

APPENDIX K

Line T-198 Structures 150-151, 151-152 over the Ashuelot River Structures 146-147 over the State Acquired Railroad Property Keene, NH

1. The location of these crossings is shown on the attached location map marked as Exhibit K1.
2. The design and proposed construction of this crossing is shown on the attached PSNH Transmission Drawings entitled "PROPOSED ADSS LINE, 115 kV. – LINE T-198, MILE 11, STR 150-151, 151-152, ASHUELOT RIVER WATER CROSSING, KEENE, NEW HAMPSHIRE." (Drawing No. D-7649-512) marked as Exhibit K2 and "115KV WIRE & FIBER OPTIC CABLE CROSSING, LINE T-198, MILE 11, B&M RAILROAD, KEENE, NH" (Drawing No. D-8045-11) marked as Exhibit K3.

For the Span between STR 150-151:

3. Line T-198 crosses the Ashuelot River on a 3 pole wood angle structure and an H frame wood tangent structure with a span of 368 feet. The river width is 104 feet at time of survey. A detail of these structures has been provided with this Petition as FIGURE 2 and FIGURE 4 respectively. Minimum distances to ground for truck traffic of 15.5 feet for the ADSS and 20.1 feet for 115kV open supply per the NESC have been met as 32.4 and 36.5 feet of clearance is provided respectively for the ADSS and the conductor wires.
4. Surface water elevations for the Ashuelot River were based on information contained in NH GRANIT, which references FEMA information. The normal flood level for this crossing is approximately 469.1 feet. The surface area of the crossing, as required by the NESC (Section 232, Note 19), is approximately 2.4 acres. This is based on the total area of the river for a 1-mile stretch of the crossing that includes the crossing based on FEMA digital maps and FEMA identified river boundaries limited by the bridge impediment. A GIS tool (ESRI ArcView) was used to calculate the surface area polygon. As stated in paragraph 6 of this petition, the minimum required clearances for 115 kV conductor and ADSS cable over water surface areas less than 20 acres is 22.1 and 17.5 feet, respectively.
5. As stated in NESC Table 232-1 Note 18, the surface area shall be enclosed by its high water mark and clearances shall be based on the normal flood level. In this case, the final river elevation at this location during the

normal flood is 469.1 feet. As stated in paragraph 6 of this petition and paragraph 4 of this Appendix, the minimum required clearances for 115 kV conductors and ADSS cable over water surface areas less than 20 acres is 22.1 and 17.5 feet, respectively. The sags and clearances to the water surface are as follows:

- Shield wires - Due to the fact that the static wires are located above the phase wires, its clearances to the water surface will always exceed the minimum required NESC distance.
- Conductors (phase wires) – The maximum conductor sag for the NESC Heavy Loading weather case is always less than the 285 deg F maximum operating temperature (phase wires) based on PSNH transmission standards. The 285 deg F condition produces the greatest sag in the phase wires and therefore the minimum clearance to the water surface. This design will exceed the minimum clearance requirement of 22.1 feet with a clearance of 35.3 feet under temporary emergency conditions.
- For ADSS cable - The maximum ADSS sag for a weather case of ½ inch radial ice at 32 deg F, no wind is the weather condition that produces the greatest sag exceeding the NESC Heavy weather condition, and therefore the minimum clearances to the water surface. This design will exceed the minimum clearance requirement of 17.5 feet with a clearance of 31.5 feet.
- Minimum phase to ADSS clearance – The conditions that would produce the minimum clearance between the phase wires and ADSS cable would be at the maximum operating temperature of 285 deg F for the phase wires and 90 deg F for ADSS. Based on NESC Section 235 and Table 235-5(1)b for communication conductors and cables located in the supply space the vertical clearance between the communication cable and 115kV of the same utility at the structure is 40 inches (3.3 feet) and its Note 10 which states there is no clearance specified between fiber optic supply cables meeting Rule 230F1b and supply cables and conductors. Since no vertical clearance is specified, this case meets the minimum clearance diagonally of 40 inches (3.3 feet) at the structure and at mid span because of horizontal separation.
- Minimum phase to overhead ground wire (static wire) clearance – Based on NESC 235E.1, the weather case that would produce the minimum clearance between the phase wires and the static wires would be a combination of winter weather factors. The phase conductor condition is 30 deg F and the static wire condition is ½”

radial ice at 30 deg F based on Table 230-1 for Zone 1. Under these conditions the vertical clearance based on NESC Table 235-6(2)a for span wires when parallel to a line is calculated to be 4.8 feet ($29'' + (115\text{kV} \times 1.05 - 50\text{kV}) \times 0.4''$). In this case the minimum NESC clearance of 4.8 feet between the static wire and the phase conductor is met through horizontal separation alone.

