Trail) and near the Windham Center NRHP Historic District and Beaver Brook State Park. As a result, for the primary reasons summarized below, the proposed Project (i.e., the 345-kV overhead transmission line configuration located within CL&P's existing ROW) is preferred.

The development of the overhead transmission line along the Willimantic South Overhead Variation would increase Project costs by approximately $17 million. Specifically, the capital cost of the overhead line-route variation is estimated at $79.3 million. In comparison, the capital cost for the 11.9-mile segment of the proposed overhead transmission line within the existing CL&P ROW is $62.3 million. As described in Section 14.3.1.3, these increased costs would not likely qualify for inclusion in New England regional transmission rates. As a result, in addition to paying 27% of the cost of building the base-case overhead line, Connecticut consumers would likely be responsible to pay 100% of any costs that exceed the cost of building the base-case overhead line, including extra costs for construction of this overhead line-route variation and EMF BMP line designs.

The Willimantic South overhead variation would cost approximately 1.3 times more than the comparable segment of the proposed overhead transmission line constructed pursuant to standard good utility practice. Consequently, the cost to Connecticut consumers for this overhead line variation (based on the cost allocation described above) would be approximately $35.8 million, or approximately two times more than the cost of the overhead line proposed within the existing ROW. This is calculated as follows:

Connecticut consumer cost for section of overhead line to be replaced:

Estimated cost of the proposed overhead transmission line (including delta structures for EMF Focus Area A and delta structures through Mansfield Hollow State Park):	$62.3 million
Estimated cost of overhead base transmission line (i.e., H-frame structures through Focus Area A and delta structures through Mansfield Hollow State Park):	$59.6 million
Incremental cost of line with delta structures through EMF Focus Area A:	$2.7 million
Connecticut consumer cost for overhead section to be replaced = (base-line cost x 27%) + (Incremental increase over base-line cost for delta structures in EMF Focus Area A x 100%)	$18.8 million

Connecticut consumer cost for overhead variation:

Estimated cost of the overhead variation:	$79.3 million
Incremental cost of the overhead variation over an overhead base-line design (i.e., H-frames in EMF Focus Area A and delta structures in Mansfield Hollow State Park):	$19.7 million
Connecticut consumer cost for overhead variation = (Incremental cost for overhead variation x 100%) + (Base-line cost x 27%):	$35.8 million

Finally, dividing the Connecticut consumer cost for the overhead variation by the Connecticut consumer cost for the overhead line section to be replaced yields: ($35.8 million / $18.8 million) = 2.

To develop an overhead 345-kV transmission line along the Willimantic South Overhead Variation, CL&P would have to obtain approximately 156 acres of new utility easements. Pursuant to CL&P standards, lands under easement for utility purposes would be precluded from land uses that would be inconsistent with the safe operation and maintenance of the overhead transmission line. In comparison, except for the approximately 11 acres of proposed easement expansion across the federally-owned

properties in the Mansfield Hollow area[23], no additional ROW would be required to install the new 345-kV transmission line overhead along the portion of the Proposed Route that the variation would replace. Selection of this line-route variation over use of the existing ROW would be inconsistent with the FERC environmental guidelines to which approved transmission line projects are required to conform.[24]

In sum, CL&P prefers the proposed overhead transmission line within the existing CL&P ROW over the Willimantic South Overhead Variation. Compared to the 11.9-mile proposed Project segment that would be replaced, the use of the overhead variation would increase costs, result in greater long-term environmental effects (particularly to forest lands), and would require the permanent conversion of 156 acres of primarily forested lands to utility use. Moreover, the development of the transmission line along the route variation would introduce a new source of transmission line magnetic fields along a new corridor, while not achieving a significant overall reduction in magnetic fields in the vicinity of the existing CL&P ROW where certain residences and statutory facilities are located.

[23] The 11-acre ROW expansion in the Mansfield Hollow area assumes the use of the proposed Project design, rather than either of the two alternative configurations described in Volume 1, Section 10. The adoption of either of these configurations would either minimize or avoid ROW expansion through Mansfield Hollow State Park and WMA.

[24] The Council is required to find that the overhead portions of any new transmission line will be consistent with the FERC's "Guidelines for the Protection of Natural Historic Scenic and Recreational Values in the Design and Location of Rights-of-Way and Transmission Facilities, " Conn. Gen. Stats. ¶16-50p(a)(3)(D)(iii). In order to minimize conflicts between electric transmission rights-of-way and other land uses, these guidelines specify that "existing rights-of-way should be given priority as locations for additions to existing transmission facilities." *Id.*, ¶1

Table 15-43: Comparison of the Willimantic South Overhead Variation to the Proposed Transmission Line Segment (Overhead Line) on Existing CL&P ROW to be Replaced

Route Characteristic	Proposed Overhead Transmission Line Segment on Existing CL&P ROW to be Replaced	Willimantic South Overhead Variation
Location, Design, and Appearance		
Route Location (ROW, Town)	Existing CL&P ROW (Lebanon, Columbia, Coventry, Mansfield, Chaplin)	0.7 mile ROW expansion (Lebanon) 8.6 miles new ROW (Lebanon, Windham, Chaplin)
Route Length (miles)	11.9 miles	9.6 miles
Structures (type)	H-frames Delta steel poles	H-frames Delta steel pole
New ROW Easements or Land Acquisition Required (approximate acres)	11 acres (USACE property, Mansfield Hollow)	156 acres
Biological Resources		
Upland Forest Clearing (est. acres)	60.0 acres	111.6 acres
Forested Wetland Clearing (est. acres)	10.5 acres	16.1 acres
Scrub-Shrub Clearing (est. acres)	9.6 acres (upland) 0.7 acre (wetland)	17.2 acres (upland) 5.5 acres (wetland)
Watercourse Crossings (no.)	2 (span)	15
Wetlands, Permanent Effects (Fill) (est. acres)	0 structures 0.4 acre (access roads)	0 structures [2] 0 (access roads) [2]
Wetlands, Temporary Effects (est. acres)	1.1 acres (access roads)	3.1 acres (access roads) [2]
Listed Species (no. species)	0	0
Land Uses		
Designated Recreational or Open Space along ROW (length, miles)	3.0 miles	1.4 miles
CL&P-Owned Land Traversed (miles)	1.8 miles	0
Total Construction ROW / Work Space, Temporary Land Disturbance (est. acres)	137.1 acres	172.5 acres
Cost of Transmission Line Segment ($ Million, $ 2010)		
Capital Cost	$62.3	$79.3
Cost to Connecticut Consumers[1]	$18.8	$35.8
Life-cycle Cost	$106.3	$126.4

1. Assumes localization of extra costs for EMF BMP line designs and for underground cables.
2. For the overhead route variation, specific structure locations have not been defined. However, for this impact evaluation, CL&P assumed that all structures could be located outside of wetlands and that all access roads across wetlands and streams would be temporary (removed after construction).

15.5.3 Willimantic South Underground Variation

15.5.3.1 Location of the Route Variation

The Willimantic South Underground Variation would replace the westernmost 11.6 miles of the proposed overhead 345-kV transmission line route. The underground route variation would entail the development of a 10.7-mile underground cable system, extending through portions of the towns of Lebanon, Windham, and Chaplin, as well as 345-kV line transition facilities at either end of the cable system (refer to Table 15-44, Appendix 15B, and the Volume 9 maps). With the exception of a 0.6-mile segment within CL&P's existing ROW in Chaplin, the underground cable system would be aligned primarily beneath or adjacent to paved road ROWs.

Table 15-44: Towns Traversed along the Willimantic South Underground Variation vs. the Proposed Route Within Existing CL&P ROW

Municipality	Proposed Overhead Transmission Line Segment on Existing CL&P ROW to be Replaced (Miles)	Willimantic South Underground Variation (Miles)
Lebanon	0.7	0.8
Columbia	1.7	-
Coventry	1.2	-
Mansfield	6.4	-
Chaplin	1.6	1.8
Windham	-	8.1
Total Miles	**11.6**	**10.7**

The cable system would commence at the Card Street Substation where 345-kV line transition facilities would be installed. From the substation, the underground cable system would extend north along Card Street to Pleasant Street, and then would follow Pleasant Street east to Plains Road. The underground route variation would continue along Plains Road, crossing the Shetucket River, to the intersection of State Routes 14 and 203 in Windham Center. The cable-system route would then turn north and follow State Route 203 to U.S. Route 6 (Boston Post Road / Willimantic Road). Following U.S. Route 6, the route would extend north into the Town of Chaplin.

At the intersection of U.S. Route 6 and CL&P's existing transmission line ROW (i.e., the 330 Line ROW, the proposed route for the preferred overhead 345-kV transmission line), the cable system would turn east to follow the CL&P ROW for approximately 0.6 mile. Between proposed 345-kV overhead line structure Nos. 107 and 108 (refer to the Volume 9 maps), a new 345-kV line transition station would have to be developed. This new 345-kV line transition station would be located approximately 100 feet east of Park Road in the Town of Chaplin.

15.5.3.2 Technical Description (Design, Appearance, Land Requirements, Cost)

The Willimantic South Underground Variation would involve the construction and operation of a 10.7-mile, 345-kV cable system (cables, splice vaults, line transition facilities). Appendix 15B illustrates the typical location of the underground cable system along public road ROWs, whereas Appendix 15B depicts the location of the underground cable system for approximately 0.6 mile within the CL&P ROW east of U.S. Route 6. As Appendix 15B illustrates, within CL&P's ROW, the center of the cable system would be aligned north of the existing 330 Line, approximately 15 feet from the outside conductors.

Along the approximately 10.1 miles of the route variation that would be aligned along roads, easements would not be required from private landowners if the cable system can be accommodated within the public highway ROWs. However, as described in Section 14.3, due to constraints posed by utilities buried beneath road travel lanes or conflicts with public highway use policies, splice vaults and portions of the cable duct bank would likely have to be located on private properties adjacent to the road ROWs. The number and acreages of easements that would be required from private landowners could not be defined until the final stages of cable-system design.

Similarly, to align the 0.6-mile segment of the cable system within CL&P's existing transmission line ROW in the Town of Chaplin, underground easement rights would have to be obtained from private landowners. In addition, up to 4 acres of land would have to be acquired from private landowners for the development of the 345-kV line transition station on the eastern end of the underground cable segment.

On the western end of the cable system, 345-kV line transition facilities would be developed on CL&P's Card Street Substation site. Shunt reactors would likely be needed at one or both of these transition facilities and could then increase the development area.

The estimated capital cost of the Willimantic South Underground Variation is $325.9 million, or $265.1 million more than the portion of the proposed overhead 345-kV transmission line that would be replaced.

15.5.3.3 Construction and Operation/Maintenance Considerations

Construction of the 10.7-mile cable system (duct banks, splice vaults, cable installation) and associated 345-kV line transition facilities would be performed using the methods described generally in Section 14.3.2. Because cable-system installation requires continuous trenching, as well as trenching for splice vaults, lands along the entire length of the route variation would be disturbed. Lands along the cable-system route would encompass paved roads, road shoulders, areas adjacent to the road ROWs, and areas along CL&P's ROW.

Along the majority of the route variation (i.e., 10.1 miles), the cable system would follow public road ROWs. Although the cable system would optimally be located within the paved portions of these ROWs, the actual alignment would depend on a variety of factors, such as the presence of buried utilities, highway use policies, site-specific land-use conditions, and the need to use special sub-surface installation techniques (such as HDD or jack and bore) to install the cable system beneath watercourses, wetlands, railroads or highly traveled state highways. As a result, it is likely that the approximately 40-foot-wide work area typically required for cable-system construction along road ROWs would encompass areas adjacent to the paved road travel lanes. Final cable-system design would be required to enable an estimate of the amount of land affected outside of the paved road ROWs. However, assuming the use of a 40-foot-wide construction work area, the installation of the cable system would affect approximately 60 acres, including approximately 4.2 acres for splice-vault installation (in excess of the 40-foot-wide

construction work area) and 4 acres at the line transition station site on the eastern end of the cable system.

Along the 0.6-mile segment within CL&P's ROW, assuming the use of a 40-foot-wide construction work area, approximately 3.6 acres of land would have to be cleared of all vegetation, and then graded and filled to create a level construction work space and to accommodate a 20-foot-wide construction / permanent access road along the length of the cable route. The 3.6 acres includes approximately 0.2 acre for installation of splice vaults adjacent to the 40-foot wide construction work area for the duct bank. To reach the access road along the cable-system route, equipment and vehicles would most likely utilize Willimantic Road (U.S. Route 6) or Park Drive.

Up to an additional 4 acres of land would have to be acquired (in fee ownership) and subsequently cleared and leveled for the development of a 345-kV line transition station at the eastern end of the cable route. A potential line transition station site (refer to the Volume 9 maps) is located on private property near the Natchaug State Forest and lands owned by the Fin, Fur, and Feather Club, Inc. The site would have to be cleared of forest vegetation, graded, and otherwise prepared for site development.

The new 345-kV line transition station at the eastern terminus of the underground cable system would consist of an above-ground line-terminal structure, a control building, and related equipment to interconnect the underground cable system to the overhead portion of the 345-kV transmission line. The developed portion of the station would be graded, surfaced with crushed stone, and fenced. On the western end of the cable system, 345-kV line transition facilities would be constructed within CL&P's property at Card Street Substation (for the purposes of this analysis, it is assumed that these facilities could be accommodated within the existing station fence line).

The construction of the underground cable system along the Willimantic South Underground Variation would require approximately two to three years to complete. This schedule assumes that duct-bank

trenching would progress at approximately 50 to100 feet per day. The development of the 345-kV line transition facilities can be expected to require approximately 12 to 18 months to complete; this work would be accomplished concurrent with the underground cable work and would not extend the time required to complete the construction of the entire underground variation project.

15.5.3.4 Existing Environmental Features

15.5.3.4.1 Topography, Geology, and Soils

The topography along the Willimantic South Underground Variation is less variable than along the portion of the Proposed Route that it would replace, as roadways tend to be in relatively level areas with gradual changes in topography. Bedrock geology in the vicinity of the variation consists of the Canterbury Gneiss, Tantic Hill, Waterford Group, Hebron Gneiss, and Scotland Gneiss formations. Surficial geology along the route variation consists of sand and gravel, sand and gravel overlying sand, till, alluvium overlying sand, gravel, and sand and gravel overlying sand overlying fines. The variation would traverse some areas classified as Farmland of Statewide Significance soils. Soils along the variation are identified in Table 15-45.

15.5.3.4.2 Water Resources

Like the Willimantic South Overhead Variation, the Willimantic South Underground Variation is located within the Thames River drainage basin. Regional drainage basins traversed by the route variation include Natchaug River, Shetucket River, and Willimantic River.

Along the portion of the underground route variation that would be aligned within or adjacent to road ROWs, wetlands and watercourses were identified using published wetland and soils maps and aerial photographs, as well as on observations from the public roads. Along the 0.6-mile segment of the route that is located within CL&P's ROW, wetlands and watercourses were field delineated as part of the analyses of the Proposed Route.

Table 15-45: Soils and Soil Characteristics along the Willimantic South Underground Variation

Soil Map Unit Name and Symbol	Parent Material	Hydric Soil	Erosion Factor[1]	Depth to Bedrock (inches)	Depth to Water Table (feet)
3 Ridgebury, Leicester, Whitman	Coarse-loamy lodgment till derived from granite and/or schist and/or gneiss	Yes	0.15	--	0.0-1.5
13* Walpole sandy loam	Sandy and gravelly glaciofluvial deposits derived from granite and/or schist and/or gneiss	Yes	--	--	0.0-1.0
15 Scarboro muck	Sandy and gravelly glaciofluvial deposits derived from granite and/or schist and/or gneiss	Yes	--	--	0.0-1.0
17 Timakwa and Natchaug	Woody organic material over sandy and gravelly glaciofluvial deposits, and woody organic material over loamy alluvium and/or loamy glaciofluvial deposits and/or loamy till	Yes	--	--	0.0-1.0
18 Catden and Freetown soils	Woody organic material	Yes	--	--	0.0-1.0
21A** Ninigret and Tisbury, 0 to 5 percent slopes	Coarse-loamy eolian deposits over sandy and gravelly glaciofluvial deposits derived from granite and/or schist and/or gneiss	No	0.43	--	1.5-2.5
23A** Sudbury sandy loam, 0 to 5 percent slopes	Sandy and gravelly glaciofluvial deposits derived from granite and/or schist and/or gneiss, and coarse-loamy eolian deposits over sandy and gravelly glaciofluvial deposits derived from granite and/or schist and/or gneiss	No	--	--	1.5-3.0
29A** Agawam fine sandy loam, 0 to 3 percent slopes	Coarse-loamy eolian deposits over sandy and gravelly glaciofluvial deposits derived from granite and/or schist and/or gneiss	No	0.28	--	--
29B** Agawam fine sandy loam, 3 to 8 percent slopes	Coarse-loamy eolian deposits over sandy and gravelly glaciofluvial deposits derived from granite and/or schist and/or gneiss	No	0.29	--	--
34A** Merrimac sandy loam, 0 to 3 percent slopes	Sandy and gravelly glaciofluvial deposits derived from granite and/or schist and/or gneiss	No	0.24	--	--
34B** Merrimac sandy loam, 3 to 8 percent slopes	Sandy and gravelly glaciofluvial deposits derived from granite and/or schist and/or gneiss	No	0.24	--	--
36B* Windsor loamy sand, 3 to 8 percent slopes	Eolian sands over sandy glaciofluvial deposits derived from granite and/or schist and/or gneiss	No	--	--	--
38A* Hinckley gravelly sandy loam, 0 to 3 percent slopes	Sandy and gravelly glaciofluvial deposits derived from granite and/or schist and/or gneiss	No	0.15	--	--

