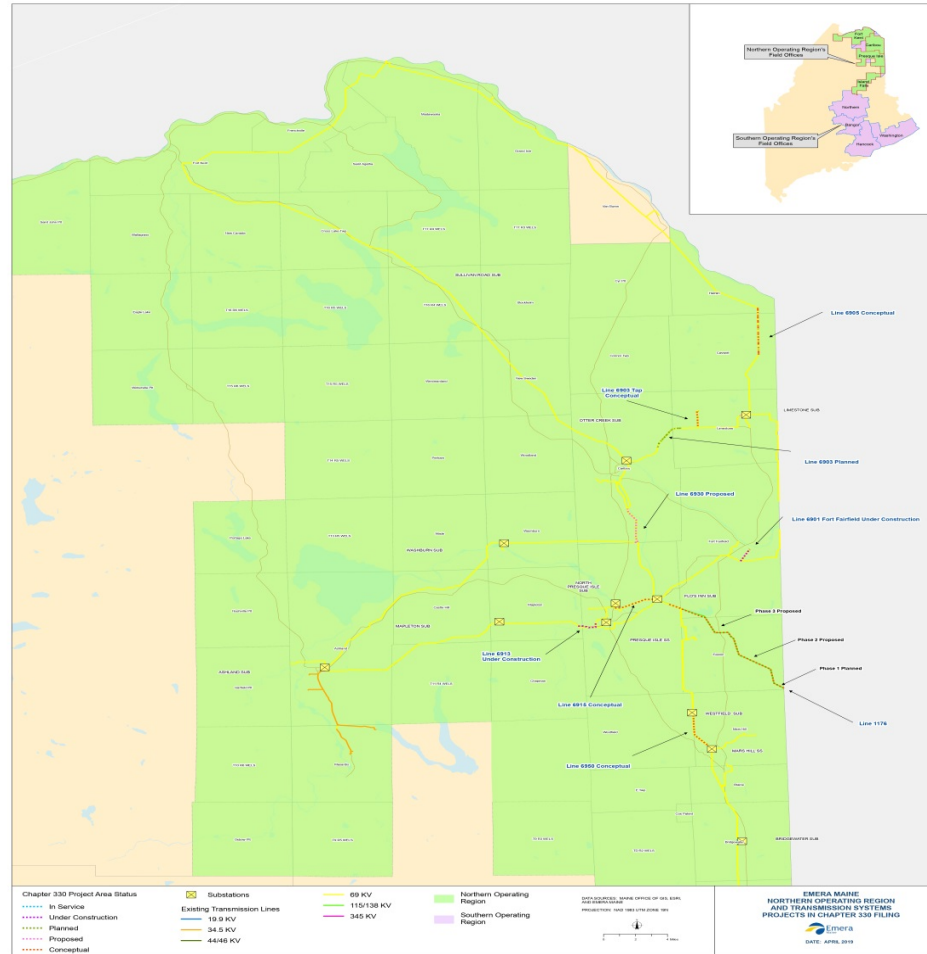




June 24, 2020

2020 PAG Meeting

Northern Maine Transmission System



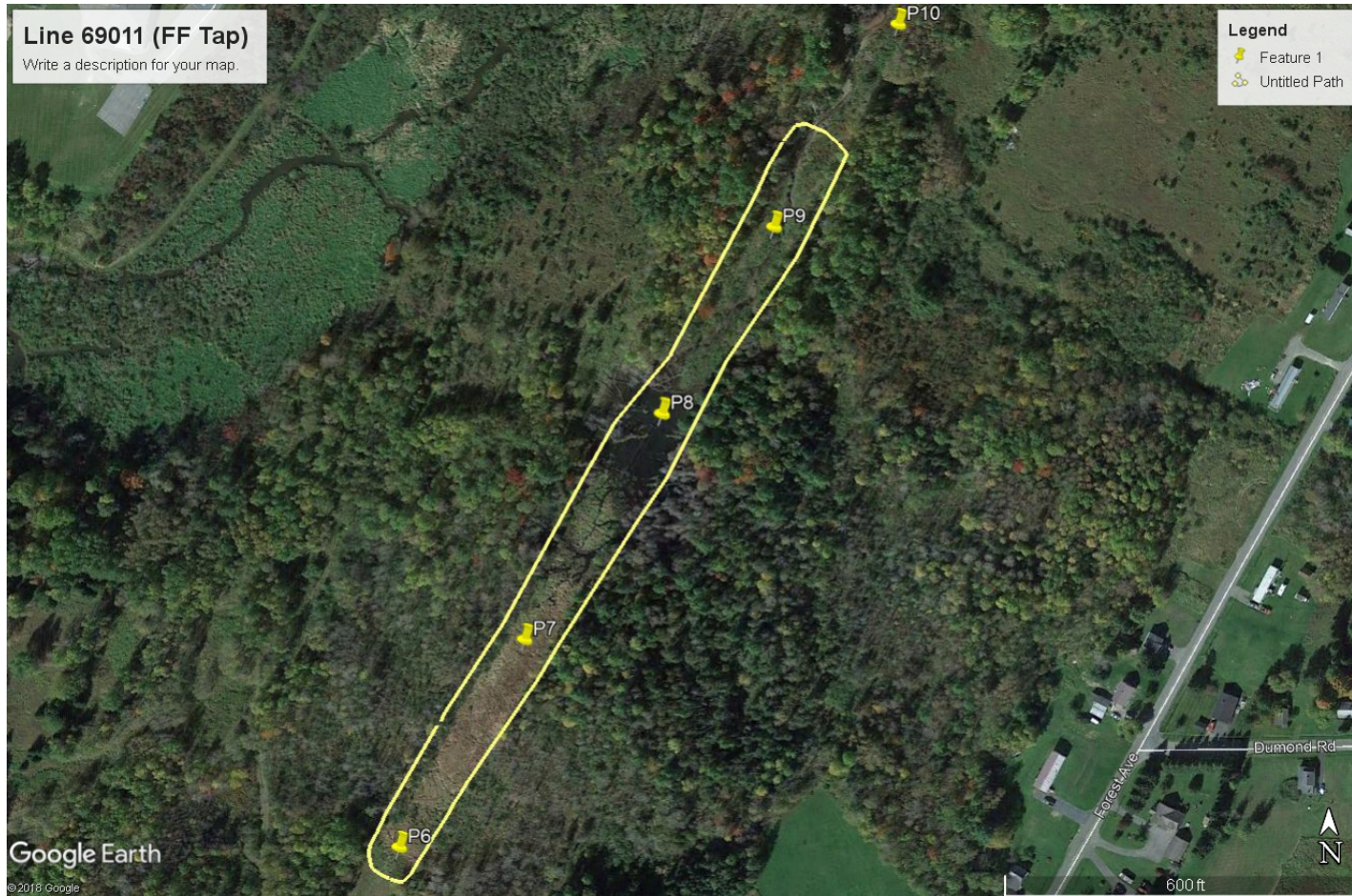
Transmission Planning Collaboration

- *Adjusted based on customer feedback*
- *Intent: spread out remaining required MPD rebuild plan over 15-20 years (total rebuild program will span nearly 30 years)*
- *Final plan subject to enhanced inspection findings (drone, resistograph, climbing)*
- *Line and targeted line segment rebuilds will be necessary*

2019 Completed Work

- *Line 69011 Fort Fairfield Tap Rebuild*
- *Line 6913 Rebuild (Presque Isle Switching Station to Pole 160)*
- *Line 6930 River Crossing Emergency Rebuild (Washburn)*
- *Line 6905 Emergency Pole Repairs*
- *Line 6903 Structure 57 to 127 (Engineering & Permitting)*
- *Line 1176 Rebuild Structure 42 to Border (Engineering & Permitting)*

Line 6901 Fort Fairfield Tap



Wood poles #6 thru #9 in a beaver swamp, replaced with composite poles and bog anchors and guys