- Minimum clearance between ADSS and wires carried on different supporting structures (i.e. ADSS to distribution power lines) – The NESC condition of $\frac{1}{2}''$ ice, no wind at 32 deg F provides the minimum NESC clearance between the ADSS cable and wires carried by other structures. Based on Section 233 and Table 233-1, the NESC minimum clearance between ADSS which meets Rule 230E1 and open supply conductors, 750V to 22kV, is 2 feet. This clearance requirement is met in the case described by this Appendix.
- Minimum clearance between phase and wires carried on different supporting structures (i.e. phase to distribution power lines) – The maximum operating condition of 285 deg F produces the greatest sag in the phase wires and the minimum clearance between the phase wire and wires carried by other structures. Based on Section 233 and Table 233-1.4, the NESC minimum clearance between an open supply conductor of 115kV and open supply conductors 750V to 22kV is 2 feet plus the clearance calculated by Rule 233.C.2, where voltages exceed 22kV. NESC Rule 233.C.2a states that an additional clearance of 1.6 feet or $[\frac{((115 \text{ kV} \times 1.05/\sqrt{3}) - 22\text{kV}) \times .4\text{in}}{12}]$ is needed for 115 kV, which brings the total required minimum clearance to 3.6 feet. This clearance requirement is met in the case described by this Appendix.

For the Span between STR 151-152:

6. Line T-198 crosses the Ashuelot River on dead end 3-pole wood structure and an H frame wood tangent structure with a span of 360 feet. The river width is 112 feet at time of survey. A detail of these structures has been provided with this Petition as FIGURE E and FIGURE 4 respectively. Minimum distances to ground for truck traffic of 15.5 feet for the ADSS and 20.1 feet for 115kV open supply per the NESC have been met as 30.0 and 33.6 feet of clearance is provided respectively for the ADSS and the conductor wires.

7. Surface water elevations for the Ashuelot River were based on information contained in NH GRANIT, which references FEMA information. The normal flood level for this crossing is approximately 465.8 feet (top of lowest bank). The surface area of the crossing, as required by the NESC

(Section 232, Note 19), is approximately 2.4 acres. This is based on the total area of the river for a 1-mile stretch of the crossing that includes the crossing based on FEMA digital maps and FEMA identified river boundaries limited by the bridge impediment. A GIS tool (ESRI ArcView) was used to calculate the surface area polygon. As stated in paragraph 6 of this petition, the minimum required clearances for 115 kV conductor and ADSS cable over water surface areas less than 20 acres is 22.1 and 17.5 feet, respectively.

8. As stated in NESC Table 232-1 Note 18, the surface area shall be enclosed by its high water mark and clearances shall be based on the normal flood level. In this case, the final river elevation at this location during the normal flood is 465.8 feet. As stated in paragraph 6 of this petition and paragraph 4 of this Appendix, the minimum required clearances for 115 kV conductors and ADSS cable over water surface areas less than 20 acres is 22.1 and 17.5 feet, respectively. The sags and clearances to the water surface are as follows:

- Shield wires - Due to the fact that the static wires are located above the phase wires, its clearances to the water surface will always exceed the minimum required NESC distance.
- Conductors (phase wires) – The maximum conductor sag for the NESC Heavy Loading weather case is always less than the 285 deg F maximum operating temperature (phase wires) based on PSNH transmission standards. The 285 deg F condition produces the greatest sag in the phase wires and therefore the minimum clearance to the water surface. This design will exceed the minimum clearance requirement of 22.1 feet with a clearance of 33.6 feet under temporary emergency conditions.
- For ADSS cable - The maximum ADSS sag for a weather case of ½ inch radial ice at 32 deg F, no wind is the weather condition that produces the greatest sag exceeding the NESC Heavy weather condition, and therefore the minimum clearances to the water surface. This design will exceed the minimum clearance requirement of 17.5 feet with a clearance of 30.0 feet.
- Minimum phase to ADSS clearance – The conditions that would produce the minimum clearance between the phase wires and ADSS cable would be at the maximum operating temperature of 285 deg F for the phase wires and 90 deg F for ADSS. Based on NESC Section 235 and Table 235-5(1)b for communication conductors and cables located in the supply space the vertical clearance between the communication cable and 115kV of the same utility at the structure is 40 inches (3.3