Soil Map Unit Name and Symbol	Parent Material	Hydric Soil	Erosion Factor[1]	Depth to Bedrock (inches)	Depth to Water Table (feet)
38C* Hinckley gravelly sandy loam, 3 to 15 percent slopes	Sandy and gravelly glaciofluvial deposits derived from granite and/or schist and/or gneiss	No	0.15	--	--
38E Hinckley gravelly sandy loam, 15 to 45 percent slopes	Sandy and gravelly glaciofluvial deposits derived from granite and/or schist and/or gneiss	No	0.15	--	--
47C Woodbridge fine sandy loam, 2 to 15 percent slopes, extremely stony	Coarse-loamy lodgment till derived from granite and/or schist and/or gneiss	No	0.10	--	1.5-2.5
50B** Sutton fine sandy loam, 3 to 8 percent slopes	Coarse-loamy melt-out till derived from granite and/or schist and/or gneiss	No	0.15	--	1.5-2.5
51B Sutton sandy loam, 2 to 8 percent slopes, very stony	Coarse-loamy melt-out till derived from granite and/or schist and/or gneiss	No	0.15	--	1.5-2.5
52C Sutton fine sandy loam, 2 to 15 percent slopes, extremely stony	Coarse-loamy melt-out till derived from granite and/or schist and/or gneiss	No	0.15	--	1.5-2.5
58B Gloucester gravelly sandy loam, 3 to 8 percent, very stony	Sandy and gravelly melt-out till derived from granite and/or schist and/or gneiss	No	0.17	--	--
60B** Canton and Charlton, 3 to 8 percent slopes	Coarse-loamy over sandy and gravelly melt-out till derived from granite and/or schist and/or gneiss	No	0.17	--	--
61B Canton and Charlton, 3 to 8 percent slopes, very stony	Coarse-loamy over sandy and gravelly melt-out till derived from granite and/or schist and/or gneiss	No	0.17	--	--
62D Canton and Charlton, 15 to 35 percent slopes, extremely stony	Coarse-loamy over sandy and gravelly melt-out till derived from granite and/or schist and/or gneiss	No	0.17	--	--
73C Charlton-Chatfield complex, 3 to 15 percent slopes, very rocky	Coarse-loamy melt-out till derived from granite and/or schist and/or gneiss	No	0.17	20-40	--
84B** Paxton and Montauk fine sandy loam, 3 to 8 percent slopes	Coarse-loamy lodgment till derived from granite and/or coarse-loamy lodgment till derived from gneiss and/or coarse-loamy lodgment till derived from gneiss and/or coarse-loamy lodgment till derived from granite	No	0.20	--	1.5-2.5

Soil Map Unit Name and Symbol	Parent Material	Hydric Soil	Erosion Factor[1]	Depth to Bedrock (inches)	Depth to Water Table (feet)
84C* Paxton and Montauk fine sandy loam, 8 to 15 percent slopes	Coarse-loamy lodgment till derived from granite and/or coarse-loamy lodgment till derived from gneiss and/or coarse-loamy lodgment till derived from gneiss and/or coarse-loamy lodgment till derived from granite	No	.020	--	1.5-2.5
85B Paxton and Montauk fine sandy loam, 3 to 8 percent slopes, very stony	Coarse-loamy lodgment till derived from granite and/or coarse-loamy lodgment till derived from gneiss and/or coarse-loamy lodgment till derived from gneiss and/or coarse-loamy lodgment till derived from granite	No	0.20	--	1.5-2.5
306 Udorthents-Urban land complex	Drift	No	0.28	--	4.5->6.0
307 Urban land	This is a miscellaneous area***				

Source: USDA Natural Resources Conservation Service, Online Soil Surveys and Geographic Data of New London, Tolland, and Windham Counties, 2009
* Soils classified as Farmland Soils of Statewide Importance
** Soils classified as Prime Farmland Soils
*** Miscellaneous areas are those instances where soils have been altered or obscured by urban works and structures (buildings, paved areas, industrial areas) or standing water.
1. Erosion Factor (K (dimensionless)): Indicates the erodability of the whole soil, the higher the value, the more susceptible the soil to erosion.
-- No Data Available. No bedrock or water encountered to survey depth

Based on this information, the Willimantic South Underground Variation would cross 17 watercourses, the largest of which are the Shetucket River and Potash Brook (refer to Table 15-46). The route variation would traverse FEMA-designated 100-year flood boundaries along both of these larger watercourses (refer to the aerial segment maps in Volume 9 for the locations of these FEMA boundaries). In the Town of Windham, the underground route variation would extend along Pleasant Street, south of the Willimantic River and its associated SCEL, and along Plains Road, across and adjacent to the SCEL associated with the Shetucket River.

Table 15-46: Watercourses along the Willimantic South Underground Variation

Municipality	Watercourse Series Number[1] and Name (Where Applicable)	Water Quality[2] / Fisheries Classification[3] (where applicable)	Watercourse Frequency Type (P or I)[4]
Lebanon			
	S22-1/Intermittent Tributary to Willimantic River	A/coldwater	I
Windham			
	S22-2/Intermittent Tributary to Shetucket River	A/coldwater	I
	S22-3/Intermittent Tributary to Shetucket River	A/coldwater	I
	S22-4/Shetucket River	B/coldwater	P
	S22-5/Intermittent Tributary to Potash Pond	A	I
	S22-6/Intermittent Tributary to Potash Pond	A	I
	S22-7/Intermittent Tributary to Potash Brook	A	I
	S22-8/Intermittent Tributary to Potash Brook	A	I
	Potash Brook		
	S22-9/Intermittent Watercourse	A	I
	S22-10/Intermittent Tributary to Hams Pond	AA	I
	S22-11Intermittent Tributary to Hams Pond	AA	I
	S22-12/Intermittent Tributary to Natchaug River	AA	I
Chaplin			
	S22-13/Tributary to Natchaug River	AA	P
	S20-25/Tributary to Natchaug River	A	P
	S20-26/Tributary to Natchaug River	A	P
	S20-27/Tributary to Natchaug River	A	I

1. Series No. refers to waterbody numbers designated in the CL&P field reports (Volume 2) and illustrated on the aerial photographs in Volume 9.
2. Table 5-2 (Volume 1) defines the water classifications as defined by the Connecticut Water Quality Standards:
3. Fishery Classification (where applicable) was obtained by personnel communication with Don Gonyea and Neal Hagstrom at CT DEEP.
4. P = Perennial; I = Intermittent.

As listed in Table 15-47, 34 wetlands are located along the Willimantic South Underground Variation. Of these, one wetland would be crossed on CL&P's Card Street Substation property and five (wetland Nos. W20-80 through -84) are located along the portion of the variation that would extend along CL&P's existing ROW. The five wetlands located within the CL&P ROW were identified during the 2008 and 2011 field delineations (refer to Volume 2 for additional information concerning the characteristics of each of these wetlands).

The remaining 28 wetlands along the underground route variation were identified based on the review of aerial photographs, NWI maps, and soil maps, as well as observations from the road ROWs along the cable system route. These 28 wetlands either are directly traversed by the road ROWs along which the underground route variation would be located or are situated along the road ROWs (these latter wetlands are identified in Table 15-39 as "adjacent" to the underground cable system route).

As identified by the CT DEEP, groundwater near the Willimantic South Underground Variation is classified as "GA" within the Town of Lebanon; "GA", "GB", "GC", or "GA/GAA" within the Town of Windham; and "GA/GAA/GAA" within the Town of Chaplin. No public wells, aquifer protection public supply wells, or Connecticut Aquifer Protection Areas are crossed by or within the vicinity of the route variation. Drinking water is obtained from a combination of private groundwater wells, and surface water drawn from the Willimantic Reservoir, which is located approximately 1.5 miles west of the route variation.

Table 15-47: Wetlands: Willimantic South Underground Variation

Route Variation Mapsheet Nos. (Volume 9)	Wetland Series No.[1]	Wetland Classification[2]	Relationship to Underground Route (Feet traversed / adjacent) [3]
Lebanon			
1 of 13	W21-15	PFO	50 feet
1 of 13	W22-1	PFO, PSS	Adjacent
1 of 13	W22-2	PFO, PEM	Adjacent
Windham			
5 of 13	W22-3	PEM	375 feet
5 of 13	W22-4	PSS / PFO	Adjacent
5 of 13	W22-5	PEM / PSS	100 feet
6 of 13	W22-8	PFO / PSS	Adjacent
7 of 13	W22-9	PFO / PEM	Adjacent
7 of 13	W22-10	PSS	Adjacent
7 of 13	W22-11	PEM	Adjacent
7 of 13	W22-12	PEM	Adjacent
Chaplin			
8 of 13	W22-13	PFO	Adjacent
9 of 13	W22-14	PFO	Adjacent
9 of 13	W22-16	PFO	400 feet
9 of 13	W22-18	PFO	200 feet
10 of 13	W22-19	PFO / PSS	100 feet
10 of 13	W22-20	PFO / PEM	50 feet
10 of 13	W22-21	PFO	150 feet
11 of 13	W22-22	PFO / PEM	Adjacent
11 of 13	W22-23	PEM	300 feet
11 of 13	W22-24	PFO	Adjacent
11 of 13	W22-25	PEM / PFO	100 feet
11 of 13	W22-26	PFO	Adjacent
12 of 13	W22-27	PSS	100 feet
12 of 13	W22-28	PSS	Adjacent
12 of 13	W22-29	PEM / PFO	Adjacent
12 of 13	W22-30	PFO	50 feet
13 of 13	W22-31	PFO	200 feet
13 of 13	W22-32	PFO	100 feet
13 of 13	W20-80	PFO / PSS	60 feet
13 of 13	W20-81	PFO / PSS	550 feet
13 of 13	W20-82	PSS	50 feet
13 of 13	W20-83	PSS / PFO	50 feet
13 of 13	W20-84	PSS / PFO	250 feet

NOTES:

1. Series No. refers to wetland number illustrated on the aerial photographs in Volume 9.
2. Wetlands classification according to Cowardin et al 1979; PEM = Palustrine Emergent Wetland; PFO = Palustrine Forested Wetland; PSS = Palustrine Scrub-Shrub Wetland; POW = Palustrine Open Water; PUB = Palustrine Unconsolidated Bottom.
3. "Feet traversed" refers to linear distance crossed by center of 345-kVcable route, as depicted on the Volume 9 and 11 maps.

Shading = Denotes wetland that provides vernal pool / amphibian habitat along CL&P ROW. Amphibian habitat studies were not performed of wetlands adjacent to road ROWs.

15.5.3.4.3 Biological Resources

Vegetative Communities

The vegetative communities adjacent to the roads along which the underground variation would be located consist of riparian wooded floodplains, maintained lawn/road shoulder areas, agricultural areas, scrub-shrub areas, scattered wetlands, and forest land. Along the portion of the variation that would be located within the existing CL&P ROW, vegetation is dominated by scrub-shrub and forested (upland and wetland) communities.

Based on a typical construction work area width of 40 feet along the road ROWs and along the CL&P ROW and the alignment of the underground cable route as generally depicted in Appendix 15B, the footprint of the Willimantic South Underground Variation would disturb approximately 60 acres.[25] Of this 60 total acres, approximately 6.9 acres are presently forested (upland and wetland). Of the 6.9 acres of forest, 0.2 acre is forested wetland. The cable system construction work area would encompass a total of 1.3 acres of wetlands overall (i.e., forested and other types).

Fish and Wildlife Resources

Wildlife species in the vicinity of the underground route variation are likely to be those most commonly associated with forested upland and wetland areas; scrub-shrub habitats; or the transition areas (edge) between these habitats (refer to Volume 1, Section 5 for a discussion of such species). Based on consultations with the CT DEEP, the Shetucket River and its tributaries support cold-water fish species.

As described in Section 15.5.2, the CT DEEP stocks the Shetucket River with Atlantic salmon below the Scotland Dam, which is located 3 miles south of the route variation. The CT DEEP also has proposed the Shetucket River as a Trophy Trout Water.

[25] The calculation of underground disturbance consists of a 40-foot construction corridor along the length of the cable with additional 40-foot by 130-foot splice vault areas located approximately every 1,600 feet along the line.

Amphibians

Along the portion of the route variation located within or adjacent to road ROWs, no field surveys to determine amphibian breeding habitat or potential areas of vernal pools were conducted (due to lack of survey rights on private lands). However, seven vernal pools and one amphibian breeding habitat were identified along the portion of the route that would be collocated within CL&P's ROW in the Town of Chaplin. These vernal pools (which are depicted for the segment of the CL&P ROW along which the variation would be located on Volume 11 mapsheets 41 and 42) are designated as follows:

- CH-3-ABH, CH-6-VP, CH-7-VP, and CH-8 VP (in wetland W20-81). CH-3-ABH, CH-7-VP, and CH-8-VP are located beneath the existing 330 Line on the managed portion of CL&P's ROW. CH-8-VP is located adjacent to and north of the existing 330 Line and will be traversed by the underground variation. These vernal pools/amphibian breeding areas provide habitat for both wood frogs, spotted salamanders, American toad, and caddisfly.

- CH-9-VP (in wetland W20-83). This vernal pool is located beneath the existing 330 Line on the managed portion of the ROW. This vernal pool provides habitat for wood frogs.

- CH-10-VP, CH-11-VP and CH-12-VP (in wetland W20-84). These vernal pools are located beneath and south of the existing 330 Line, on the southern edge of the existing CL&P ROW. Amphibians observed include wood frog, spotted salamander, green frog, and red-back salamander.

Listed Species

Based on consultations with the USFWS, the Willimantic South Underground Variation does not encompass the known habitat for any federally-listed species. However, the New England cottontail (*Sylvilagus transitionalis*), which is listed as a candidate species for federal protection, occurs in the Town of Lebanon.

The western-most portion of the Willimantic South Underground Variation does not traverse any state-designated threatened, endangered, or special concern habitats, as identified by the CT NDDB. However, in the vicinity of the Shetucket River (Windham), U.S. Route 6 (Windham / Chaplin), and the CL&P ROW (Chaplin), the underground route variation is within the known habitat of various state-listed

species. Consultations with the CT NDDB revealed that the following six state-listed species of invertebrates (dragonflies, butterflies, moths) may occur in proximity to the Willimantic South Underground Variation:

- One endangered species, the banded bog skimmer dragonfly (*Williamsonia lintneri*);
- Three threatened species, the frosted elfin (*Callophryus irus*), Harris' checkerspot (*Chlosyne harrisii*), and the moustached clubtail (*Gomphus adelphus*); and
- Two species of special concern, Horace's duskywing (*Erynnis horatius*) and the bog copper butterfly (*Lycaena epixanthe*).

With the exception of the banded bog skimmer dragonfly and the bog copper butterfly, these state-listed species have also been identified along the Proposed Route (refer to Volume 1, Section 5.3.6 and the Insect Survey Report in Volume 4 for details regarding these species, including preferred habitat types). The banded bog skimmer dragonfly is associated with bog/fen habitat, whereas the bog copper butterfly is associated with sphagnum bogs in Connecticut. Both of the species have been identified as inhabiting areas near the Shetucket River.

15.5.3.4.4 Land Uses

The Willimantic South Underground Variation would traverse the northeastern portion of the Town of Lebanon, central and northern portions of the Town of Windham, and the southern portion of the Town of Chaplin. Land-use plans for these towns were reviewed, and land uses along and adjacent to the road ROWs within which the underground cables would be aligned, were characterized.

As illustrated on the Volume 9 maps, extending east – northeast and then east from Card Street Substation into Windham, the route variation would be aligned along Card Street, State Route 32 (Pleasant Street), Plains Road, and State Route 203. These road ROWs are bordered by a mix of land uses, consisting of residential, civic, and commercial developments, agricultural areas, and forests. In northern Windham and extending into Chaplin, the route variation would be aligned along U.S. Route 6, adjacent to which

are forest lands, open fields, commercial / industrial developments and residential areas. In Chaplin, the underground route variation also would extend along CL&P's existing overhead transmission line ROW, which traverses mostly forested areas near Natchaug State Forest and lands owned by the Fin, Fur, and Feather Club, Inc. The local zoning classifications along the route variation reflect the variety of land uses traversed, and range from rural residential and open space zones to business, commercial, and industrial zones (refer to the Volume 9 maps for specific zoning classifications).

Overall, the underground variation would traverse approximately 45.8 acres of road ROWs, 2.7 acres of open field / shrub land upland, 6.7 acres of upland forest, 0.2 acre of forested wetland, 0.1 acre of agricultural land, 3.1 acres of house / yard / other areas, 0.1 acre of emergent wetland, 0.9 acre of scrub-shrub wetland, and 0.4 acre of commercial / industrial uses.

The Willimantic South Underground Variation would be located within 300 feet of six Statutory Facilities. These facilities, which are identified on the Volume 9 maps, include:

- **Town of Windham**: a residential child day-care adjacent to Plains Road (mapsheet 5 of 13), the Windham Center School and playground, and North Windham Elementary School and playground (mapsheet 10 of 13). Another residential child day-care is located approximately 350 feet from the underground route variation, adjacent to Jordan Lane (mapsheet 10 of 13).

- **Town of Chaplin**: Carelot Children's Center, located adjacent to U.S. Route 6 (Willimantic Road) and Old Willimantic Road (mapsheets 11-12 of 13).

Following the road ROWs, the route variation also would traverse adjacent to various residential developments, ranging from low-density rural residential areas to subdivisions. The most densely developed residential areas are located along Pleasant Street and Plains Road in Windham and U.S. Route 6 in Windham and Chaplin. These areas consist primarily of single-family residences interspersed with some multi-family apartments. Less-densely developed areas of single-family residences are located along Card Street in Lebanon and North Road and North Windham Road in Windham.

The Willimantic South Underground Variation would not traverse any designated open space or recreational areas in the Town of Lebanon. However, in Windham, the route variation would be aligned near several recreational land uses, including, as shown on the Volume 9 maps, the American Legion athletic fields and the Willimantic Camp Meeting Association property (a Methodist Church retreat) along State Route 32 (mapsheet 3 of 13), town open space and ball fields (mapsheet 4 of 13), the Windham Center School Playground (mapsheet 5 of 13), and the Windham Elementary School Playground (mapsheet 10 of 13). Along State Route 203 (North Windham Road), the route variation would traverse the Airline State Park Trail, Northern Section (mapsheet 10 of 13).

Along U.S. Route 6 in Windham and Chaplin, the route variation would extend south of and adjacent to the Mansfield Hollow State Park and WMA. Within CL&P's existing ROW, the underground route variation would traverse approximately 300 feet south of the Natchaug State Forest. Along this segment of the route variation, parcels of land owned by the Fin, Fur, and Feather Club, Inc. abut portions of CL&P's ROW to both the north and south. The proposed line transition station at the eastern end of the route variation would be located within a wooded area, adjacent to the CL&P ROW and Fin, Fur, and Feather Club, Inc. property off Park Drive.

15.5.3.4.5 Transportation, Access, and Utility Crossings

For 10.1 miles of the 10.7-mile route, the Willimantic South Underground Variation would be aligned within or adjacent to public roads and would traverse beneath various cross streets. Along the 0.6-mile portion of the variation that would be located within CL&P's ROW, the route would cross one road.

The road ROWs within which the variation could be located are all two-lane roads (one lane in each direction), except for turning lanes located at intersections. Table 15-48 lists the roads along which the variation would be located, as well as the road, railroad, and major utility crossings.