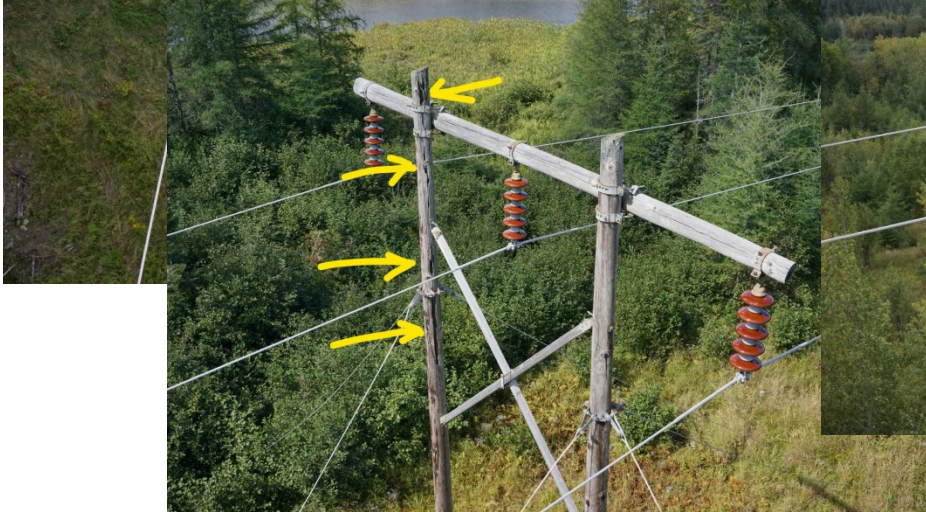
Line 6901 Fort Fairfield Tap continued...



Extremely poor condition three pole deadend structure, left pole previously stubbed to provide support for weakened pole, right pole rejected due to excessive internal decay.

Line 6905

Excessive pole and crossarm rot detected by UAS (a.k.a. drone) inspection resulted in an emergency structure replacement project



Line 6913 Rebuild (Presque Isle SS to Pole 160)



Rotting pole bases resulting in a leaning pole, other poles with cracked base and woodpecker damage, small 3/0 ACSR conductor

Line 6930 Aroostook River Crossing

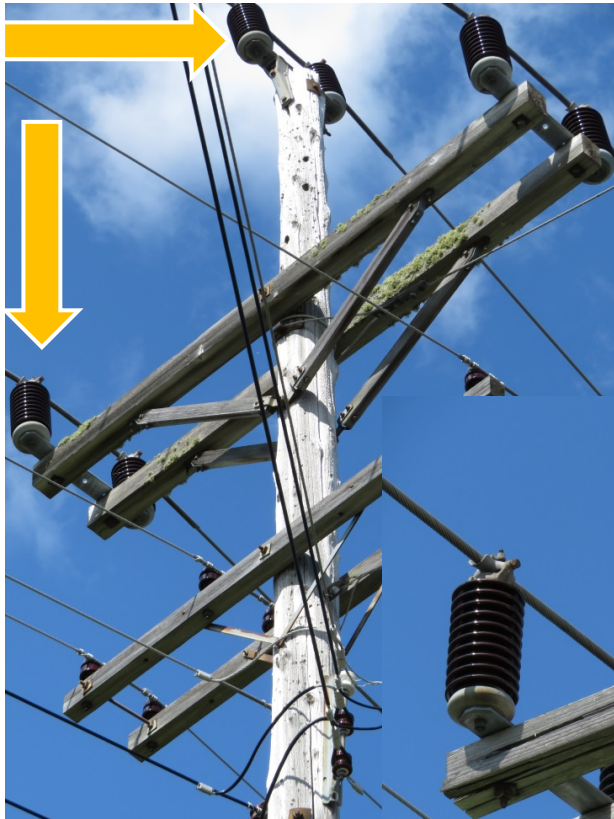
**Aroostook River flooding
damaged poles and moved
protective barriers**