feet) and its Note 10 which states there is no clearance specified between fiber optic supply cables meeting Rule 230F1b and supply cables and conductors. Since no vertical clearance is specified, this case meets the minimum clearance diagonally of 40 inches (3.3 feet) at the structure and at mid span because of horizontal separation.

- Minimum phase to overhead ground wire (static wire) clearance – Based on NESC 235E.1, the weather case that would produce the minimum clearance between the phase wires and the static wires would be a combination of winter weather factors. The phase conductor condition is 30 deg F and the static wire condition is ½” radial ice at 30 deg F based on Table 230-1 for Zone 1. Under these conditions the vertical clearance based on NESC Table 235-6(2)a for span wires when parallel to a line is calculated to be 4.8 feet ($29'' + (115\text{kV} \times 1.05 - 50\text{kV}) \times 0.4''$). In this case the minimum NESC clearance of 4.8 feet between the static wire and the phase conductor is met through horizontal separation alone.
- Minimum clearance between ADSS and wires carried on different supporting structures (i.e. ADSS to distribution power lines) – The NESC condition of ½” ice, no wind at 32 deg F provides the minimum NESC clearance between the ADSS cable and wires carried by other structures. Based on Section 233 and Table 233-1, the NESC minimum clearance between ADSS which meets Rule 230E1 and open supply conductors, 750V to 22kV, is 2 feet. This clearance requirement is met in the case described by this Appendix.
- Minimum clearance between phase and wires carried on different supporting structures (i.e. phase to distribution power lines) – The maximum operating condition of 285 deg F produces the greatest sag in the phase wires and the minimum clearance between the phase wire and wires carried by other structures. Based on Section 233 and Table 233-1.4, the NESC minimum clearance between an open supply conductor of 115kV and open supply conductors 750V to 22kV is 2 feet plus the clearance calculated by Rule 233.C.2, where voltages exceed 22kV. NESC Rule 233.C.2a states that an additional clearance of 1.6 feet or $[\frac{((115 \text{ kV} \times 1.05/\sqrt{3}) - 22\text{kV}) \times .4\text{in}}{12}]$ is needed for 115 kV, which brings the total required minimum clearance to 3.6 feet. This clearance requirement is met in the case described by this Appendix.

For the Span between STR 146-147:

9. Line T-198 crosses the State acquired railroad property on H frame wood tangent structures with a span of 280 feet. A detail of this structure

has been provided with this Petition as FIGURE 4. Minimum distances to the railroad track of 23.5 feet for the ADSS and 28.1 feet for 115kV open supply per the NESC have been met as 27.1 and 33.0 feet of clearance is provided respectively for the ADSS and the conductor wires.

10. As stated in paragraph 6 of this petition and paragraph 9 of this Appendix, the minimum required clearances for 115 kV conductors and ADSS cable over railroad beds is 28.1 and 23.5 feet, respectively. The sags and clearances to the railroad track are as follows:

- Shield wires - Due to the fact that the static wires are located above the phase wires, its clearances to the water surface will always exceed the minimum required NESC distance.
- Conductors (phase wires) – The maximum conductor sag for the NESC Heavy Loading weather case is always less than the 285 deg F maximum operating temperature (phase wires) based on PSNH transmission standards. The 285 deg F condition produces the greatest sag in the phase wires and therefore the minimum clearance to the railroad bed. This design will exceed the minimum clearance requirement of 28.1 feet with a clearance of 33.0 feet under temporary emergency conditions.
- For ADSS cable - The maximum ADSS sag for a weather case of ½ inch radial ice at 32 deg F, no wind is the weather condition that produces the greatest sag exceeding the NESC Heavy weather condition, and therefore the minimum clearances to the railroad bed. This design will exceed the minimum clearance requirement of 23.5 feet with a clearance of 27.1 feet.
- Minimum phase to ADSS clearance – The conditions that would produce the minimum clearance between the phase wires and ADSS cable would be at the maximum operating temperature of 285 deg F for the phase wires and 90 deg F for ADSS. Based on NESC Section 235 and Table 235-5(1)b for communication conductors and cables located in the supply space the vertical clearance between the communication cable and 115kV of the same utility at the structure is 40 inches (3.3 feet) and its Note 10 which states there is no clearance specified between fiber optic supply cables meeting Rule 230F1b and supply cables and conductors. Since no vertical clearance is specified, this case meets the minimum clearance diagonally of 40 inches (3.3 feet) at the structure and at mid span because of horizontal separation.
- Minimum phase to overhead ground wire (static wire) clearance – Based on NESC 235E.1, the weather case that would produce the

minimum clearance between the phase wires and the static wires would be a combination of winter weather factors. The phase conductor condition is 30 deg F and the static wire condition is ½” radial ice at 30 deg F based on Table 230-1 for Zone 1. Under these conditions the vertical clearance based on NESC Table 235-6(2)a for span wires when parallel to a line is calculated to be 4.8 feet (29”+(115kV x1.05 – 50kV) x 0.4”). In this case the minimum NESC clearance of 4.8 feet between the static wire and the phase conductor is met through horizontal separation alone.

- Minimum clearance between ADSS and wires carried on different supporting structures (i.e. ADSS to distribution power lines) – The NESC condition of ½” ice, no wind at 32 deg F provides the minimum NESC clearance between the ADSS cable and wires carried by other structures. Based on Section 233 and Table 233-1, the NESC minimum clearance between ADSS which meets Rule 230E1 and open supply conductors, 750V to 22kV, is 2 feet. This clearance requirement is met in the case described by this Appendix.
- Minimum clearance between phase and wires carried on different supporting structures (i.e. phase to distribution power lines) – The maximum operating condition of 285 deg F produces the greatest sag in the phase wires and the minimum clearance between the phase wire and wires carried by other structures. Based on Section 233 and Table 233-1.4, the NESC minimum clearance between an open supply conductor of 115kV and open supply conductors 750V to 22kV is 2 feet plus the clearance calculated by Rule 233.C.2, where voltages exceed 22kV. NESC Rule 233.C.2a states that an additional clearance of 1.6 feet or $[\frac{((115 \text{ kV} \times 1.05/\sqrt{3}) - 22\text{kV}) \times .4\text{in}}{12}]$ is needed for 115 kV, which brings the total required minimum clearance to 3.6 feet. This clearance requirement is met in the case described by this Appendix.