Table 15-48: Roads and Major Utility Crossings along the Willimantic South Underground Variation

Municipality	Road / Railroad / Utility Name	Relationship to Route Variation	
		Variation aligned within or adjacent to road (miles)	Crosses
Lebanon			
	Card Street	0.7 miles	
	CL&P 310 Line		Overhead transmission line
	Pipeline		Buried pipeline crossing
Windham			
	Card Street	0.3 miles	
	Pleasant Street. Windham Road	2.0 miles	
	Mountain Street		Road crossing
	Jackson Street		Road crossing
	Plains Road	1.9 miles	
	New England Central Railroad		Railroad crossing
	North Road	0.8 miles	
	North Windham Road	2.8 miles	
	Airline State Park Trail		Former railroad crossing (now state park trail)
	U.S. Route 6 (Boston Post Road)	0.4 miles	
Chaplin			
	U.S. Route 6 (Willimantic Road)	1.0 miles	
	Park Road		Crosses along CL&P ROW

The Windham Airport is located approximately 1 mile west of the route variation, adjacent to the Willimantic Reservoir. The Willimantic South Underground Variation crosses one active rail line, the New England Central Railroad (which provides freight service on a line west of the Shetucket River).

15.5.3.4.6 Cultural (Archaeological and Historic) Resources

A total of 16 reported Native American archaeological sites are located within 1 mile of the Willimantic South Underground Variation. None of the sites are adjacent to or within the construction work area for the underground route variation. Due to previous in-road construction disturbance, underground line construction within existing paved roadways is assumed to have no archaeological sensitivity. However, along these roads, approximately 71% of adjacent unpaved areas appear sensitive, and undocumented disturbance may have occurred within some of these areas.

Reviews of historical maps and available secondary sources indicate that the Willimantic South Underground Variation would be located primarily in or adjacent to road ROWs built on previously undeveloped land. Most of the roads traversed by the underground route variation were established between the late 17th and late 19th centuries. Episodes of road and utility construction have probably removed or severely damaged remains of original unpaved roads, as well as much of the underlying soils.

There are 16 previously reported Euro-American archaeological sites within approximately 1 mile of the Willimantic South Underground Variation. Two of these sites are Rochambeau Army Revolutionary War encampments in the Town of Windham; both sites are listed on the NRHP. The Fourth Camp of Rochambeau's Army is a 16-acre site delineated approximately 850 feet from the underground route variation. The 47th Camp of Rochambeau's Army is a 16-acre site delineated approximately 2,300 feet from the variation. The specific locations of these sites are restricted to protect the integrity of the archaeological sites.

The former New York & New England Railroad once crossed this route variation near the Windham Airport, but recent maps and aerial photographs suggest that this crossing has been completely removed.

Seven significant above-ground historic properties (including 32 individual sites or structures) are located within 500 feet of the underground route variation (refer to the Volume 9 maps). These sites are all located in the Town of Windham and include: Willimantic Armory, Willimantic Elks Club, Willimantic Footbridge, Windham Road Bridge (No. 01850), Dr. Chester Hunt Office, Windham Center Historic District, and North Windham Cemetery. Additional information about these resources is presented in the *Cultural Resources Assessment* in Volume 3.

15.5.3.5 Potential Environmental Effects and Mitigation Measures

The construction of the Willimantic South Underground Variation would predominantly impact soils, water resources, and transportation patterns. Along the roads that the underground route variation would

follow, lane closures, detours, and traffic delays would commonly occur throughout the construction process. Construction activities also would create nuisance effects by limiting access to businesses and residences in the vicinity of duct-bank and splice vault construction work, and by creating construction-generated noise and dust.

Along the portion of the route variation that would be constructed within CL&P's ROW, the cable system would directly impact water resources as a result of excavations for the duct bank and splice vaults and the creation of a permanent access road adjacent to the duct bank. The 345-kV line transition station that would be located on the eastern end of the underground route variation (near the Natchaug State Forest and the Fin, Fur, and Feather Club property) also would represent a permanent land-use change and modification to the visual environment.

In addition, along the underground route, CL&P would have to acquire easement rights from private landowners for the installation of splice vaults (where ConnDOT or local highway policies preclude the location of the splice vaults within road ROWs). CL&P also would have to acquire new easements from private landowners for an underground cable system within the existing overhead transmission line ROW.

Appendix 15A reviews the typical environmental effects associated with underground cable construction and the principal measures that could be applied to mitigate such effects. Table 15-49 summarizes these potential environmental effects, along with the mitigation measures that CL&P would typically use to minimize adverse effects to the extent possible.

Table 15-49: Summary of Primary Effects and Potential Mitigation for the Willimantic South Underground Variation

Environmental Feature	Environmental / Social Effects		Potential Mitigation
	Construction	Operation / Maintenance	
Topography and Soils	Effects on topography and soils due to: • Grading / filling along 0.6-mile construction ROW within CL&P easement • Grading / filling at transition station sites • Excavations for duct-bank trench and splice vaults. Saw cutting pavement and excavation of soils beneath roads could disturb potentially contaminated soils. Potential for erosion and sedimentation into watercourses and wetlands.	Permanent change in grade along 0.6-mile segment of ROW along CL&P easement; permanent access road; permanent change in topography and soils at the line transition station site.	Install temporary erosion and sediment controls. Segregate topsoil layer during construction. To the extent practical and safe, restore contours and replace topsoil along ROW as part of restoration. Develop material handling plan
Water Resources	Direct disturbance to streams and wetlands as a result of clearing, grading, excavating for trench / splice vaults, and access road development. Approximately 0.2 acre of forested wetland, 0.9 acre of scrub-shrub wetland, and 0.1 acre of emergent marsh wetland would be affected. Vernal pools would also be affected. Potential effects associated with dewatering if groundwater is encountered in excavations Installation of flowable thermal backfill in duct-bank trench would constitute permanent fill in wetlands, as will the development of permanent access roads through wetlands.	An estimated net loss of 1.1 acres of wetlands due to duct-bank fill, splice vaults and access roads.	Use temporary erosion and sediment controls to minimize off-ROW water resource impacts. Revegetate or otherwise stabilize disturbed soil areas to limit the potential for sedimentation into water resources. Coordinate with USACE and CT DEEP regarding off-site compensation for permanent loss of wetlands.
Biological Resources	Direct disturbance to an estimated 13.8 acres of vegetation, including removal of 6.9 acres of forest lands (including 6.7 acres of upland forest and 0.2 acre of forested wetland)	Permanent conversion of forested areas, including forested wetland to scrub-shrub vegetative communities ; net loss of wetland habitat as detailed above due to access roads and cable trench	

Environmental Feature	Environmental / Social Effects		Potential Mitigation
	Construction	Operation / Maintenance	
Land Use, including Statutory Facilities and Designated Recreational Areas	Development of cable system along road ROWs would cause temporary potential disruption to adjacent land uses, as well as nuisance effects. Cable system would affect approximately 2.7 acres of open field and shrubland; 45.8 acres of transportation ROWs; 6.7 acres of upland forest; 0.1 acre of agricultural land.		
Visual Resources	Visual changes associated with the development of the line transition station, including the removal of existing forested vegetation. Construction activities along the ROW will cause temporary changes in the viewscape.	Change to visual environment associated with the development of the line transition station on previously undeveloped forested sites; maintenance of permanent access road along the 0.6-mile segment of route along CL&P's ROW	
Transportation	Increase in traffic as a result of movement of construction equipment and vehicles to / from the ROW and work sites; lane closures and delays during trenching and splice-vault installation along roads.	Permanent access required for access to the line transition station and along cable system ROW	Implement traffic management plan during construction; coordinate with affected towns
Cultural Resources	Any archaeological sites within the construction footprint would be adversely and permanently affected as a result of earth-disturbing activities such as grading, excavation, and access road development	Permanent adverse effects would occur to archaeological sites during construction	Conduct field investigations to identify archaeological sites and, if significant sites are found, to develop appropriate mitigation measures (e.g., data recovery), based on consultations with the SHPO

In general, the use of the underground variation would likely require a trenchless crossing of the Shetucket River (e.g., using jack and bore or HDD), which would involve extensive staging areas on either side of the river. The installation of the cable system beneath the active railroad line also would have to be performed using trenchless technology. Overall, the construction footprint for the route variation would encompass approximately 1.2 acres of wetlands (based on data from the CT DEEP); all of these wetlands would be directly affected by the duct-bank installation. Seven significant above-ground historic resources, encompassing 32 individual structures, would be located within approximately 500 feet of the route variation.

15.5.3.6 Electric and Magnetic Fields

Electric and magnetic fields were calculated for the 10.7-mile Willimantic South Underground Variation, which would be aligned principally along public road ROWs. A short section of the variation route would be located within CL&P's existing ROW in the Town of Chaplin between existing 330 Line structures Nos. 9101 and 9107. Along this in-ROW segment, the electric and magnetic field calculations assume an alignment of the underground cable system within CL&P's 300-foot-wide ROW offset 41 feet north from the centerline of the existing 330 Line. Along the portion of the variation that would follow road ROWs, the calculations assumed for simplicity that no other sources of electric and magnetic fields, such as electric distribution lines, are present.[26] Refer to Figure 15-14 for a graph of the magnetic field calculation results at AAL along the road route and to Figure 15-15 for a graph of the AAL results along the short ROW section.

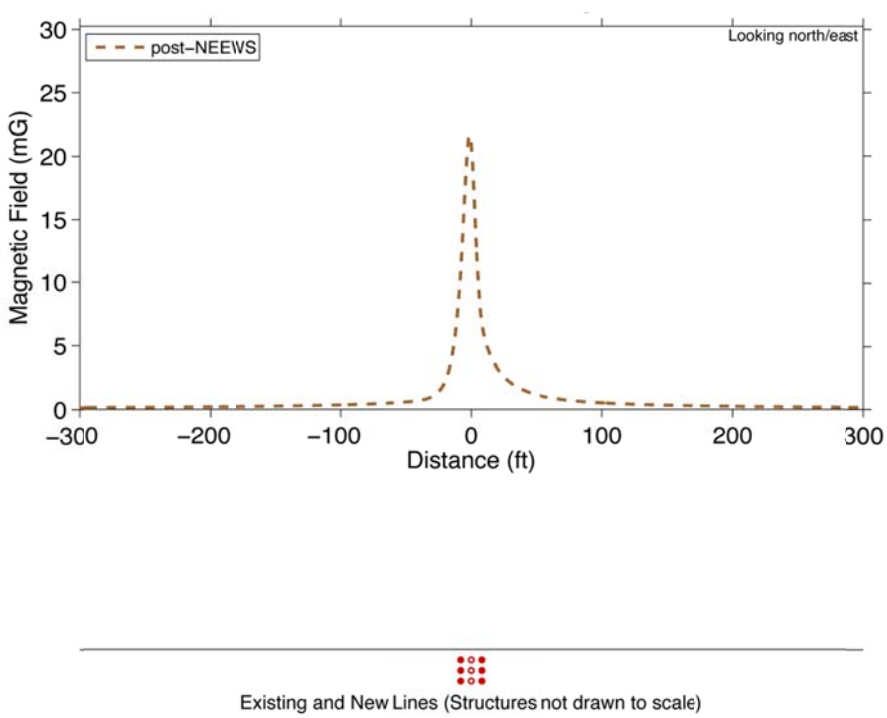
The relatively long length (10.7 miles) of the Willimantic South Underground Variation would significantly change the new circuit's impedance. Therefore, the system power-flow modeling to determine circuit currents for magnetic field calculations was repeated with an appropriate circuit-

[26] That there are such existing sources is evident in measurement results presented subsequently in Figure 15-16.

impedance change. Volume 1, Section 7 of the Application includes details on the system assumptions made in the power-flow modeling used to determine these circuit currents.

As Figure 15-14 shows, magnetic fields would be elevated directly above and near the underground cable system, but would decrease with distance to background levels. The calculated levels of magnetic fields at 25 feet to either side of the center of the cables after the completion of the Project with the Willimantic South Underground Variation at AAL are listed in Table 15-50. There are no defined ROW boundaries for underground cable systems installed within public roads, and the 25-foot distances were arbitrarily selected to show that magnetic fields from the cables would drop off to background levels over short distances. Near cable-splice vaults, many of which would need to be located outside of the road ROWs on private property, the magnetic fields produced by the underground cables would increase because of increased spacing between the cables.

Figure 15-14: Magnetic Field Profiles under Post-NEEWS (2020) Conditions at AAL for the Willimantic South Underground Variation Route from Card Street Substation to Existing Structure 9101 – XS-UG-1



Underground transmission cable systems do not produce electric fields above ground. Therefore, electric field values at the ROW edge are shown as N/A in Table 15-51 for this portion of the Willimantic South Underground Variation.

Table 15-50: Summary of Post-Project (2020) EMF Levels at ±25 Feet from the ROW Centerline at AAL for the Willimantic South Underground Variation Route from Card Street Substation to Existing Structure 9101 – XS-UG-1

Cross-Section	Magnetic Field (mG)		Electric Field (kV/m)	
	-25 ft from center	+25 ft from center	-25 ft from center	+25 ft from center
XS-UG-1 Post-NEEWS	1.4	2.5	N/A	N/A

Between existing structure Nos. 9101 and 9106, a 0.7-mile portion of the Willimantic South Underground Variation would be located within CL&P's overhead transmission line ROW. Along this segment, the underground cable system would be aligned approximately 41 feet north of the existing 345-kV transmission line (refer to Appendix 15B). Magnetic fields produced by both the existing and proposed lines along the short ROW section of the route in Chaplin at AAL were calculated and graphed on Figure 15-15. Figure 15-15 depicts the pre-Project (2015) and post-NEEWS (2020) magnetic field profiles at AAL for the ROW cross-section where the underground cable system would be installed.

The cable system location is shown in red on the sketch beneath the graph. The calculated levels of magnetic and electric fields at the ROW edges of this short segment before and after the completion of the Project with the Willimantic South Underground Variation at AAL are summarized in Table 15-51.

Figure 15-15: Magnetic Field Profiles under Pre-Interstate (2015) and Post-NEEWS (2020) Conditions at AAL for the Willimantic South Underground Variation Route between Existing Structures 9101 and 9106 – XS-UG-2

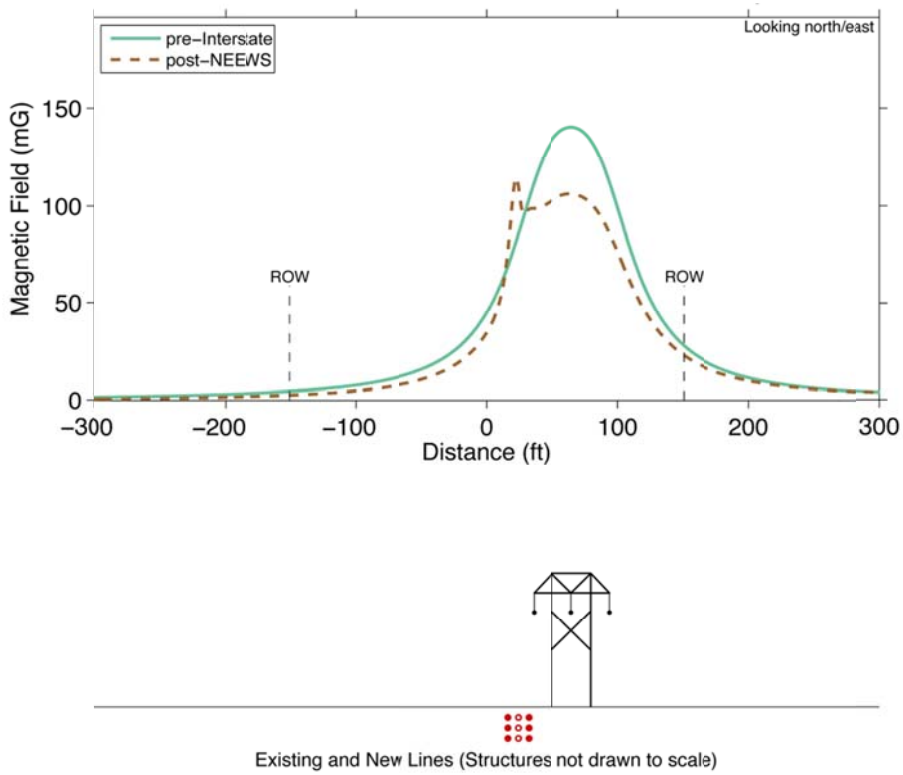


Table 15-51: Summary of Post-Project (2020) EMF Levels at the Edge of the ROW at AAL for the Willimantic South Underground Variation Route between Existing Structures 9101 and 9106 – XS-UG-2

Cross-Section	Magnetic Field (mG)		Electric Field (kV/m)	
	West/North ROW Edge	East/South ROW Edge	West/North ROW Edge	East/South ROW Edge
XS-UG-2 Pre-Interstate	4.6	28.0	0.09	1.20
XS-UG-2 Post-NEEWS	2.7	23.0	0.09	1.20

Underground transmission cable systems do not produce electric fields above ground. Therefore, the electric field profile across the road route and across the short ROW section in Chaplin with the Willimantic South Underground Variation would be the same as the existing electric field profile. Thus,

in Table 15-52 for the short ROW section in Chaplin, there is no difference between the ROW edge levels before and after the construction of the Willimantic South Underground Variation.

Table 15-52 compares the electric fields at ROW edges with the Willimantic South Underground Variation to those with the proposed overhead transmission line within the existing CL&P ROW.

Table 15-52: Comparison of Electric Field Levels at the Edge of the Existing 345-kV ROW With the Proposed Overhead Transmission Line and the Underground Variation Within the CL&P ROW

ROW Edge	Electric Field (kV/m)		
	Pre-Interstate	Post-NEEWS	
	Existing Configuration	Proposed Overhead Transmission Line Within Existing CL&P ROW	Underground Variation
North	0.09	0.39	0.09
South	1.20	1.19	1.20

If the Willimantic South Underground Variation were incorporated into the new 345-kV line, the existing 330 Line would remain on the avoided segments of ROW, but would carry different currents. The calculated levels of magnetic fields in 2020 along such existing ROW segments, compared to pre-Interstate levels in 2015, would be as shown in Table 15-53.

Table 15-53: Comparison of Pre-Interstate (2015) and Post-NEEWS (2020) EMF Levels at the Edge of the ROW at AAL for Existing ROW, With and Without Use of the Willimantic South Underground Variation (WSUV)

Cross Section(s)	Magnetic Fields for Annual Average Load Case			
	South/West ROW Edge Level (mG)	North/East ROW Edge Level (mG)	North/West ROW Edge Level (mG)	South/East ROW Edge Level (mG)
XS-1 Pre-Interstate (2015)	7.6	28.2		
XS-1 Post-NEEWS (2020) With WSUV	7.1	22.6		
XS-1 Post-NEEWS (2020) Without WSUV	5.8	18.7		
XS-2, XS-4, & XS-6 Pre-Interstate (2015)			4.6	28.0
XS-2, XS-4, & XS-6 Post-NEEWS (2020) With WSUV			3.7	22.4
XS-2, XS-4, & XS-6 Post-NEEWS (2020) Without WSUV			7.2	18.4
XS-2 BMP Pre-Interstate (2015)			4.6	28.0
XS-2 BMP Post-NEEWS (2020) With WSUV			3.7	22.4
XS-2 BMP Post-NEEWS (2020) Without WSUV			5.2	20.6
XS-3 Pre-Interstate (2015)			8.8	24.7
XS-3 Post-NEEWS (2020) With WSUV			7.0	19.8
XS-3 Post-NEEWS (2020) Without WSUV			24.1	22.3
XS-5 Pre-Interstate (2015)			8.3	35.2
XS-5 Post-NEEWS (2020) With WSUV			6.6	28.1
XS-5 Post-NEEWS (2020) Without WSUV			25.1	24.1

Six Statutory Facilities would be within 300 feet of the Willimantic South Underground Variation, including: Carelot Children's Center, one residential child day-care, the Windham Center School and playground, and the North Windham Elementary School and playground. A summary of magnetic and electric field measurements taken along the route of the Willimantic South Underground Variation in the vicinity of these locations is shown in Table 15-54. Field measurements were taken on November 17, 2008, between the hours of 9 a.m. and 3 p.m. Further measurements were taken along the entire route of XS-UG-1, which are graphed on Figure 15-16. These measurements were taken on the same day between the hours of 3 p.m. and 5 p.m.