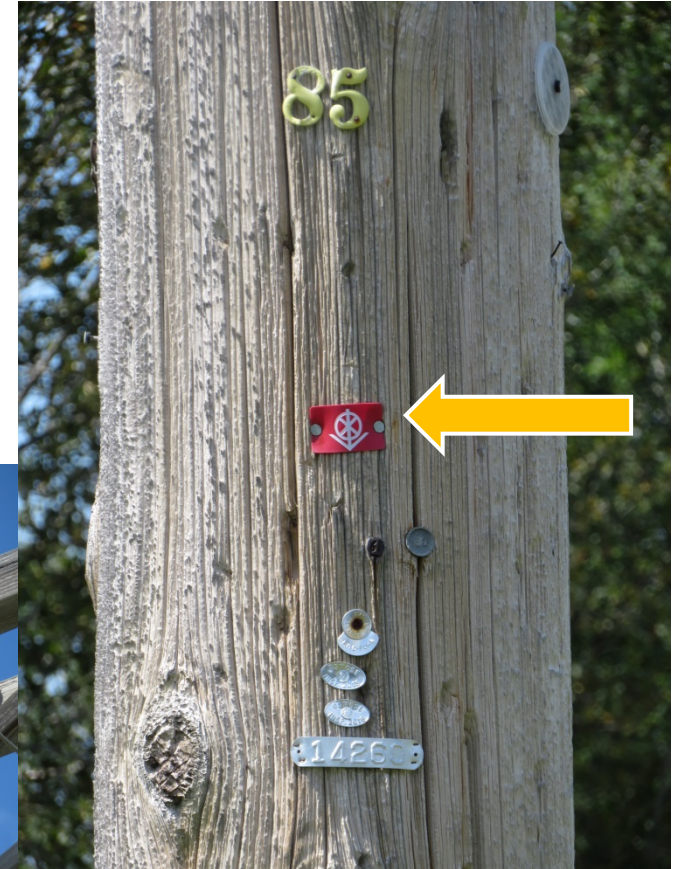
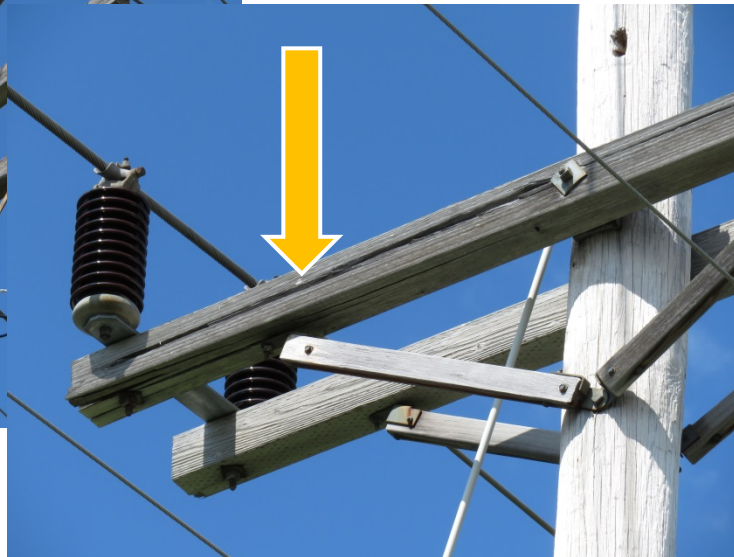
2020 Active and Planned Projects

- *Line 6903 Rebuild (Pole 57 to 126)*
- *Line 1176 Rebuild (Pole 42 to Border)*
- *Line 6930 Rebuild Salmon Brook Crossing*
- *Line 6930 Targeted Maintenance*

Line 6903 Rebuild (pole 57 to 127)



Brown glass post type insulators, cracked crossarms and rejected pole due to internal decay



Line 6903 Rebuild continued...

Examples of past lighting strikes due to inadequate overhead shielding protection