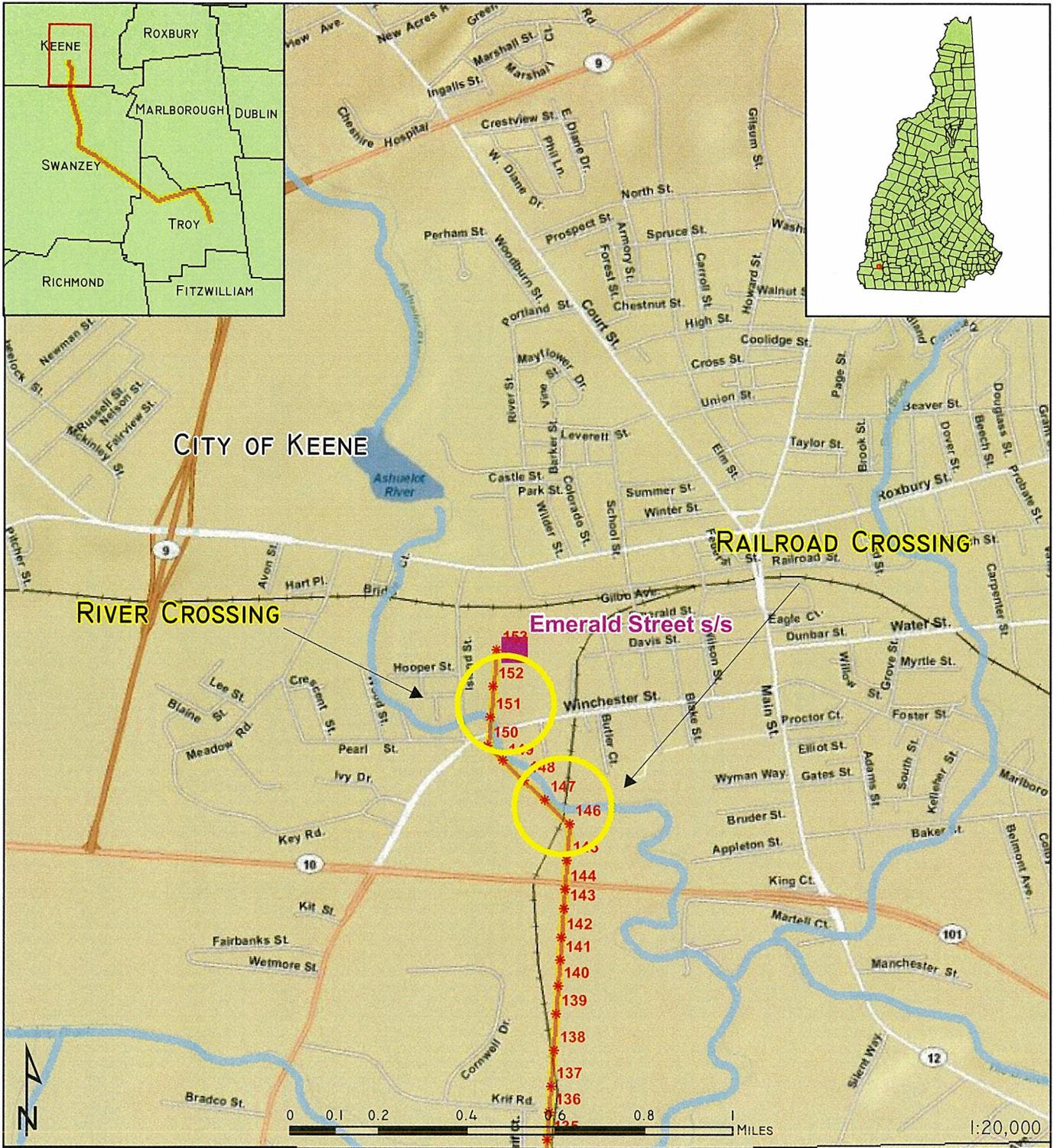
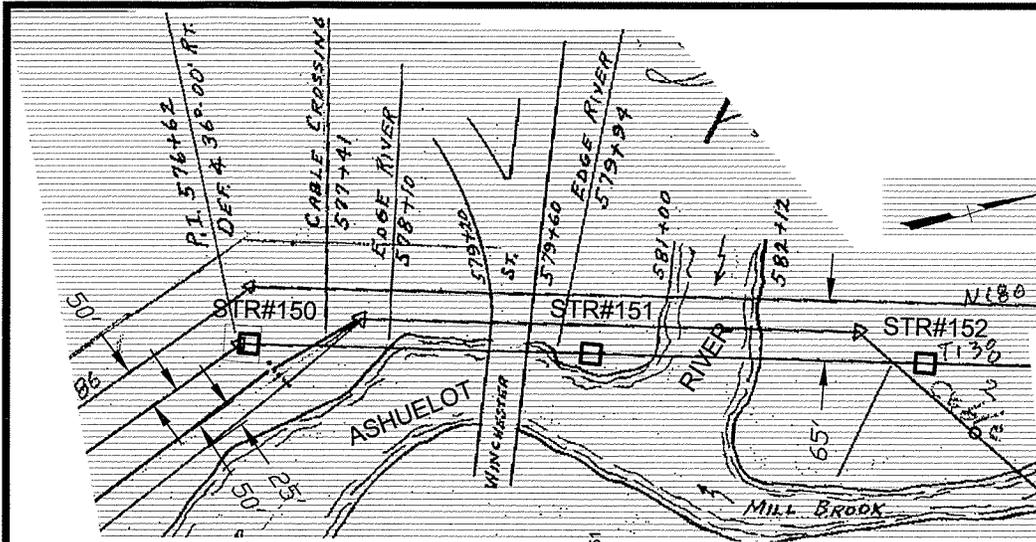