Figure 15-16: Measured Magnetic Fields Along Willimantic South Underground Variation Route From Card Street Substation to Near Existing Structure 9101

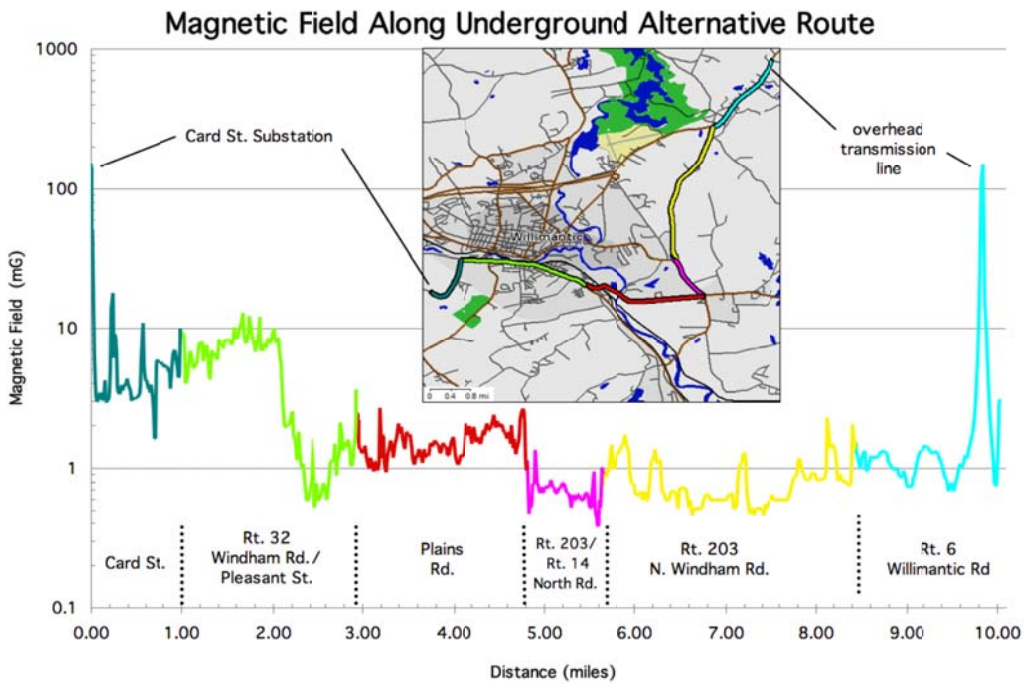


Table 15-54: Measured Electric and Magnetic Fields for the Willimantic South Underground Variation in the Vicinity of Child Day-Care Facilities, Playgrounds, and Schools: Cross Section XS-UG1 (Road ROWs)

Location Name/Address	Town	Volume 9 Route Variation Mapsheet No. (of 13)	Magnetic Field (mG)	Electric Field (kV/m)	Distance From New 345-kV Undergound Transmission Cables (ft)
Little Lights Christian Learning Center 90 South Park St	Windham	18	0.7-1.0**	0.140	590
Windham Center School 45 North Rd	Windham	19 of 21	0.3 – 0.5**	0.022	50
Windham Center School Playground 45 North Rd	Windham	19 of 21	0.2	--	100
North Windham Elementary School 112 Jordan Lane	Windham	21 of 21	0.3 – 0.4**	--	40
North Windham Elementary Playground 112 Jordan Lane	Windham	21 of 21	0.1	--	240
Residential Child Day-Care 90 Jordan Lane	Windham	21 of 21	0.1 – 0.3**	0.011	230

-- Shielding by vegetation prevented the collection of measurable electric field levels at this location from existing sources, e.g., distribution lines.

** Range of measurements made at several different sites near this location. Measurements generally made on the side of the street closest to address.

15.5.3.7 Comparison of the Willimantic South Underground Variation to the Segment of the Proposed Route Replaced

Like the Willimantic South Overhead Variation, the Willimantic South Underground Variation would avoid the federally-owned properties in the Mansfield Hollow area and would avoid aligning the new proposed 345-kV overhead transmission line within CL&P's ROW near existing and potential Statutory Facilities in the Town of Mansfield. However, as summarized in Table 15-55, compared to the development of the new proposed 345-kV overhead transmission line within the CL&P ROW, the use of the Willimantic South Underground Variation would substantially increase Project costs. In addition, the development of the underground cable system and an associated 345-kV line transition station on the eastern end of the cable segment would cause direct impacts to environmental resources, visual resources, and privately-owned properties. As a result, for the primary reasons summarized below, CL&P prefers the proposed 345-kV overhead transmission line located within CL&P's existing ROW.

The cost of the underground cable-system segment is a significant consideration. While the comparable 11.6-mile segment of the proposed overhead transmission line would cost $60.8 million, the capital cost of the 10.7-mile underground route variation is estimated at $325.9 million. Therefore, the underground route variation would add $265.1 million to the total cost of the Project.[27]

As described in Section 14.3.1.3, these increased costs would not likely qualify for inclusion in New England regional transmission rates. As a result, in addition to paying 27% of the cost of building the base-case overhead line, Connecticut consumers would likely be responsible to pay 100% of any costs that exceed the cost of building the base-case overhead line, including extra costs for constructing underground cables and EMF BMP line designs. Since the Willimantic South Underground Variation would cost approximately five times more than the comparable segment of proposed overhead transmission line (constructed pursuant to standard good utility practice), the cost to Connecticut

[27] For this length of underground cables, it is likely that shunt reactors would be needed at one or both ends of the underground cables. No costs for shunt reactors are included in the cost estimate.

consumers for the 10.7-mile underground segment would be approximately 15 times more than that of the overhead line. This is calculated as follows:

Connecticut consumer cost for section of overhead line to be replaced:

Estimated cost of the proposed overhead transmission line (including delta structures for EMF Focus Area A and delta structures through Mansfield Hollow State Park):	$60.8 million
Estimated cost of overhead base transmission line (i.e., H-frame structures through Focus Area A and delta structures through Mansfield Hollow State Park):	$58.1 million
Incremental cost of overhead line with delta structures through EMF Focus Area A:	$2.7 million
Connecticut consumer cost for overhead section to be replaced = (base-line cost x 27%) + (Incremental increase over base-line cost for delta structures in EMF Focus Area A x 100%)	$18.4 million

Connecticut consumer cost for underground variation:

Estimated cost of the underground variation:	$325.9 million
Incremental increase of underground variation over an overhead H-frame transmission line (but including delta structures in Mansfield Hollow State Park):	$267.8 million
Connecticut consumer cost for underground variation = (Incremental cost for underground x 100%) + (H-frame line cost x 27%):	$283.6 million

Finally, dividing the Connecticut consumer cost for the underground variation by the Connecticut consumer cost for the overhead line section to be replaced yields: ($283.6 million / $18.4 million) = 15.

In addition, CL&P would have to purchase up to 4 acres of privately-owned land (in fee) for the eastern line transition station site. This land would be converted to utility use for the life of the Project, and

would involve the removal of up to approximately 4 acres of existing upland forest, representing a permanent change in the nearby viewscape.

The development of the underground cable system would cause transportation management issues as a result of construction work (i.e., continuous trenching for the duct banks as well as excavations for the splice vaults) within or adjacent to road ROWs.

Overall, CL&P prefers the proposed Project design over the Willimantic South Underground Variation. Compared to the proposed overhead line, the variation would be significantly more costly, would result in greater long-term environmental effects (particularly to water resources), and would require the permanent conversion of up to 8 acres of land to transition station use.

Table 15-55: Comparison of the Willimantic South Underground Variation to the Proposed Project Segment (Overhead Line) to be Replaced

Route Characteristic	Proposed Route Segment to be Replaced	Willimantic South Underground Variation
Location, Design, and Appearance		
Route Location (ROW, Town[s])	Existing CL&P ROW (Lebanon, Columbia, Coventry, Mansfield, Chaplin)	Within or adjacent to road ROWs, CL&P ROW (Lebanon, Windham, Chaplin)
Route Length (miles)	11.6 miles	10.7 miles
Splice Vaults (est. number)	N/A	35 sets (106 separate splice vaults)
New ROW Easements or Land Acquisition Required (est. acres)	11 acres (ROW expansion: Mansfield Hollow State Park and WMA)	8.2 acres (Line transition station and splice vaults) Underground easement rights along existing ROW and adjacent to road ROWs as needed
Biological Resources		
Upland Forest Clearing (est. acres)	61.4 acres	6.7 acres
Forested Wetland Clearing (est. acres)	10.2 acres	0.2 acre
Scrub-Shrub Clearing (est. acres)	8.8 acres (upland) 0.5 acre (wetland)	2.7 acres (upland) 0.9 acre (wetland)
Watercourse Crossings (no.)	25 (span)	3 (direct effects, trenching)
Wetlands, Permanent Effects (Fill) (est. acres)	1 structure 104 0.4 acre (access roads, structure)	Approximately 1.1 acres
Wetlands, Temporary Effects (est. acres)	1.1 acres (access road)	0.1 acre
Land Uses		
Designated Open Space or Recreational Uses along ROW (length)	0	0
CL&P-Owned Land Traversed	1.8 miles	Less than 0.1 miles
Total Construction ROW / Work Space, Temporary Land Disturbance (est. acres)	136 acres	60 acres
Cost of Transmission Line Segment ($ Million, $ 2010)		
Capital Cost	$60.8	$325.9
Cost to Connecticut Consumers[1]	$18.4	$283.6
Life-cycle Cost	$103.7	$467.8

1. Assumes localization of extra costs for EMF BMP line designs and for underground cables.

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Appendix 15A – General Description of Potential Environmental Effects Associated with the Development of the Overhead and Underground Route Variations

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15A. GENERAL DESCRIPTION OF POTENTIAL ENVIRONMENTAL EFFECTS ASSOCIATED WITH THE DEVELOPMENT OF THE OVERHEAD AND UNDERGROUND ROUTE VARIATIONS

This appendix describes the environmental effects that would commonly occur as a result of the construction and operation of segments of the new 345-kV transmission line along:

- The overhead line-route variations (i.e., Brooklyn Overhead Variation and Willimantic South Variation), both of which would entail the creation of "greenfield" corridors for the new 345-kV transmission line; or
- The underground line-route variations, which would involve the development of a 345-kV cable system either along portions of CL&P's existing transmission line ROWs (i.e., the Mansfield Underground Variation, Mount Hope Underground Variation, Brooklyn Underground Variation) or along a combination of highway ROWs and CL&P's ROW (i.e., the Willimantic South Underground Variation).

The potential environmental effects discussed in this appendix are typical to the types of construction and maintenance activities that would be associated with each type of variation. The appendix supplements the specific impact analyses included for each of the variations in Sections 15.2 through 15.5.

15A.1 OVERHEAD VARIATIONS TO THE PROPOSED ROUTE

The development of the new 345-kV transmission line along either of the two overhead line-route variations (Brooklyn Overhead Variation and Willimantic South Overhead Variation) would require the creation of a new 150-foot-wide utility corridor across mostly privately-owned properties currently used for other purposes. This section discusses the potential environmental effects and mitigation measures that would apply to the development of the new 345-kV line along these route variations, focusing on the areas that would differ from the development of the overhead line along the Proposed Route.

15A.1.2 Topography, Geology, and Soils

Whereas along the Proposed Route the new 345-kV transmission lines would be located predominantly within CL&P's existing long-established ROWs, the overhead line-route variations would create new

corridors through the landscape. The construction of a new transmission line along the overhead variations also would alter topography where grading or filling is necessary to improve or create new access roads, or to prepare work areas around structure sites.

Based on a review of soil types found along the route variations, in general, depth to bedrock along the overhead line-route variations is greater than 6 feet. As a result, extensive areas of rock would not likely be encountered during drilling for transmission line structure foundations. Erosion and sedimentation control measures would be deployed and maintained where soils are disturbed during construction.

However, the two variations traverse agricultural lands where special soil preservation methods may be required during construction. Typically, construction activities in agricultural lands would be performed to minimize crop damage and the mixing of topsoil and subsoil layers. As part of ROW restoration, de-compaction may be performed in agricultural areas to assist in restoring pre-construction soil texture.

15A.1.2 Water Resources

Wetlands and watercourses along the new ROWs associated with the overhead variations would be spanned to the extent possible. However, some structures and associated foundations, and guy-wire anchors may have to be located in wetlands due to design and safety codes.

As a result of vegetation clearing and subsequent vegetation management, the creation of new ROWs would affect previously undisturbed wetland systems. Clearing of vegetation for construction along these variations would convert primarily forested wetland communities to primarily scrub-shrub and/or emergent cover types. In addition, construction along a new ROW could increase the potential for erosion and sedimentation because activities such as tree clearing, removal of vegetation, and grading for access roads could expose large previously, undisturbed areas of soil to erosional forces and would remove existing wetland buffers and riparian vegetation along watercourses.

Line safety and reliability requirements would determine the extent of vegetative buffers retained along stream and riverbanks. New access roads along the ROWs would be required, likely resulting in some permanent wetland loss due to fill. Mitigation or compensation for these permanent effects would be required by state and federal permitting agencies.

15A.1.3 Biological Resources

Wildlife and Vegetation

Along the two overhead variations, vegetation would have to be cleared to allow for construction of the new 345-kV transmission line and to establish and maintain appropriate clearances between forest vegetation and the conductors of the new line. In general, the use of the overhead variations would require comparatively more vegetation removal than the alignment of a new 345-kV line overhead along the Proposed Route, along which portions of the on-ROW vegetation is presently managed in conjunction with the operation of the existing transmission lines. In areas along the route variations where forest lands presently exist, a conversion to shrubland would represent a long-term localized effect on habitat.

The effects of this habitat change on wildlife would be similar to those described for the Proposed Route in Volume 1, Section 6. However, whereas the Proposed Route would be aligned along an existing, vegetatively managed ROW where scrub-shrub habitat already exists, the route variations would create a new linear corridor through tracts of forestland.

Like the Proposed Route, the two overhead variations would be designed to avoid the placement of transmission line structures in watercourses; the conductors would span rivers, streams, and ponds. However, access roads would likely be required across smaller streams, and the construction and use of such roads would disturb stream banks and riparian vegetation.

Measures would be taken to minimize the potential for sedimentation into watercourses resulting from construction activities in nearby upland areas. In particular, temporary soil erosion and sedimentation

controls would be installed around areas of disturbed soils at work sites up gradient from streams. These temporary erosion controls would remain in place until the disturbed areas are re-vegetated or otherwise stabilized.

Fisheries

Both of the overhead line-route variations traverse watercourses that support fisheries. The potential for localized, adverse effects on water quality, fisheries, or other aquatic organisms could occur as a result of new access road construction and equipment crossings of these watercourses.

In general, riparian vegetation along the variation ROWs would be maintained, to the extent possible, to provide shade. Vegetation along stream banks would be cut only if required to maintain safe clearances from the transmission facilities or to allow the development of access roads. Riparian vegetation removal could have effects on streamside shading and could locally disturb fish habitat.

Riparian forests minimize disruption of aquatic communities by maintaining stream flow during droughts and reducing stream bank erosion during flood events. Streamside forest areas serve as biological buffers to absorb excessive levels of sediment, nutrients, and other pollutants; and also serve to minimize erosion and/or sedimentation into the stream.

CL&P would minimize the potential for indirect effects (e.g., sedimentation into watercourses) by installing temporary soil erosion and sedimentation controls around areas of disturbed soils at work sites located near streams. These temporary erosion and sedimentation controls would remain in place until the disturbed areas are re-stabilized.

15A.1.4 Land Use, Land-Use Plans and Recreational/Scenic Resources

The development of a new 345-kV transmission line along the overhead route variations would create new utility corridors and would not be consistent with federal and state policies for collocating linear

utility corridors where practical. For example, both of the overhead variations would require the creation of a new utility corridor through presently undeveloped lands within the Quinebaug-Shetucket Rivers Valley National Heritage Corridor. The use of the variations would also require the conversion of various existing land uses to utility line development. CL&P would have to acquire easement rights from the affected property owners. In such areas, future land uses along the ROW would be restricted to those compatible with utility use.

Construction of the overhead line-route variations may temporarily affect recreational and scenic resources, particularly those crossed by the transmission facilities. Construction of new utility ROWs and transmission line structures would also have a permanent effect on view-sheds within the Project area.

The Willimantic South Overhead Variation would traverse or be located adjacent to certain recreational, open space, or otherwise protected land uses (Pomeroy State Park, Airline State Park Trail, and Beaver Brook State Park). While similar resources also would be traversed by, or would be adjacent to, the Proposed Route, construction of the Willimantic South Overhead Variation would represent a new utility line crossing of these facilities. In addition, the Willimantic South Overhead Variation would extend across the Windham Center Historic District and State Route 14/203, a state-designated scenic road. The creation of a new utility crossing through these areas could affect views to / from scenic or historic sites.

Although the Brooklyn Overhead Variation would not extend across any state or federally designated scenic areas, the new transmission line structures and ROW would parallel and also cross Barretts Hill Road in Brooklyn. This road offers panoramic views of the valley to the southeast, which could be affected by the transmission line structures.

15A.1.5 Transportation, Access, and Utility Crossings

The construction of an overhead 345-kV transmission line along the overhead route variations would typically cause only temporary and highly localized adverse effects on transportation patterns. These

effects would stem primarily from the movement of construction vehicles and equipment to and from the new ROWs via public roads. These vehicular movements could cause localized traffic congestion. In addition, the movement of heavy construction equipment over local roads may cause road damage.

The construction and maintenance of an overhead 345-kV line along the overhead route variations would require the creation of new on-ROW access roads (both temporary and – in some cases - permanent). Along the overhead variations, the overhead 345-kV transmission lines would span all public roads, railroad, and pipelines. As a result, the operation of the overhead transmission lines would not affect transportation.