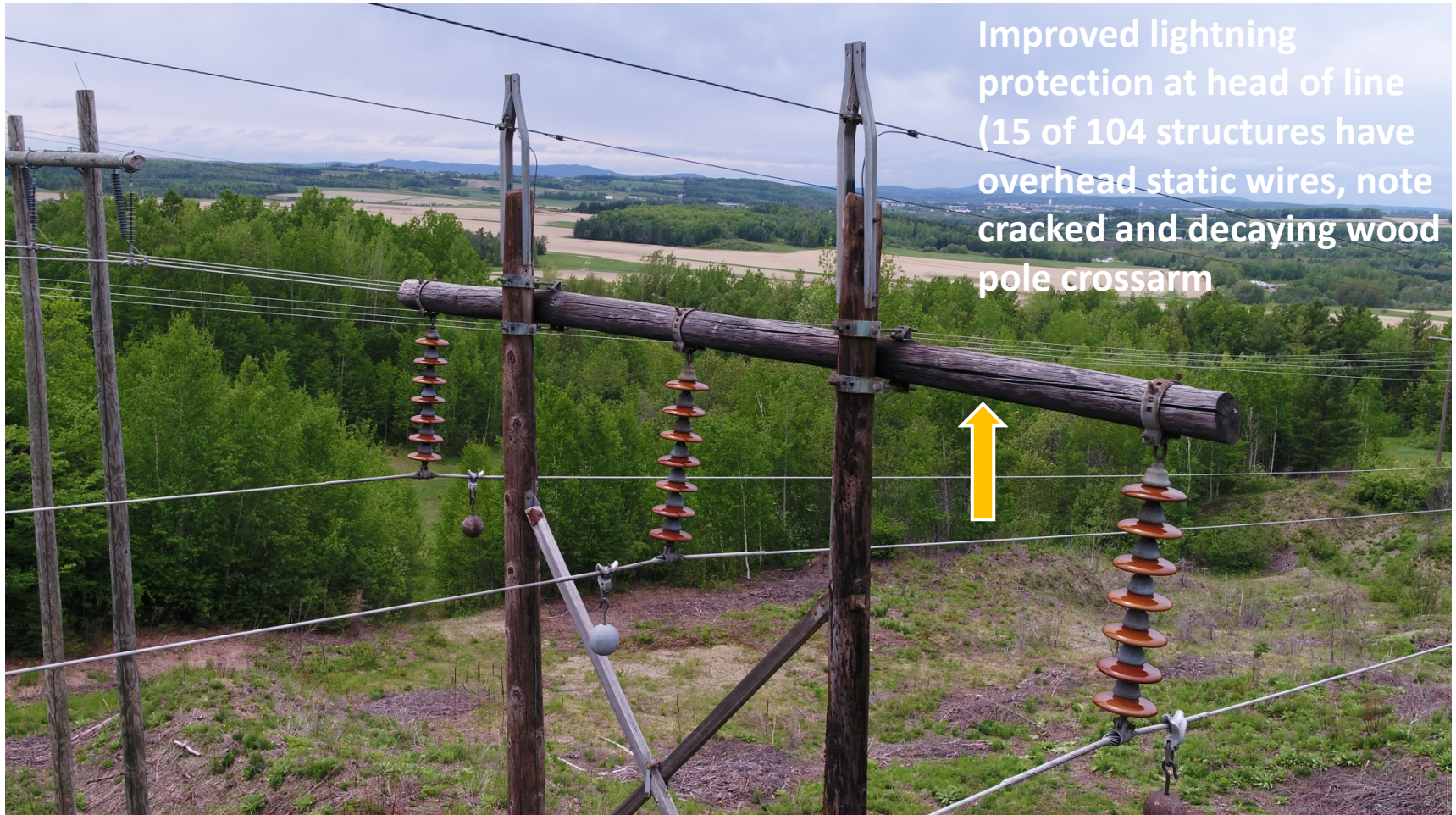
Line 1176 Rebuild Phase 1



Line 1176 Lightning Protection



Line 1176 Lightning Protection Continued...



Line 1176 Rebuild Phase 1 continued...