EXHIBIT KI

115 kV LINE - T-198
 MONADNOCK S/S TO EMERALD STREET S/S
 LOCUS MAP - STRUCTURES 146-147 AND 150-152
 KEENE, NH



- SUBSTATIONS
- STRUCTURES
- T-198 CIRCUIT



PLAN VIEW

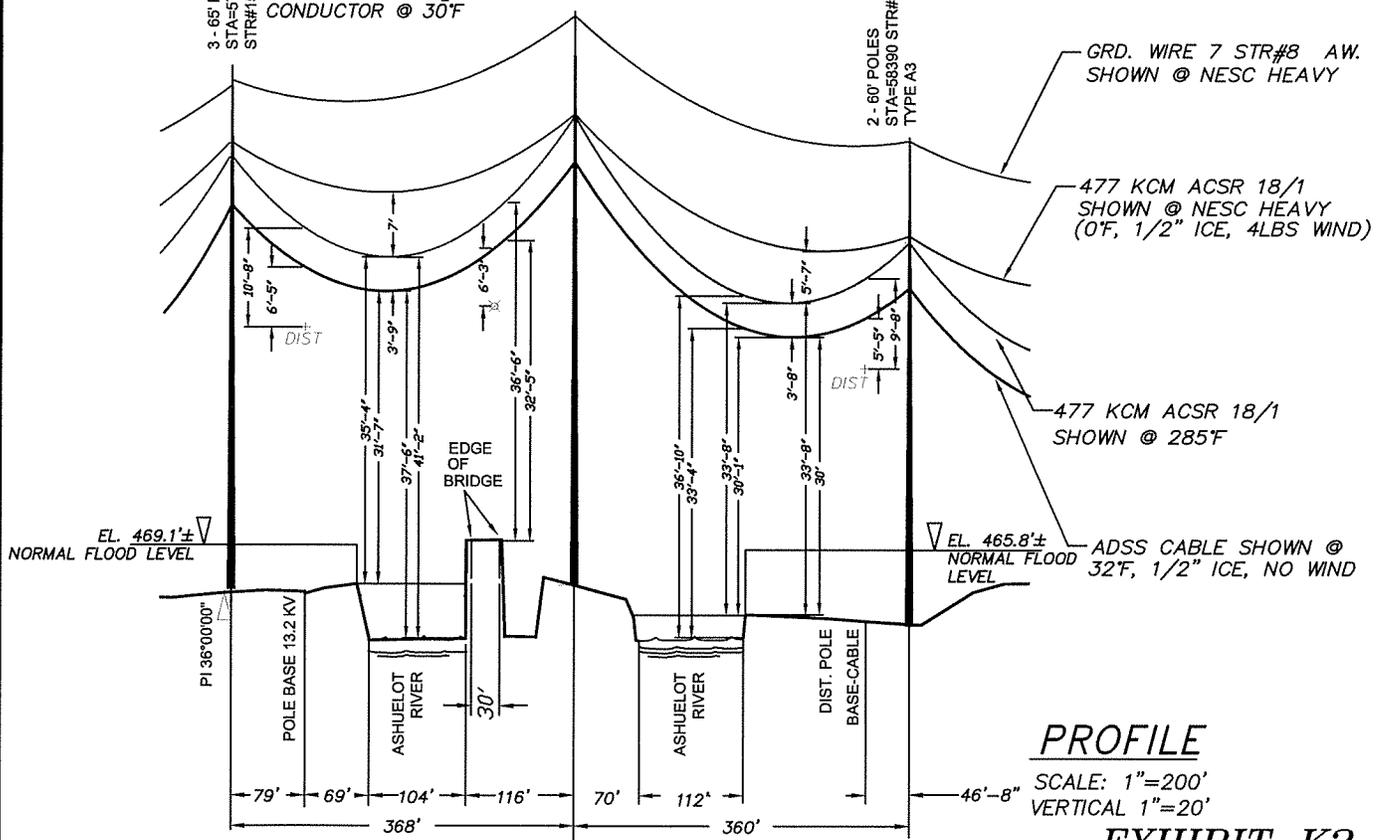
SCALE: 1"=200'