15A.1.6 Cultural Resources

Because the overhead variations generally traverse undeveloped areas, where soils may not previously have been disturbed, the potential for locating intact buried archaeological sites can be expected to be higher than along the Proposed Route. Further field assessments of the archaeological sensitivity along the route variations would be required to evaluate the need for and extent of cultural resources testing. Field investigations also would be required, in coordination with Native American Tribal representatives, to determine areas of potential interest for Tribal purposes.

15A.2 UNDERGROUND VARIATIONS

The development of 345-kV transmission cable systems along any of the four underground variations, either within or adjacent to road ROWs or along sections of the existing CL&P ROWs, would have direct effects on all environmental resources within the construction footprint. These effects would occur as a result of grading (if necessary) and excavations for a cable-duct bank and splice vaults, as well as for construction access. In addition, all of the underground variations would require one or two 345-kV line transition stations, the development of which would represent long-term land-use conversions and cause localized adverse effects on the visual environment.

Within paved road ROWs, the operation of the underground transmission cable system typically would not result in adverse environmental effects, except to the extent that maintenance activities may require re-excavation of portions of the cable system or work within the existing splice vaults. This could cause traffic congestion due to lane closures or detours. In contrast, cable systems within the existing CL&P ROWs would require long-term land use conversions because of the need to maintain a permanent road allowing access along the entire length of any cable route.

The following sections first describe the potential effects of underground cable-system construction and maintenance on environmental resources in general (Sections 15A.2.1 through 15A.2.6), and then discuss the potential effects of the 345-kV line transition stations.

15A.2.1 Topography, Geology, and Soils

Underground cable-system construction, either within or adjacent to road ROWs or along the transmission line ROW, would result in effects to topography, geology, and soils as a result of grading, excavation (possibly requiring blasting or other rock removal activities), and soil disturbance. Unlike the development of an overhead transmission line along which such activities are only required along access roads or at structure locations, the installation of an underground cable system requires continuous and linear grading, excavation (of a trench for the cable ducts and splice vaults), and soil disturbance along the entire length of the underground cable route.

Additionally, subsurface conditions along the underground cable routes would have to be characterized prior to construction to develop a subsurface profile (to assess locations where bedrock and groundwater would be encountered) and also to test the quality of soils and groundwater. Based on the results of these analyses, a *Material Handling Guideline* would be prepared defining how soils and groundwater encountered during the trenching / excavation process would have to be managed.

The installation of the underground cables and splice vaults along road ROWs (i.e., the Willimantic South Underground Variation) would not require extensive grading and thus would have minimal adverse effects on topography and geology in most areas. In general, a construction width of approximately 40 feet would be needed to install the cable system along roads. However, in areas where the cables or splice vaults must be located off-road, including at watercourse crossings, clearing and grading would be necessary to cut stream banks, excavate the trench through the stream bed, and otherwise level the terrain so the cable system or vaults could be installed safely and at an appropriate elevation below grade. Extra work space would also be required in such areas to stage the equipment and materials required for the installation of the cable system beneath the watercourses. Additionally, extra work space for other staging areas (e.g., at jack and bore or HDD sites, or areas where construction equipment and materials would have to be temporarily stored) may involve localized earth-disturbing activities such as clearing and grading.

In contrast, the installation of a cable system along CL&P's transmission line ROWs (e.g., the Mansfield, Mount Hope, and Brooklyn Underground Variations) would involve vegetation clearing and grading along the entire length of the underground segment. For example, grading would be required to create permanent access roads[1], provide a level work space for construction equipment, and achieve appropriate subsurface elevations for the installation of the entire cable system (cables and splice vaults).

A minimum construction workspace width of approximately 40 feet would be required to install the cable system duct bank within the existing transmission line ROWs. Within CL&P's existing ROWs, the center of the cable duct bank would be offset 15 feet from the outside conductor of the existing 345-kV line. Additional space would be required at splice vault locations. This construction workspace would be needed to accommodate an access road (approximately 20 feet wide), as well as the trench/splice-vaults.

[1] Access roads would be developed and used during construction, but would have to remain in place permanently because access to the entire underground cable systems is required for maintenance purposes.

Within this construction area, all vegetation would be removed and the area would be graded or filled to create a level work space.

Whether along a road ROW or within the transmission line ROWs, cross-linked polyethylene (XLPE) cable installation would involve the excavation of a continuous trench (approximately 7 to 10 feet deep and 5 feet wide at the bottom, and typically with a 10-foot-wide opening at the surface), as well as excavations for concrete splice vaults (each requiring an excavation area approximately 13 feet wide by 13 feet high and 35 feet long). The splice vaults would typically be required at approximately 1,600-foot intervals along the cable system route (note, however, that this interval between vaults may vary depending on site-specific factors). The required excavations may be deeper or wider, depending on soil conditions and, when trenching along roads in particular, depending on whether the cable system must be installed below other buried utilities (e.g., water lines, sanitary sewers, storm sewers). Trench boxes and other types of shoring would be required to support the trenches during duct-bank installation. Shoring also is typically required at splice-vault installations.

To excavate the trench and splice-vault locations for the underground cables through areas of rock, special rock removal methods would be required. The preferred techniques for removing rock are mechanical methods (e.g., mechanical excavators and pneumatic hammers) or mechanical methods supplemented by controlled blasting. Such rock removal activities result in dust and vibration/noise in the immediate vicinity of the excavation work. Controlled blasting would only be used if other methods of rock removal are not practical.

Because underground cable installation is time-consuming, the lengths of time soils or excavations are exposed in any one location (and therefore subject to the potential for erosion or sedimentation into water resources) can be significant. The amount of construction time required at any one location depends on subsurface conditions, particularly whether bedrock or groundwater are encountered in the excavations.

During cable system excavations, temporary erosion and sediment controls would have to be deployed to contain spoil piles and to avoid erosion and sedimentation into watercourses or wetlands, either from erosion of disturbed soils or from sedimentation caused by excavation dewatering. Temporary erosion and sedimentation control measures would have to be consistent with CL&P's established plans and with the 2002 *Connecticut Guidelines for Soil Erosion and Sedimentation Control*.

For work within and adjacent to road ROWs, typical erosion and sedimentation control measures may include catch-basin protection, the use of fractionization tanks, or the use of dewatering structures or filter bags. Such temporary controls are typically maintained until the restoration of disturbed work sites is deemed successful.

After the completion of conduit and splice-vault installation, the excavated trench and splice-vault areas would be backfilled with special "flowable fill", a concrete mix designed to better dissipate heat from the cables. For the most part, the material originally excavated from the trench would not be used as backfill. Instead, soils would be trucked off-site and disposed of at approved sites, in accordance with applicable regulations.

After the completion of cable-system installation, disturbed ROW areas would be restored to grade to the extent practical. Along the Willimantic South Underground Variation, disturbed pavement would be resurfaced and affected road shoulders/curbing/sidewalks repaired. Along the in-ROW underground variations, the ROW would be reseeded and allowed to re-vegetate, except for the 20-foot-wide permanent access road, which would be maintained for operation and maintenance purposes.

15A.2.2 Water Resources

The construction and operation of the underground variations would cause both direct and, potentially, indirect effects to water resources. All of the underground variation routes traverse both wetlands and watercourses. While the Willimantic South Underground Variation may be constructed within road

ROWs above or below certain of these water resources, avoidance of effects to all water resources is unlikely because in some areas along the route, it would likely be infeasible to install the cable system on bridges or culverts. As a result, some in-water construction would be required.

Furthermore, while subsurface techniques, such as jack and bore or HDD may be considered for some larger watercourse crossings, even these techniques, which are both costly and time-consuming, would involve effects to water resources. For example, jack and bores near watercourses typically encounter groundwater, which must be pumped continuously from the excavated pits and typically is ultimately discharged to a surface water. HDDs require withdrawal of water for the drilling fluid mix, and also may result in inadvertent returns of the drilling fluid/drill cutting mix to surface or ground waters.

The in-ROW underground variations would involve direct effects to all water resources within the construction footprint. In order to install the duct bank, excavations would be required through both streams and wetlands. In addition, a permanent access road would likely be required across these water resources.

Potential effects to water resources associated with underground cable-system construction include sedimentation and turbidity (potentially caused by clearing and grading of stream banks), excavation in wetlands and streams, trench/vault dewatering, and backfilling. Additionally, the soils disturbed along the cleared ROW could erode, resulting in effects to water quality. In general, along the in-ROW underground variation routes, the clearing and grading of the ROW exposes large areas of soil to erosional forces and increases the potential for sedimentation into water resources. Riparian vegetation also must be removed along the ROW at watercourse crossings.

The use of flowable fill, rather than native backfill in the trench and splice vaults, could also have long-term localized adverse effects on water resources. It is possible that the flowable fill could disrupt natural subsurface water flows or could affect infiltration rates. This could be a potential concern along the in-

ROW underground variations, rather than for the construction of the Willimantic South Underground Variation, which would be aligned mostly within paved road ROWs.

Neither the construction nor the operation of the underground variations would result in significant adverse effects to groundwater resources or public water supplies. However, groundwater is likely to be encountered along all of the underground variations and would require careful management throughout the excavation phases of construction. Trench dewatering, whether along roads or along CL&P's transmission line ROW, has the potential to cause the discharge of turbid or sediment-laden water to streams and wetlands.

In general, if groundwater is encountered during trench or splice-vault construction, the water would be pumped from the excavated areas and discharged in accordance with the requirements of applicable regulations. Depending on regulatory authorizations and on the alignment of the underground variation, the water may be pumped into municipal storm water catch basins, to the sanitary sewer system, into temporary settling basins and sediment filter bags, or watercourses (if the water is sufficiently free of sediment). Alternatively, water may be pumped into a tank truck for off-site disposal.

Furthermore, along the Willimantic South Underground Variation and where the in-ROW variations traverse roads, the cable system would require careful alignment to avoid effects to other buried utilities, such as municipal water lines, as well as storm and sanitary sewers. Excavations for trenches or splice vaults would have to be performed carefully to avoid conflicts with these existing utilities.

15A.2.3 Biological Resources

The effects of underground cable-system installation and maintenance on biological resources would differ substantially, depending upon whether the underground cables are aligned within or adjacent to existing road ROWs or within the CL&P transmission line ROWs.

Wildlife and Vegetation

The construction and operation of an underground transmission cable system within or adjacent to road ROWs (e.g., the majority of the Willimantic South Underground Variation) would result in minimal effects on vegetation and wildlife resources. Where an underground cable can be aligned within paved portions of road ROWs, vegetation removal would not typically be required, except for vegetation within or near road shoulders or tree branches that overhang the road and that may interfere with construction. In addition, vegetation (including riparian areas and wetlands) could potentially be affected where the cable system must be aligned across water resources outside of the road ROWs.

If splice vaults must be located outside of road ROWs (as required pursuant to ConnDOT policies along state roads), existing lawns, trees, and ornamental vegetation would be affected. The amount and type of vegetation affected would depend on the actual splice-vault locations. In such areas, after the completion of the cable-system installation, lawn and ornamental vegetation could be restored in locations where it would not affect future access for cable system inspections and repairs.

In contrast, the construction and operation of an underground cable system along the route variations within CL&P's ROWs would result in both temporary and permanent effects on vegetation. Along the entire underground cable routes, all vegetation would have to be cleared, stumps removed, and the ROWs graded. After the completion of the cable-system installation, temporary work areas would be reseeded and then allowed to re-vegetate naturally, except the areas over the cable trench and splice vaults, which would be maintained in low-growth vegetation. However, along the permanent graveled access road that would have to be created and maintained along the entire underground cable system, vegetation would be precluded for the life of the Project.

Wildlife habitat would be altered both temporarily and permanently due to the vegetation changes described above. Construction activities would have direct effects on wildlife within the ROWs in terms

of displacement, disturbance, and (for less mobile species), mortality. Vegetation clearing also would reduce cover, nesting, and foraging habitats for some wildlife. In forested areas, the principal effect of the vegetation removal and the long-term ROW maintenance, in low-growth vegetation, would be a change in the species using areas from those favoring wooded habitats to those preferring edge habitats or scrub-shrub or open habitats. The conversion of forested habitat to scrub-shrub would be advantageous to some species.

Fisheries

All of the underground route variations traverse watercourses, some of which support fisheries. Where the installation of the underground cable system may be accomplished without disturbing stream banks or stream beds (e.g., potentially along portions of the Willimantic South Underground Variation where the cable system could be installed above or below streams), no adverse effects would occur to water quality, fisheries, or other aquatic organisms. CL&P would minimize the potential for indirect effects (e.g., sedimentation into watercourses) by installing temporary soil erosion and sedimentation controls around areas of disturbed soils at work sites located near streams. These temporary erosion controls would remain in place until the disturbed areas are re-stabilized.

Along the underground variations within CL&P's existing ROWs, the cable system would have to be trenched across watercourses, causing direct effects to water quality and fishery resources. These direct effects would be unavoidable, because subsurface methods such as HDD or jack and bore would not be practical for all of the small watercourse crossings along the ROWs. To mitigate effects to fishery resources, CL&P would consult with CT DEEP to identify appropriate timing windows for in-water construction to avoid fish spawning periods. Additionally, construction methods such as dam and pump or dam and flume could be used to minimize adverse effects to water quality, and thus to fish habitat.

Amphibians

The cable-system construction along the underground variations would directly affect wetland resources and could potentially affect amphibian habitat or amphibians. Construction best management practices would be employed to contain the construction sites and control soil erosion and the discharge of sediment-laden water to wetlands and watercourses located along the existing roadways.

15A.2.4 Land Uses

In general, the development of an underground cable system along the route variations, either within CL&P's existing transmission line ROWs and/or within or adjacent to road ROWs, would not conflict with local, regional, state, or federal land-use plans. However, the 345-kV line transition stations required at each end of the underground segments represent utility uses that would not be consistent with local land uses or zoning.

Cable-system construction activities would cause land disturbance within construction work areas and would create temporary, highly localized nuisance effects (e.g., noise, dust, and traffic congestion). These effects would occur throughout the period of active construction, and would depend on the type of construction work at each location, as well as the schedule for such activities. Construction work could be designed and scheduled to avoid or limit the potential for interference with recreational activities. However, underground trenching, duct-bank installation, and backfilling work, as well as the excavations for and installation of splice vaults can require substantial time at any one location, depending on the subsurface conditions encountered (e.g., presence of rock, groundwater). As a result, construction work could extend over multiple months.

The development of the 345-kV facilities along any of the underground variations would change the visual environment. During construction, these effects would be associated with the removal of vegetation within the construction work spaces and views of work sites, etc. After the cable system is installed, the construction work areas would be restored (i.e., re-paved or re-vegetated). However, along

the in-ROW underground variations, both the creation of the permanent access road along the cable system route and the management of the lands along the cable system route in non-forested vegetation would represent a long-term change in the visual environment. In addition, the above-ground 345-kV line transition stations would cause a long-term change in the character of the visual environment in the vicinity of each site.

15A.2.5 Transportation, Access, and Utility Crossings

The potential effects of underground cable-system construction and operation on transportation would depend on the location of the cable route.

In general, the construction of an underground cable system along CL&P's ROWs would have minor or highly localized effects on transportation and access. During construction, construction vehicles and equipment would have to access the ROW via local roads, which could cause traffic delays. In addition, the movement of heavy equipment over local roads may cause road damage. Along each of the in-ROW underground variations, local or state roads would have to be crossed, requiring temporary lane closures or detours during the construction period. The maintenance of the underground cables along the CL&P ROWs would not affect transportation patterns, except that permanent access would have to be maintained to the 345-kV line transition stations.

By comparison, the development of the Willimantic South Underground Variation would have temporary, but potentially significant effects on local traffic patterns. The variation also would have to be carefully designed to avoid conflicts with utilities buried within the roads. Because a majority of the underground variation would be aligned along road ROWs, construction activities would require temporary lane closures and would result in traffic disruption, delays, detours, and/or congestion. Construction workers traveling to work sites, as well as the movement of construction equipment, also could temporarily cause localized increases in traffic volumes, further aggravating traffic congestion. To mitigate the potential effects of the cable-system construction, CL&P would coordinate closely with ConnDOT and local

highway authorities, and would typically develop a *Traffic Control Plan* and construction schedule (to avoid lane closures during peak travel periods).

The operation of the cable systems would not affect transportation patterns, except when maintenance or repair is required, involving access to the splice vaults or other portions of the buried cable, is necessary.

15A.2.6 Cultural (Archaeological and Historic) Resources

In general, the trenching and splice-vault excavation required for underground cable system construction would disturb soils and could potentially directly affect archaeological sites. As a prerequisite of regulatory approvals, all construction work spaces associated with an underground cable system would have to be investigated for the presence of buried cultural resources and, based on the results of such field investigations, if potentially significant cultural sites are discovered, mitigation strategies would have to be developed and implemented as appropriate. The *Cultural Resources Assessment Report* (refer to Volume 3) identifies the cultural resources potentially affected by the underground variations, including the identification of known or potential archaeological resources in the vicinity of each route and the evaluation of the potential visual effects of the Project on historic properties listed or eligible for listing on the State and National registers of historic places.

15A.2.7 Air Quality

The development of a cable system along any of the underground variations would result in short-term, highly localized effects on air quality during construction, primarily from fugitive dust and vehicular emissions associated with cable trench and splice-vault excavations. For in-road cable system installation, saw cutting of pavement also would generate dust and silt-laden water. During dry periods, to minimize the amount of fugitive dust generated by construction activities, water would be used as needed to wet down excavated spoil piles and dirt/gravel access roads. No adverse effects on air quality would be associated with the operation of the facilities.

15A.2.8 Noise

During construction of the cable system along any of the underground variations, activities such as vegetation removal, grading, access road development, trench excavation (particularly involving rock drilling, jack-hammering or blasting), the installation of splice vaults, and the general operation of construction equipment would increase ambient sound levels. Along the Willimantic South Underground Variation, saw-cutting of pavement, pavement removal, and re-paving also would emit noise. The underground cable-system operation would not result in any noise effects.

Construction-related noise would be short-term and highly localized in the vicinity of work sites. However, there are noise sensitive sites (receptors) in the vicinity of the underground variations. These include residences, schools, and public recreational areas. Because of the slow pace of underground construction work, noise-emitting activities could be localized in the vicinity of these receptors for several days or more.

Additionally, it is possible that some underground cable-system construction along the Willimantic South Underground Variation would have to occur at night, to minimize the potential for traffic congestion associated with lane closures or detours. People are more sensitive to increases in ambient sound levels at night; as a result, such night construction work could result in greater perceived adverse noise effects, particularly on sensitive noise receptors.