NOTE:
CLEARANCE 10.8' BETWEEN
GROUND WIRE @ 1/2" ICE AND
CONDUCTOR @ 30°F

NOTE:
CLEARANCE 7.2' BETWEEN
GROUND WIRE @ 1/2" ICE AND
CONDUCTOR @ 30°F

2 - 70' POLES
STA=58030 STR#151
TYPE D3

2 - 60' POLES
STA=58390 STR#152
TYPE A3



PROFILE

SCALE: 1"=200'
VERTICAL 1"=20'

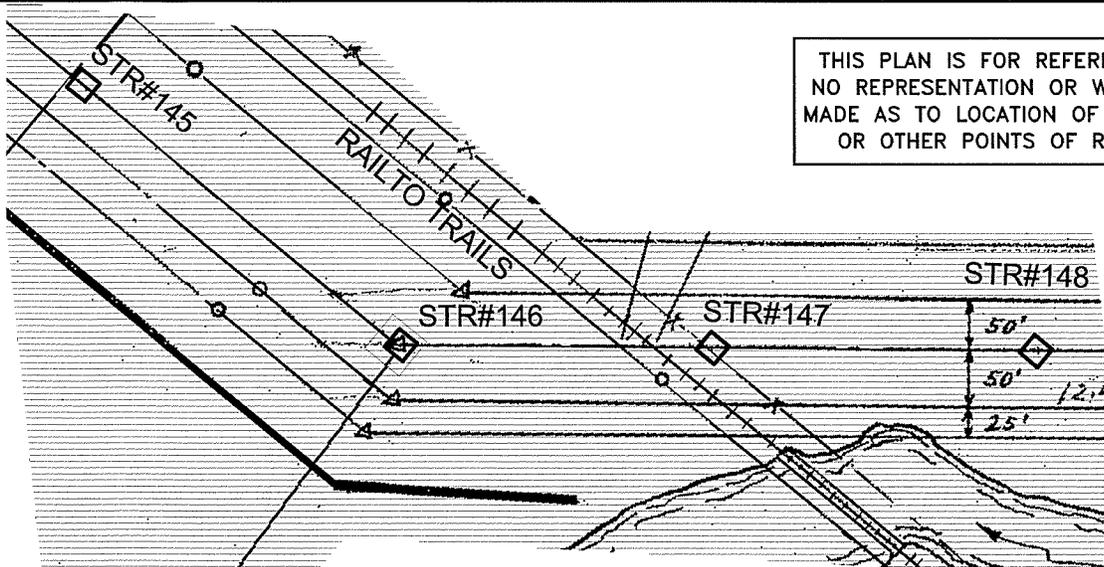
EXHIBIT K2

COMMUNICATIONS	ADSS 24 FIBER
CONDUCTOR	477 KCM ACSR 18/1
GROUND WIRE	7 STR#8 ALUMOWELD

ISSUED FOR LICENSING	6/17/08	JPR	AD	GAO	
NO.	REVISION	DATE	DRWN	CHCK	APPR

DRAWN	JPR	Public Service of New Hampshire	Transmission Business Unit				
DESIGNED		PROPOSED ADSS LINE 115 KV.-LINE T-198, MILE 11, STR 150-152 ASHUELOT RIVER WATER CROSSING KEENE, NEW HAMPSHIRE					
CHECKED	AD						
APPROVED	GAO						
SCALE	AS NOTED	DATE	7/1/08	SHEET	1 OF 1	DRAWING NO.	D-7649-512