15A.2.9 345-kV Line Transition Stations

The development of any of the underground variations would require the associated construction and operation of one or two 345-kV line transition stations, each of which would involve the permanent conversion of approximately 2 to 4 acres of land to utility uses for the life of the Project. Except for the line transition stations that could be located entirely on CL&P's fee-owned property, lands for the sites would have to be acquired from private owners. Figure 15A-1, located at the end of this appendix,

provides an illustration of a typical 345-kV line transition station for three underground cable sets connecting to one overhead line with no shunt reactors.

In general, the construction and operation of each line transition station would result in a range of effects on environmental resources. The site development activities would require the removal of all vegetation within the construction footprint, permanently displacing the existing wildlife habitat. Subsequently, each site would be grubbed and graded to create a level area for the line transition station facilities. Potential short-term effects to soil resources, associated with earth-moving activities and the increased potential for erosion, would occur during the construction of the station.

New line transition stations would typically be sited in upland areas. As a result, the development of the sites would not directly affect water resources (i.e., watercourses, wetlands, or floodplains). However, construction activities could increase the potential for off-site erosion and sedimentation into water resources. Similarly, construction activities involving refueling and the storage of fuels and lubricants, etc. could increase the potential for accidental spills that could reach ground or surface water resources.

Further, the location of line transition stations in generally rural or rural residential areas would not typically be consistent with existing land-use patterns and also would create permanent visual changes to the character of the surrounding areas. Although located adjacent to the existing CL&P overhead transmission line ROWs, the line transition station facilities would constitute a visual contrast with the other undeveloped lands or existing land uses in the vicinity. On the other hand, the collocation of a line transition station within or adjacent to an existing substation (such as would be the case at Card Street Substation for the western line transition station for the Willimantic South Underground Variation) would be consistent with the utility use of the property and typically would result in only incremental visual effects.

The construction and operation of the 345-kV line transition stations would generally result in the same types of effects on transportation/access, noise, and air quality as described for the cable systems. However, some noise may be associated with the operation of circuit breakers. In addition, the line transition stations would be equipped with lighting, which would be used for night work or inspections and possibly for security purposes.

Likewise, as described in the *Cultural Resources Assessment* (refer to Volume 3), each potential line transition station site would be located in an area sensitive for potential (as yet undocumented) Native American archaeological sites. As a result, detailed field studies would be required to determine whether any archaeological sites are present and, if so, the potential effects of the line transition station development on such resources. In contrast, none of the proposed line transition station sites areas would be sited within 0.25 mile of significant above-ground historic resources; consequently, none of the stations would cause any potential for adverse visual effects on such historic structures.

Figures 15A-2 and 15A-3 illustrate existing CL&P line transition stations where two sets of 345-kV underground cables transition to an overhead line.

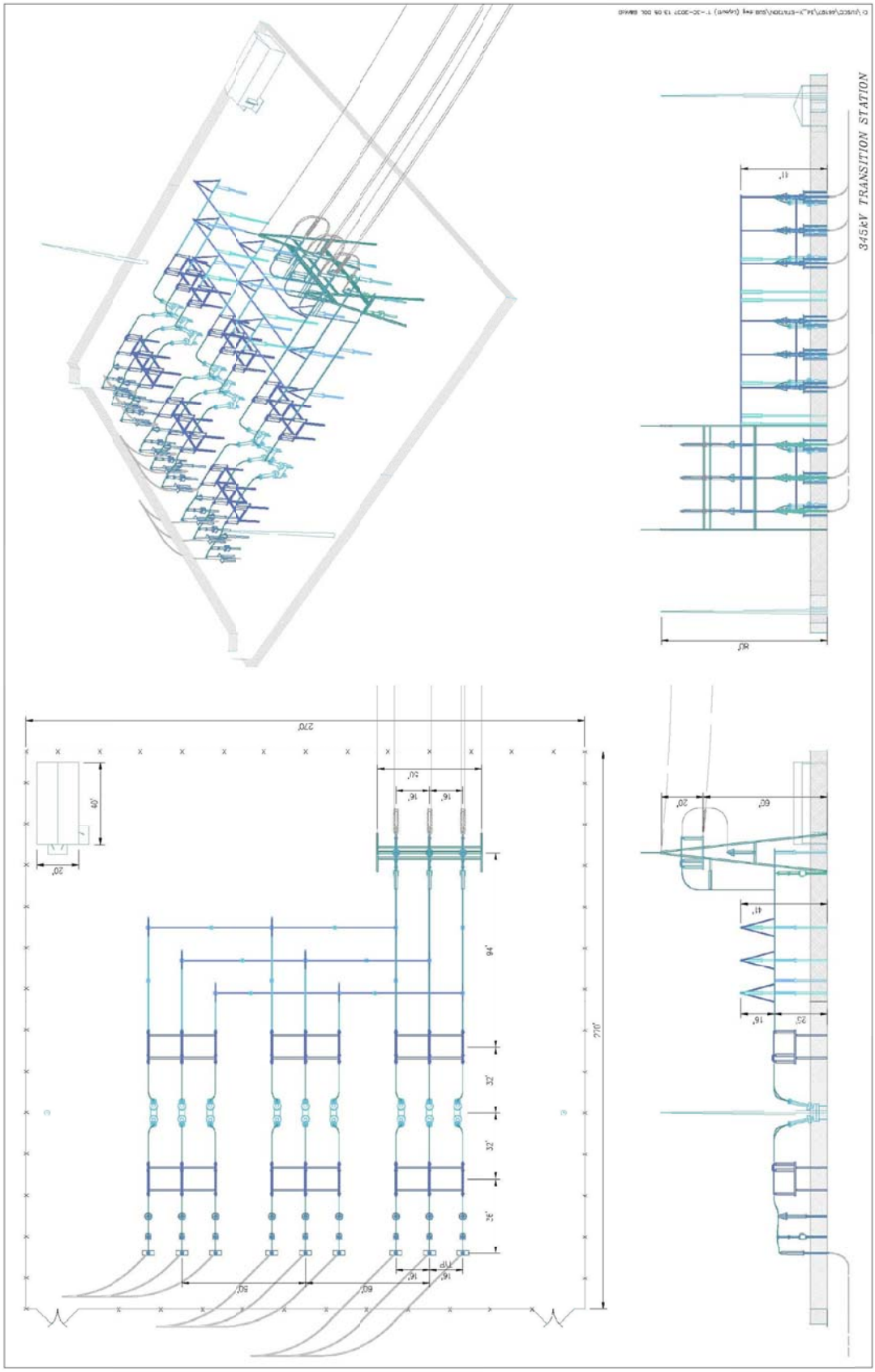
345kV TRANSITION STATION
41'
80'
20'
60'
41'
18'
25'
270'
20'
40'
20'
16'
16'
94'
32'
32'
25'
270'
16'
16'
TYP
60'
60'

Figure 15A-2: 345-kV Line Transition Station with Shunt Reactors

Figure 15A-3: 345-kV Line Transition Station with no Shunt Reactors

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Appendix 15B –Variations: Cross-Sections

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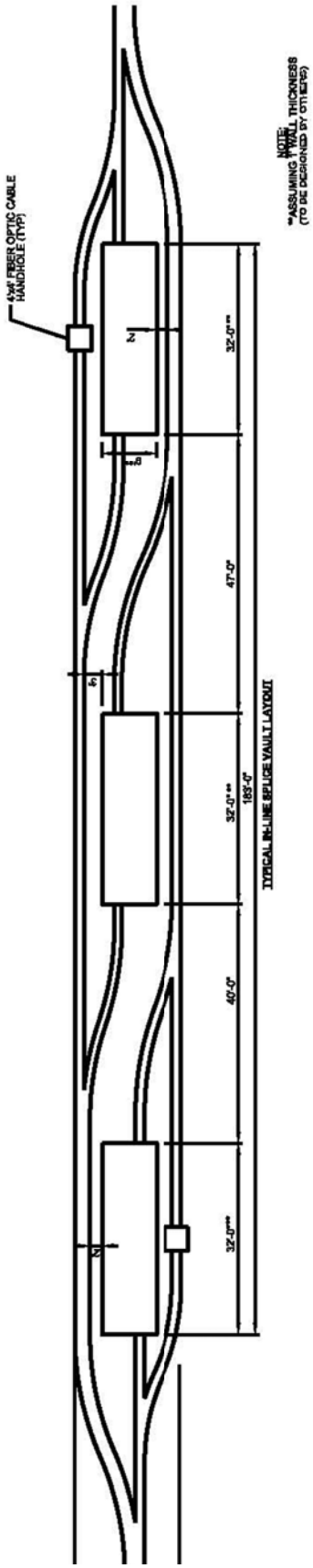
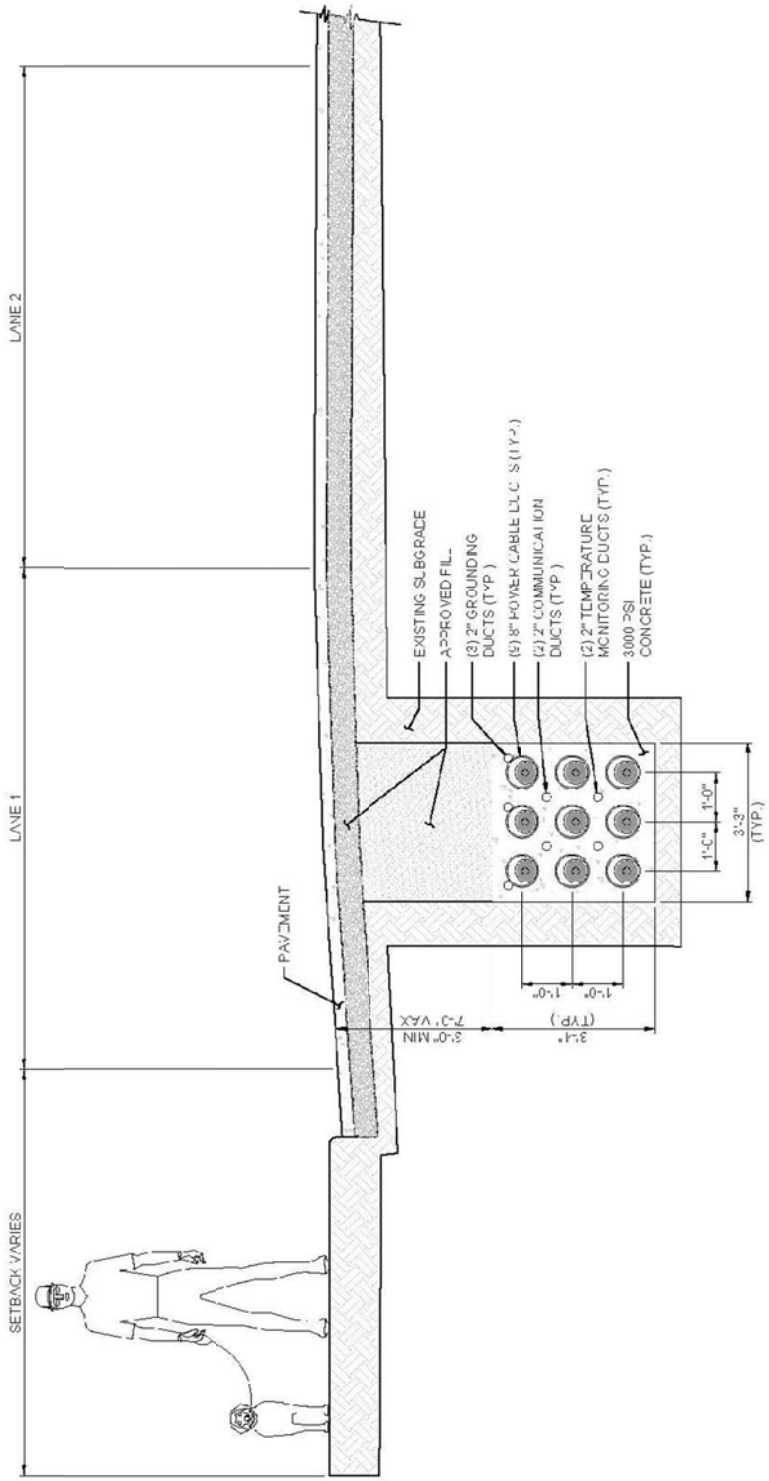
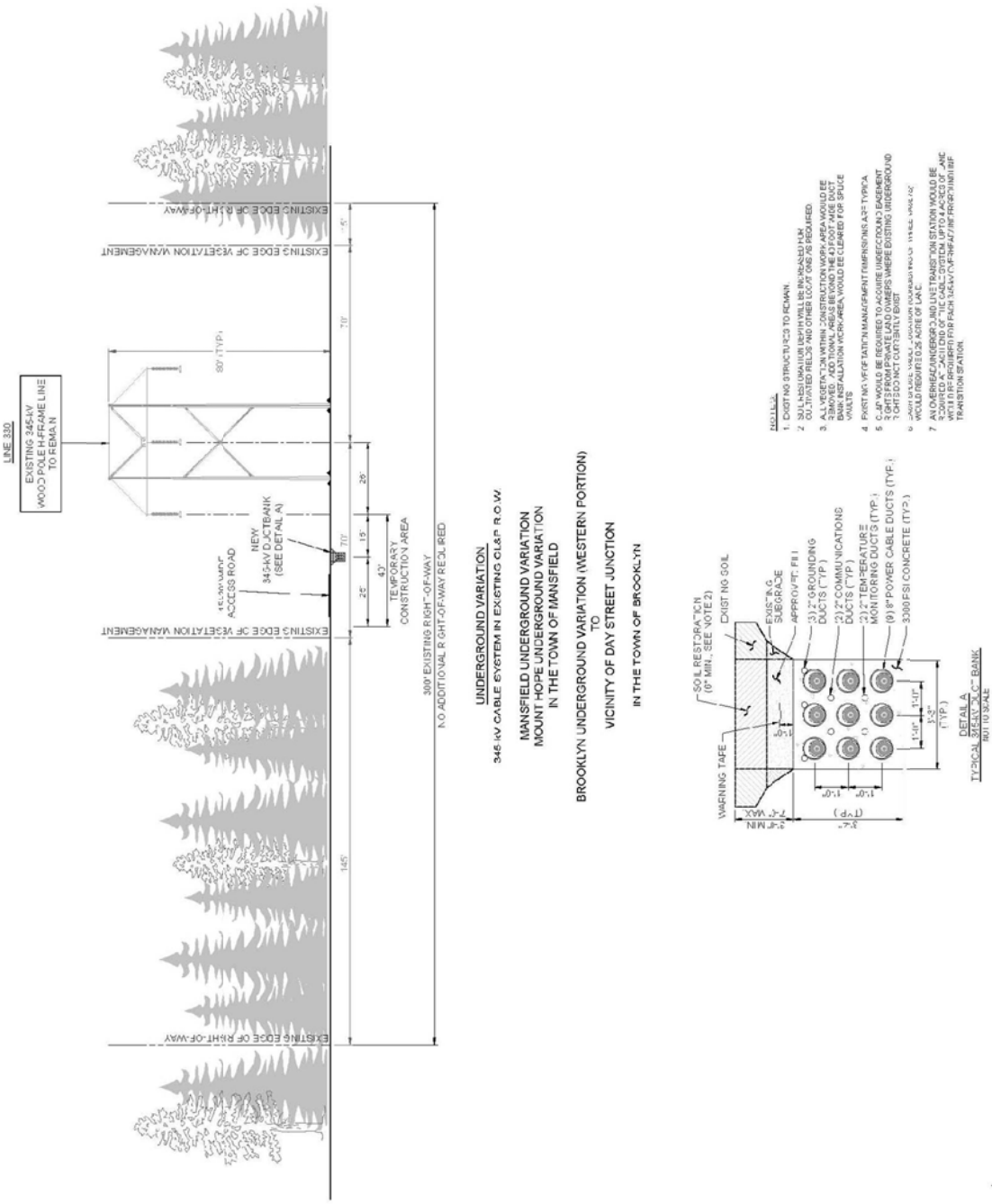
Typical Underground Cable System Layout at Splice Vault Locations



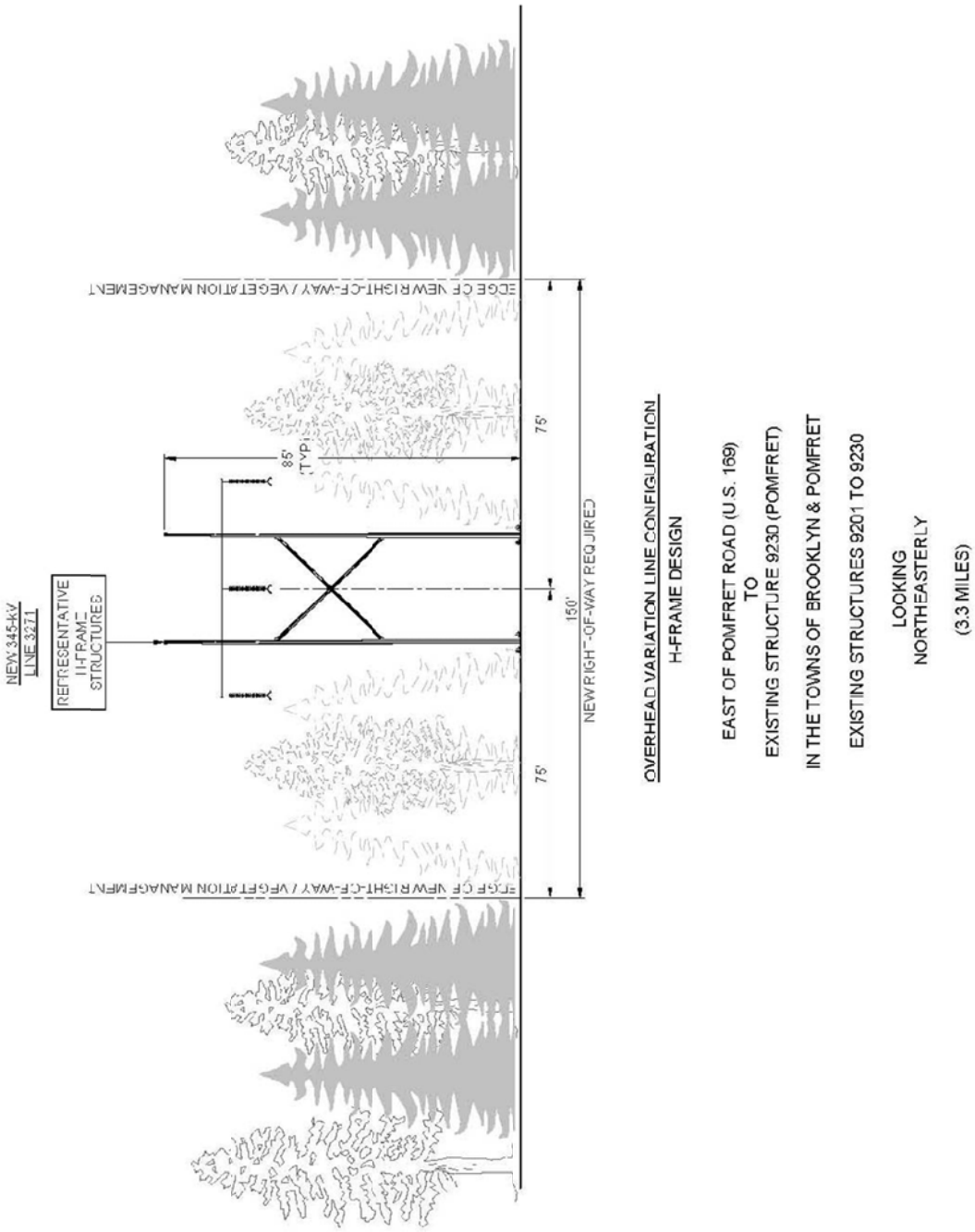
XS-UG-1: Underground Variation – 345-kV Cable System in Road



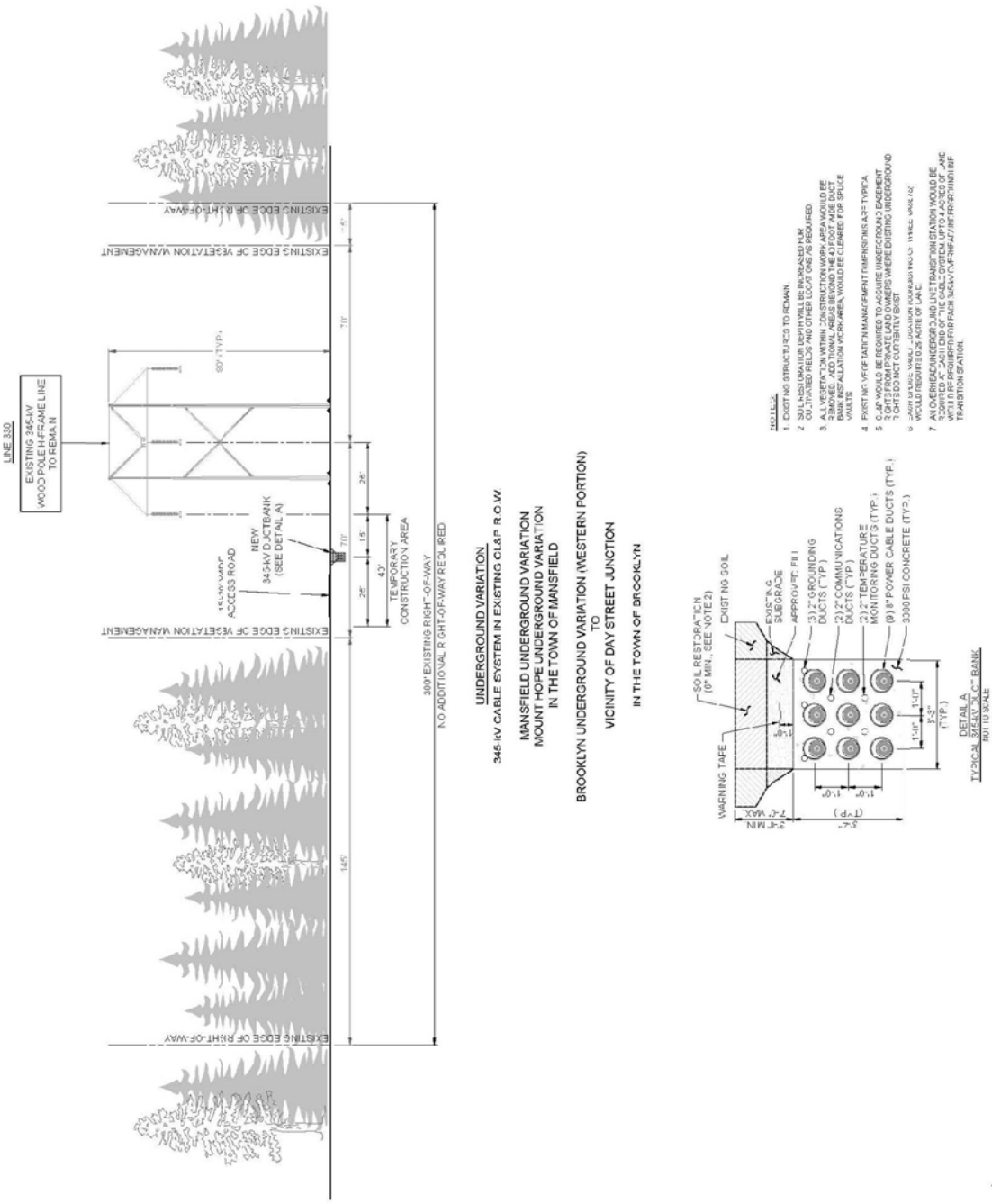
XS-UG-2: Underground Variation – 345-kV Cable System in Existing CL&P ROW



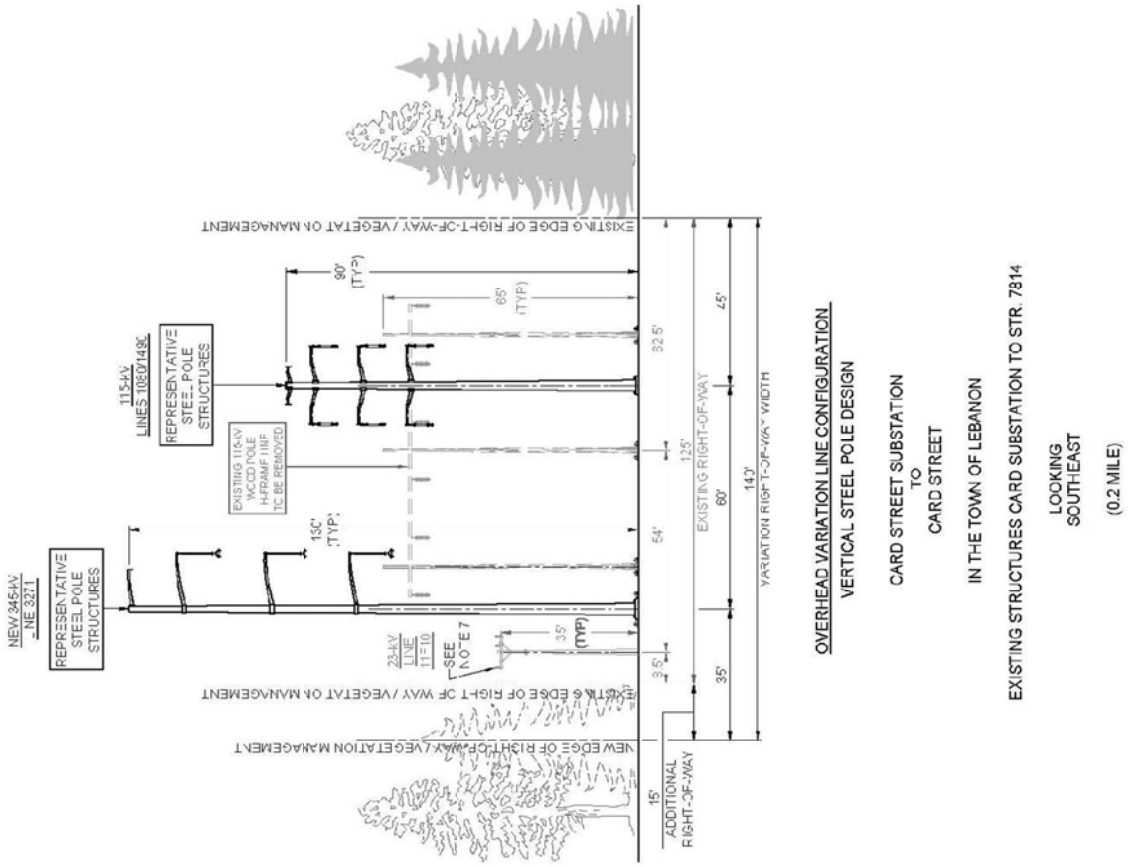
XS-B-1: Brooklyn Overhead Variation – Pomfret Road to Ten Spans North of Day Street Junction



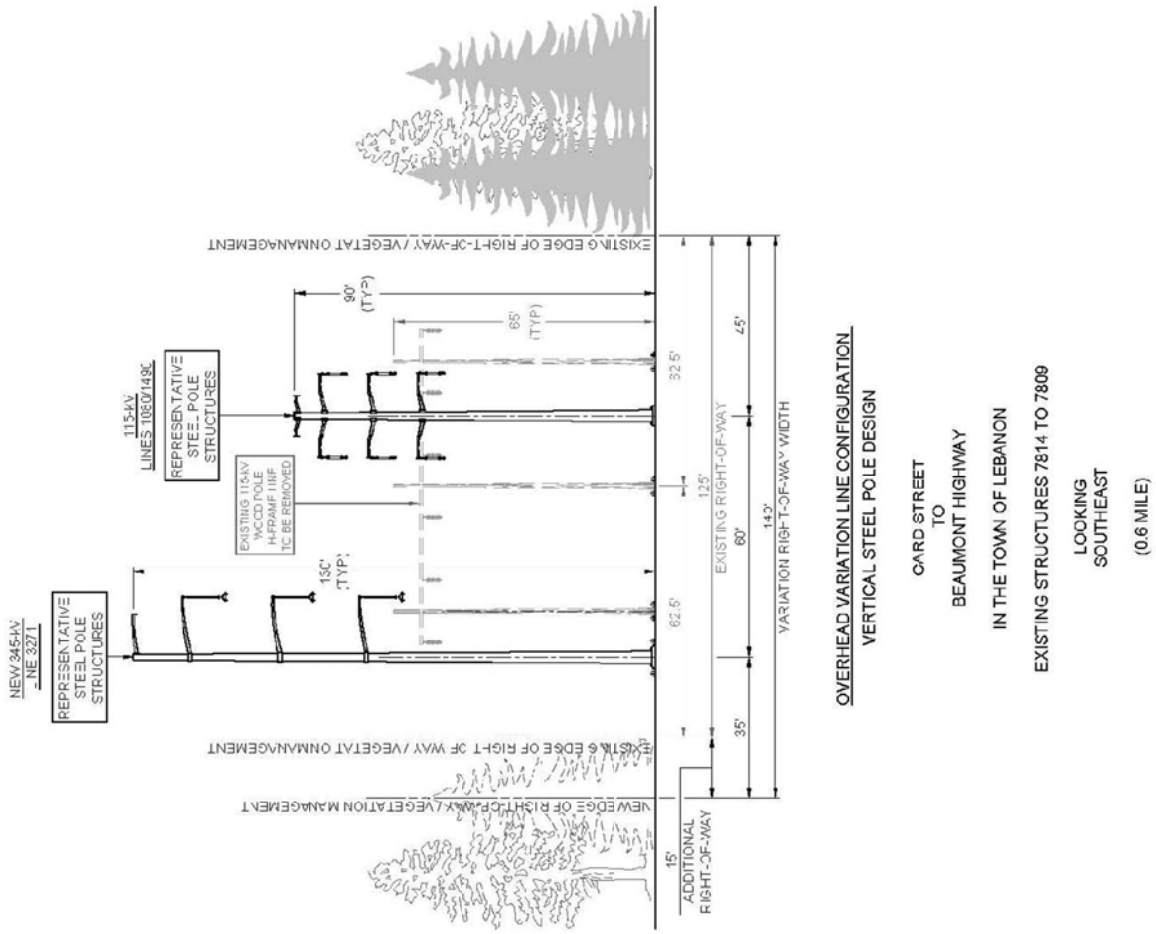
XS-UG-3: Underground Variation – 345-kV Cable System in Existing CL&P ROW



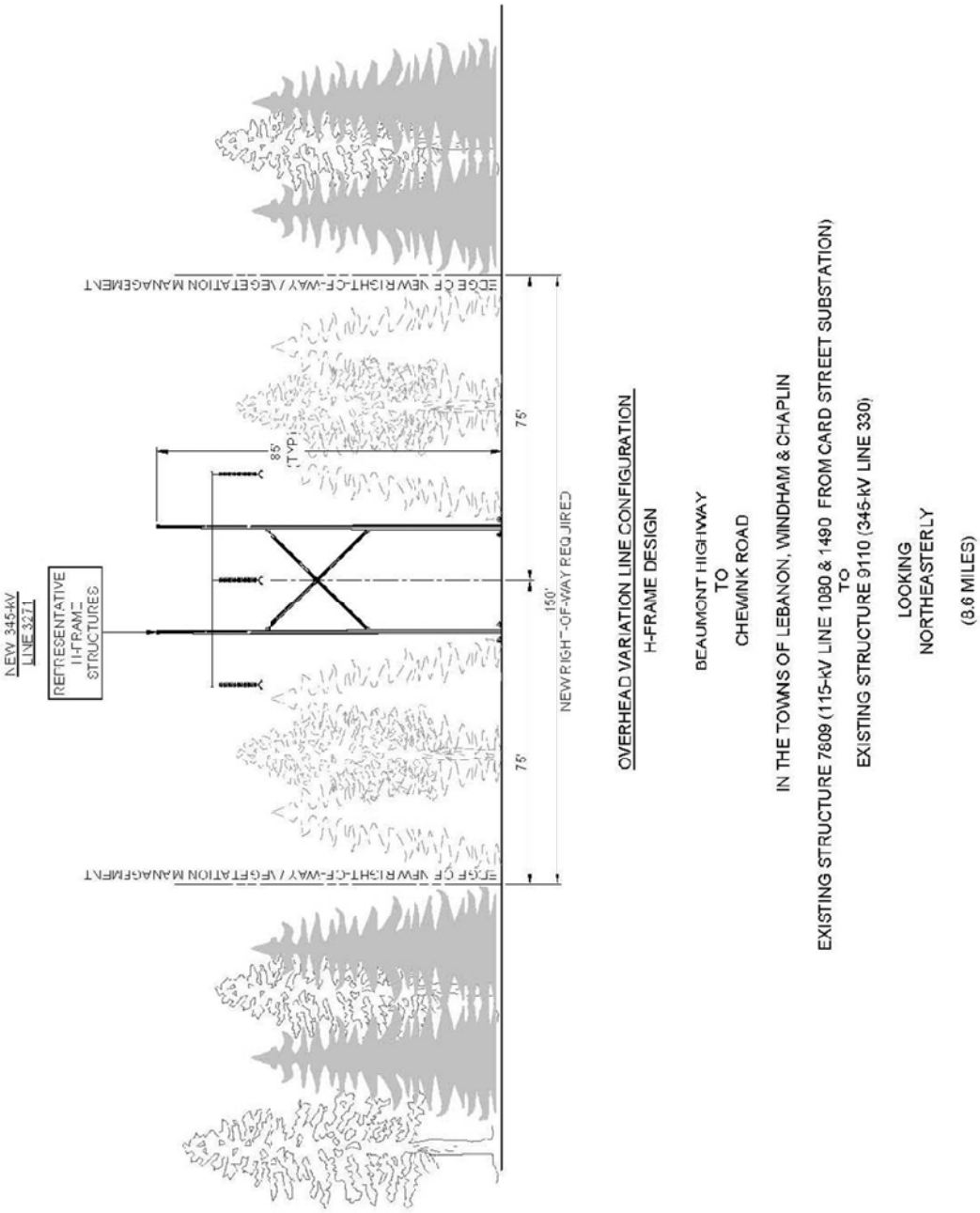
XS-WS-OH-1: Willimantic South Overhead Variation – Card Street Substation to Card Street



XS-WS-OH-2: Willimantic South Overhead Variation – Card Street to Beaumont Highway



XS-WS-OH-3: Willimantic South Overhead Variation – Beaumont Highway to Chewink Road



Appendix 15C – Tabular EMF Data for Variation Cross-Sections

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Table 1: Magnetic Field (mG) at Distances Relative to the ROW Centerline (ft) - Annual Average Load Condition (AAL)

Line Section	Configuration	-300	-275	-250	-225	-200	-175	-150	-125	-100	-75	-50	-25	0	25	50	75	100	125	150	175	200	225	250	275	300	- ROW Edge	+ ROW Edge
XS-UG-1: Mansfield Underground Variation - 345-kV Cable System in Existing CL&P ROW	pre-Interstate	1.6	1.8	2.1	2.5	3.0	3.7	4.6	5.9	7.8	10.7	15.8	25.2	45.0	87.7	133.5	137.5	98.9	51.3	28.0	17.2	11.5	8.3	6.2	4.8	3.9	4.6	28.0
	post-NEEWS	0.8	0.9	1.1	1.4	1.7	2.2	2.8	3.7	5.1	7.4	11.3	19.0	37.3	114.8	109.5	111.0	81.7	43.8	24.6	15.5	10.7	7.9	6.1	4.8	4.0	2.8	24.6
XS-B-1: Brooklyn Overhead Variation - Pomfret Road to Ten Spans North of Day Street Junction	pre-Interstate	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	post-NEEWS	2.1	2.5	3.0	3.7	4.7	6.1	8.2	11.8	18.1	30.9	59.1	105.0	123.4	105.0	59.1	30.9	18.1	11.8	8.2	6.1	4.7	3.7	3.0	2.5	2.1	30.9	30.9
XS-UG-2: Brooklyn Underground Variation - 345-kV Cable System in Existing CL&P ROW	pre-Interstate	1.6	1.8	2.1	2.5	3.0	3.7	4.6	5.9	7.8	10.7	15.8	25.2	45.0	87.7	133.5	137.5	98.9	51.3	28.0	17.2	11.5	8.3	6.2	4.8	3.9	4.6	28.0
	post-NEEWS	0.8	0.9	1.1	1.4	1.7	2.2	2.8	3.7	5.1	7.4	11.3	19.0	37.3	114.8	109.5	111.0	81.7	43.8	24.6	15.5	10.7	7.9	6.1	4.8	4.0	2.8	24.6
XS-UG-3: Brooklyn Underground Variation - 345-kV Cable System in Existing CL&P ROW	pre-Interstate	2.1	2.5	3.1	3.9	5.1	6.8	9.6	14.4	23.6	43.3	86.6	135.3	144.4	112.2	78.2	58.1	22.3	50.1	47.7	20.2	7.9	3.5	1.7	0.9	0.5	6.4	16.6
	post-NEEWS	1.4	1.7	2.1	2.7	3.5	4.8	6.9	10.7	18.2	37.0	120.4	109.9	114.3	91.2	67.6	55.0	18.9	47.1	49.9	23.5	10.5	5.5	3.3	2.1	1.5	4.5	19.8
XS-WS-OH-1: Willimantic South Overhead Variation - Card St. Substation to Card St.	pre-Interstate	0.7	0.8	1.0	1.3	1.6	2.1	3.0	4.4	7.4	14.8	28.6	19.6	13.3	34.2	33.1	16.4	8.5	5.1	3.4	2.4	1.8	1.4	1.1	0.9	0.8	17.4	19.1
	post-NEEWS	1.7	2.0	2.4	3.0	3.9	5.1	7.1	10.3	16.2	29.0	40.4	64.5	61.9	41.9	21.3	9.9	6.1	4.4	3.4	2.7	2.2	1.8	1.5	1.3	1.1	32.3	11.3
XS-WS-OH-2: Willimantic South Overhead Variation - Card St. to Beaumont Hwy.	pre-Interstate	0.6	0.7	0.8	1.0	1.2	1.6	2.2	3.0	4.6	7.8	14.8	21.6	16.4	35.7	32.9	16.0	8.1	4.8	3.2	2.2	1.7	1.3	1.0	0.8	0.7	8.8	18.6
	post-NEEWS	1.7	2.0	2.4	3.0	3.9	5.1	6.9	10.0	15.2	24.7	42.9	67.3	63.2	42.0	20.8	9.4	5.8	4.3	3.3	2.7	2.2	1.8	1.5	1.3	1.1	27.5	10.8
XS-WS-OH-3: Willimantic South Overhead Variation - Beaumont Hwy. to Chewink Rd.	pre-Interstate	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	post-NEEWS	2.1	2.5	3.0	3.7	4.7	6.1	8.2	11.8	18.1	30.9	59.1	105.0	123.4	105.0	59.1	30.9	18.1	11.8	8.2	6.1	4.7	3.7	3.0	2.5	2.1	30.9	30.9
XS-UG-1: Willimantic South Underground Variation - 345-kV Cable System in Road*	pre-Interstate	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	post-NEEWS	0.1	0.1	0.2	0.2	0.2	0.2	0.3	0.3	0.4	0.4	0.6	1.4	20.9	2.5	1.1	0.7	0.5	0.4	0.3	0.3	0.2	0.2	0.2	0.2	0.2	1.4	2.5
XS-UG-2: Willimantic South Underground Variation - 345-kV Cable System in Existing CL&P ROW	pre-Interstate	1.6	1.8	2.1	2.5	3.0	3.7	4.6	5.9	7.8	10.7	15.8	25.2	45.0	87.7	133.5	137.5	98.9	51.3	28.0	17.2	11.5	8.3	6.2	4.8	3.9	4.6	28.0
	post-NEEWS	0.7	0.9	1.1	1.3	1.6	2.1	2.7	3.5	4.8	6.9	10.6	17.8	34.7	104.6	102.7	103.8	76.3	40.9	23.0	14.5	10.0	7.3	5.7	4.5	3.7	2.7	23.0