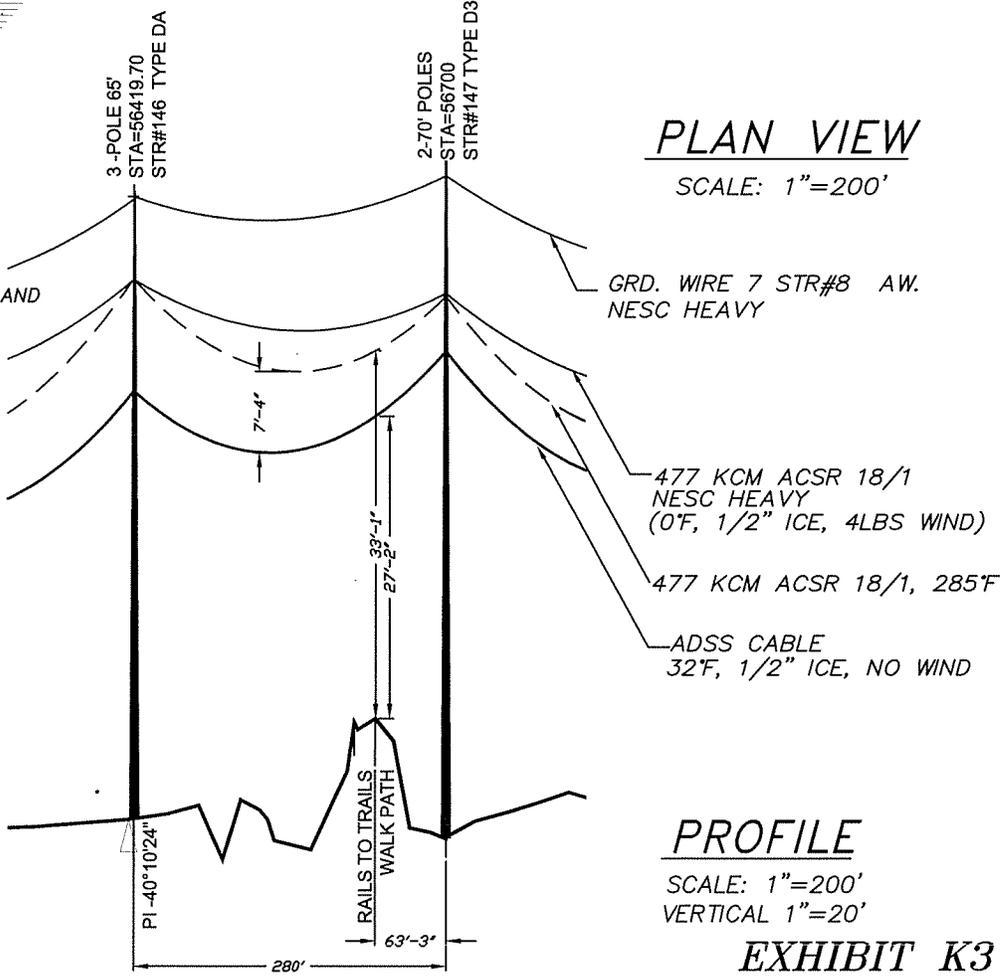
THIS PLAN IS FOR REFERENCE ONLY.
NO REPRESENTATION OR WARRANTY IS
MADE AS TO LOCATION OF BOUNDARIES
OR OTHER POINTS OF REFERENCE



PLAN VIEW

SCALE: 1"=200'

NOTE:
CLEARANCE 6' BETWEEN
GROUND WIRE @ 1/2" ICE AND
CONDUCTOR @ 30°F



PROFILE

SCALE: 1"=200'
VERTICAL 1"=20'

EXHIBIT K3

NOTE:

1. ALL WORK SHALL BE DONE IN ACCORDANCE WITH THE LATEST RAILROAD SPECIFICATIONS.

RAILROAD VAL. SHT. V42.5/22 ENGINEERING STATION 1112+80

				CONDUCTOR	477 KCM ACSR 18/1 4000# MDT NESC HEAVY FINAL			
				STATIC	7 #8 ALUMOWELD @ 2000# MDT			
1	No. Wires Added	071262	CAC	DRAWN	Public Service of New Hampshire Engineering Division			
2	Add ADSS FO Wire	070108	CAF AD GAO	CAC				
				DESIGNED				
				CHECKED	115 KV. WIRE & FIBER OPTIC CABLE CROSSING LINE T-198 MILE 11 B & M RAILROAD KEENE, NEW HAMPSHIRE			
				HN				
				APPROVED				
				GAO	SCALE	DATE	SHEET	DRAWING NO.
					AS NOTED	6/17/08	1 OF 1	D-8045-11 Rev 2
NO.	REVISION	DATE	DRWN	CHCK	APPR			