Table 2: Magnetic Field (mG) at Distances Relative to the ROW Centerline (ft) - Annual Peak Load Condition (APL)

Line Section	Configuration	-300	-275	-250	-225	-200	-175	-150	-125	-100	-75	-50	-25	0	25	50	75	100	125	150	175	200	225	250	275	300	- ROW Edge	+ ROW Edge
XS-UG-1: Mansfield Underground Variation - 345-kV Cable System in Existing CL&P ROW	pre-Interstate	3.3	3.8	4.5	5.3	6.3	7.7	9.5	12.2	16.1	22.3	32.7	52.2	93.4	181.8	276.8	285.0	205.0	106.4	58.0	35.6	23.9	17.1	12.8	10.0	8.0	9.5	58.0
	post-NEEWS	1.4	1.7	2.0	2.5	3.1	4.0	5.1	6.8	9.4	13.5	20.7	34.8	68.1	209.9	200.2	203.0	149.5	80.1	45.0	28.4	19.6	14.4	11.1	8.9	7.3	5.1	45.0
XS-B-1: Brooklyn Overhead Variation - Pomfret Road to Ten Spans North of Day Street Junction	pre-Interstate	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	post-NEEWS	3.8	4.5	5.5	6.7	8.5	11.1	15.1	21.5	33.1	56.4	108.0	192.0	225.6	192.0	108.0	56.4	33.1	21.5	15.1	11.1	8.5	6.7	5.5	4.5	3.8	56.4	56.4
XS-UG-2: Brooklyn Underground Variation - 345-kV Cable System in Existing CL&P ROW	pre-Interstate	3.3	3.8	4.5	5.3	6.3	7.7	9.5	12.2	16.1	22.3	32.7	52.2	93.4	181.8	276.8	285.0	205.0	106.4	58.0	35.6	23.9	17.1	12.8	10.0	8.0	9.5	58.0
	post-NEEWS	1.4	1.7	2.0	2.5	3.1	4.0	5.1	6.8	9.4	13.5	20.7	34.8	68.1	209.9	200.2	203.0	149.5	80.1	45.0	28.4	19.6	14.4	11.1	8.9	7.3	5.1	45.0
XS-UG-3: Brooklyn Underground Variation - 345-kV Cable System in Existing CL&P ROW	pre-Interstate	4.5	5.5	6.7	8.4	10.9	14.6	20.5	30.6	49.7	90.6	180.1	279.8	295.8	225.1	146.8	101.8	42.9	86.4	77.7	30.7	10.7	3.9	1.5	1.0	1.1	13.7	24.7
	post-NEEWS	2.6	3.1	3.9	5.0	6.5	8.9	12.8	19.8	33.6	68.1	223.0	200.6	206.1	161.6	113.2	86.9	30.8	76.2	78.1	35.7	15.5	7.8	4.5	2.8	1.9	8.4	29.9
XS-WS-OH-1: Willimantic South Overhead Variation - Card St. Substation to Card St.	pre-Interstate	0.3	0.3	0.4	0.5	0.7	1.0	1.5	2.4	4.8	12.6	36.3	27.9	16.0	15.9	12.6	5.8	2.9	1.7	1.1	0.8	0.6	0.5	0.4	0.3	0.2	15.9	6.8
	post-NEEWS	3.4	4.1	5.0	6.2	7.9	10.4	14.2	20.4	31.2	50.8	73.1	117.5	102.3	63.8	33.8	19.7	13.7	10.2	7.8	6.2	5.0	4.1	3.4	2.9	2.5	55.1	21.5
XS-WS-OH-2: Willimantic South Overhead Variation - Card St. to Beaumont Hwy.	pre-Interstate	0.1	0.2	0.2	0.2	0.3	0.4	0.6	0.8	1.3	2.5	5.9	12.6	18.1	18.6	12.5	5.3	2.5	1.4	0.9	0.6	0.4	0.3	0.3	0.2	0.2	3.0	6.4
	post-NEEWS	3.4	4.0	4.9	6.1	7.8	10.2	13.9	19.8	29.9	48.3	82.0	122.5	104.9	64.7	33.9	19.7	13.7	10.2	7.8	6.2	5.0	4.1	3.4	2.9	2.5	53.5	21.5
XS-WS-OH-3: Willimantic South Overhead Variation - Beaumont Hwy. to Chewink Rd.	pre-Interstate	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	post-NEEWS	3.8	4.5	5.5	6.7	8.5	11.1	15.1	21.5	33.1	56.4	108.0	192.0	225.6	192.0	108.0	56.4	33.1	21.5	15.1	11.1	8.5	6.7	5.5	4.5	3.8	56.4	56.4
XS-UG-1: Willimantic South Underground Variation - 345-kV Cable System in Road*	pre-Interstate	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	post-NEEWS	0.2	0.3	0.3	0.3	0.4	0.4	0.5	0.5	0.6	0.8	1.1	2.5	38.4	4.7	2.1	1.3	0.9	0.7	0.6	0.5	0.4	0.4	0.3	0.3	0.3	2.5	4.7
XS-UG-2: Willimantic South Underground Variation - 345-kV Cable System in Existing CL&P ROW	pre-Interstate	3.3	3.8	4.5	5.3	6.3	7.7	9.5	12.2	16.1	22.3	32.7	52.2	93.4	181.8	276.8	285.0	205.0	106.4	58.0	35.6	23.9	17.1	12.8	10.0	8.0	9.5	58.0
	post-NEEWS	1.3	1.6	1.9	2.3	2.9	3.7	4.8	6.3	8.7	12.5	19.1	32.1	62.6	191.5	185.4	187.4	137.9	74.0	41.6	26.3	18.1	13.3	10.3	8.2	6.7	4.8	41.6

Table 3: Magnetic Field (mG) at Distances Relative to the ROW Centerline (ft) - Peak Daily Average Load Condition (PDAL)

Line Section	Configuration	-300	-275	-250	-225	-200	-175	-150	-125	-100	-75	-50	-25	0	25	50	75	100	125	150	175	200	225	250	275	300	- ROW Edge	+ ROW Edge
XS-UG-1: Mansfield Underground Variation - 345-kV Cable System in Existing CL&P ROW	pre-Interstate	2.5	2.9	3.3	3.9	4.7	5.7	7.1	9.1	12.0	16.6	24.4	39.0	69.8	135.8	206.8	213.0	153.1	79.5	43.4	26.6	17.9	12.8	9.6	7.5	6.0	7.1	43.4
	post-NEEWS	1.0	1.2	1.4	1.8	2.2	2.8	3.7	4.9	6.7	9.6	14.8	24.8	48.6	149.7	142.7	144.7	106.5	57.1	32.1	20.3	14.0	10.3	7.9	6.3	5.2	3.7	32.1
XS-B-1: Brooklyn Overhead Variation - Pomfret Road to Ten Spans North of Day Street Junction	pre-Interstate	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	post-NEEWS	2.7	3.2	3.9	4.8	6.1	7.9	10.7	15.4	23.6	40.3	77.0	136.9	160.9	136.9	77.0	40.3	23.6	15.4	10.7	7.9	6.1	4.8	3.9	3.2	2.7	40.3	40.3
XS-UG-2: Brooklyn Underground Variation - 345-kV Cable System in Existing CL&P ROW	pre-Interstate	2.5	2.9	3.3	3.9	4.7	5.7	7.1	9.1	12.0	16.6	24.4	39.0	69.8	135.8	206.8	213.0	153.1	79.5	43.4	26.6	17.9	12.8	9.6	7.5	6.0	7.1	43.4
	post-NEEWS	1.0	1.2	1.4	1.8	2.2	2.8	3.7	4.9	6.7	9.6	14.8	24.8	48.6	149.7	142.7	144.7	106.5	57.1	32.1	20.3	14.0	10.3	7.9	6.3	5.2	3.7	32.1
XS-UG-3: Brooklyn Underground Variation - 345-kV Cable System in Existing CL&P ROW	pre-Interstate	3.3	4.0	4.9	6.2	8.0	10.8	15.1	22.6	36.8	67.4	134.4	209.2	222.3	170.9	115.0	82.7	32.8	70.8	65.8	27.0	10.0	4.1	1.8	0.9	0.7	10.1	22.0
	post-NEEWS	1.8	2.2	2.7	3.5	4.6	6.3	9.1	14.0	23.8	48.3	157.6	143.2	148.3	117.7	85.4	68.0	23.4	61.1	63.9	29.8	13.2	6.9	4.1	2.6	1.8	5.9	25.1
XS-WS-OH-1: Willimantic South Overhead Variation - Card St. Substation to Card St.	pre-Interstate	0.5	0.7	0.8	1.0	1.3	1.7	2.4	3.7	6.5	14.3	31.3	14.9	10.2	27.1	25.1	12.2	6.3	3.7	2.5	1.8	1.3	1.0	0.8	0.7	0.6	17.3	14.3
	post-NEEWS	2.3	2.8	3.4	4.2	5.4	7.1	9.8	14.1	22.0	37.9	52.6	83.6	76.0	48.8	24.7	13.0	8.8	6.6	5.1	4.0	3.3	2.7	2.3	1.9	1.7	41.7	14.4
XS-WS-OH-2: Willimantic South Overhead Variation - Card St. to Beaumont Hwy.	pre-Interstate	0.4	0.4	0.5	0.6	0.8	1.0	1.3	1.8	2.6	4.3	7.8	10.6	14.5	29.2	24.9	11.7	5.8	3.4	2.2	1.5	1.1	0.9	0.7	0.6	0.5	4.8	13.7
	post-NEEWS	2.3	2.8	3.4	4.2	5.4	7.0	9.6	13.7	20.7	33.5	57.4	87.5	77.9	49.2	24.3	12.7	8.7	6.5	5.0	4.0	3.3	2.7	2.3	1.9	1.6	37.2	14.0
XS-WS-OH-3: Willimantic South Overhead Variation - Beaumont Hwy. to Chewink Rd.	pre-Interstate	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	post-NEEWS	2.7	3.2	3.9	4.8	6.1	7.9	10.7	15.4	23.6	40.3	77.0	136.9	160.9	136.9	77.0	40.3	23.6	15.4	10.7	7.9	6.1	4.8	3.9	3.2	2.7	40.3	40.3
XS-UG-1: Willimantic South Underground Variation - 345-kV Cable System in Road*	pre-Interstate	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	post-NEEWS	0.2	0.2	0.2	0.2	0.3	0.3	0.3	0.4	0.5	0.6	0.8	1.8	27.3	3.3	1.5	0.9	0.7	0.5	0.4	0.4	0.3	0.3	0.2	0.2	0.2	1.8	3.3
XS-UG-2: Willimantic South Underground Variation - 345-kV Cable System in Existing CL&P ROW	pre-Interstate	2.5	2.9	3.3	3.9	4.7	5.7	7.1	9.1	12.0	16.6	24.4	39.0	69.8	135.8	206.8	213.0	153.1	79.5	43.4	26.6	17.9	12.8	9.6	7.5	6.0	7.1	43.4
	post-NEEWS	0.9	1.1	1.4	1.7	2.1	2.6	3.4	4.5	6.2	9.0	13.7	23.0	44.8	136.2	132.8	134.2	98.8	52.9	29.8	18.8	13.0	9.5	7.3	5.8	4.8	3.4	29.8

Table 4: Electric Field (kV/m) at Distances Relative to the ROW Centerline (ft)

Line Section	Configuration	-300	-275	-250	-225	-200	-175	-150	-125	-100	-75	-50	-25	0	25	50	75	100	125	150	175	200	225	250	275	300	- ROW Edge	+ ROW Edge
XS-UG-1: Mansfield Underground Variation - 345-kV Cable System in Existing CL&P ROW	pre-Interstate	0.02	0.02	0.03	0.04	0.05	0.06	0.09	0.13	0.19	0.30	0.53	1.03	2.25	4.55	3.60	3.15	4.85	2.65	1.20	0.60	0.34	0.21	0.14	0.09	0.07	0.09	1.20
	post-NEEWS	0.02	0.02	0.03	0.04	0.05	0.06	0.09	0.13	0.19	0.30	0.53	1.03	2.25	4.55	3.60	3.15	4.85	2.65	1.20	0.60	0.34	0.21	0.14	0.09	0.07	0.09	1.20
XS-B-1: Brooklyn Overhead Variation - Pomfret Road to Ten Spans North of Day Street Junction	pre-Interstate	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	post-NEEWS	0.04	0.04	0.06	0.08	0.11	0.16	0.26	0.43	0.80	1.67	3.69	4.80	2.97	4.80	3.69	1.67	0.80	0.43	0.26	0.16	0.11	0.08	0.06	0.04	0.04	1.67	1.67
XS-UG-2: Brooklyn Underground Variation - 345-kV Cable System in Existing CL&P ROW	pre-Interstate	0.02	0.02	0.03	0.04	0.05	0.06	0.09	0.13	0.19	0.30	0.53	1.03	2.25	4.55	3.60	3.15	4.85	2.65	1.20	0.60	0.34	0.21	0.14	0.09	0.07	0.09	1.20
	post-NEEWS	0.02	0.02	0.03	0.04	0.05	0.06	0.09	0.13	0.19	0.30	0.53	1.03	2.25	4.55	3.60	3.15	4.85	2.65	1.20	0.60	0.34	0.21	0.14	0.09	0.07	0.09	1.20
XS-UG-3: Brooklyn Underground Variation - 345-kV Cable System in Existing CL&P ROW	pre-Interstate	0.04	0.05	0.07	0.09	0.13	0.20	0.31	0.54	1.04	2.26	4.55	3.60	3.18	5.08	3.26	0.78	0.53	0.56	1.17	0.82	0.32	0.14	0.07	0.04	0.03	0.18	0.68
	post-NEEWS	0.04	0.05	0.07	0.09	0.13	0.20	0.31	0.54	1.04	2.26	4.55	3.60	3.18	5.08	3.26	0.78	0.53	0.56	1.17	0.82	0.32	0.14	0.07	0.04	0.03	0.18	0.68
XS-WS-OH-1: Willimantic South Overhead Variation - Card St. Substation to Card St.	pre-Interstate	0.00	0.01	0.01	0.01	0.02	0.02	0.04	0.07	0.13	0.28	0.49	0.73	0.28	0.35	1.34	0.71	0.29	0.14	0.08	0.05	0.03	0.02	0.02	0.01	0.01	0.33	0.86
	post-NEEWS	0.07	0.08	0.10	0.12	0.15	0.18	0.21	0.25	0.24	0.19	1.66	4.94	3.90	2.24	0.97	0.17	0.13	0.14	0.13	0.11	0.10	0.08	0.07	0.06	0.05	0.21	0.25
XS-WS-OH-2: Willimantic South Overhead Variation - Card St. to Beaumont Hwy.	pre-Interstate	0.01	0.01	0.01	0.02	0.02	0.03	0.05	0.09	0.18	0.41	1.01	1.08	0.24	0.35	1.33	0.71	0.29	0.14	0.07	0.04	0.03	0.02	0.01	0.01	0.01	0.49	0.85
	post-NEEWS	0.07	0.08	0.10	0.11	0.14	0.16	0.19	0.20	0.12	0.35	1.98	5.02	3.92	2.24	0.97	0.17	0.13	0.14	0.13	0.11	0.09	0.08	0.07	0.06	0.05	0.54	0.25
XS-WS-OH-3: Willimantic South Overhead Variation - Beaumont Hwy. to Chewink Rd.	pre-Interstate	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	post-NEEWS	0.04	0.04	0.06	0.08	0.11	0.16	0.26	0.43	0.80	1.67	3.69	4.80	2.97	4.80	3.69	1.67	0.80	0.43	0.26	0.16	0.11	0.08	0.06	0.04	0.04	1.67	1.67
XS-UG-1: Willimantic South Underground Variation - 345-kV Cable System in Road*	pre-Interstate	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	post-NEEWS	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
XS-UG-2: Willimantic South Underground Variation - 345-kV Cable System in Existing CL&P ROW	pre-Interstate	0.02	0.02	0.03	0.04	0.05	0.06	0.09	0.13	0.19	0.30	0.53	1.03	2.25	4.55	3.60	3.15	4.85	2.65	1.20	0.60	0.34	0.21	0.14	0.09	0.07	0.09	1.20
	post-NEEWS	0.02	0.02	0.03	0.04	0.05	0.06	0.09	0.13	0.19	0.30	0.53	1.03	2.25	4.55	3.60	3.15	4.85	2.65	1.20	0.60	0.34	0.21	0.14	0.09	0.07	0.09	1.20