Line 6930 Salmon Brook Flood Damage

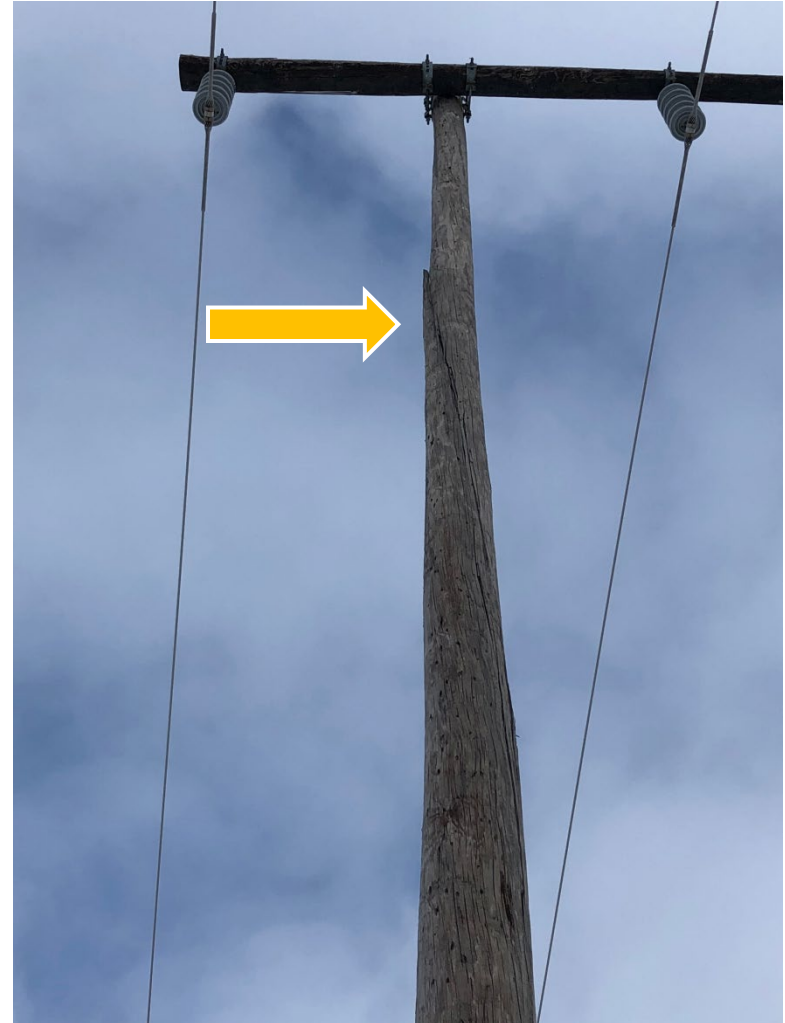


2019 spring flooding impacted structures alongside Salmon Brook destabilizing them and conductor too low for navigable waterway. Rebuild to include taller heavier class composite poles placed on berms with culverts and stone backfill.

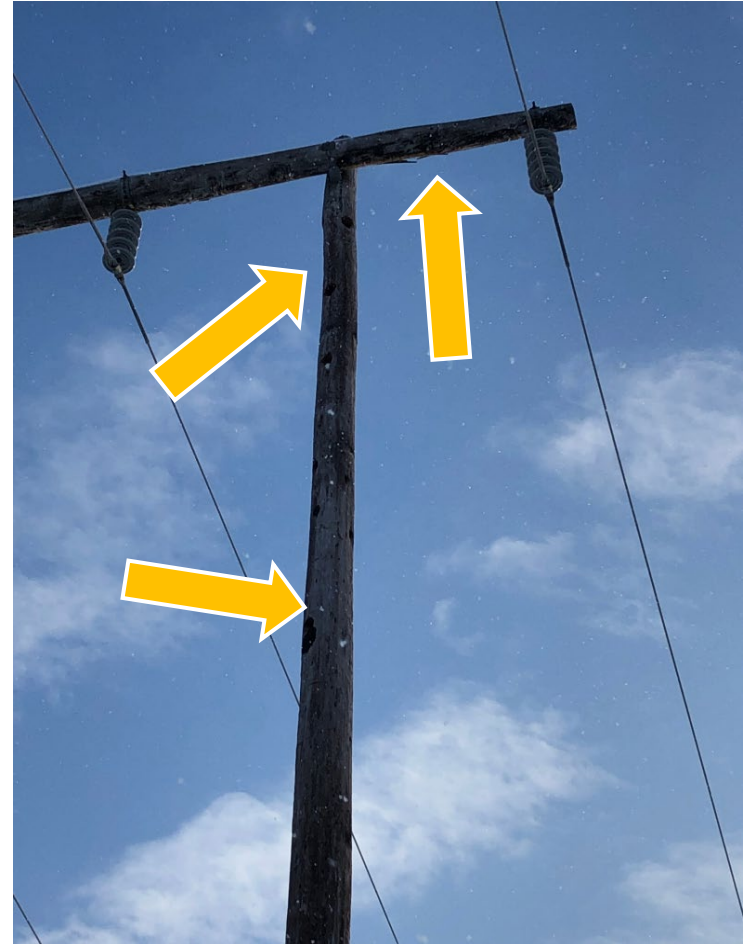
Line 6930 Targeted Maintenance



Woodpeckers nesting activity has damaged many poles while others need to be replaced because of wood pole failure



Line 6930 Targeted Maintenance

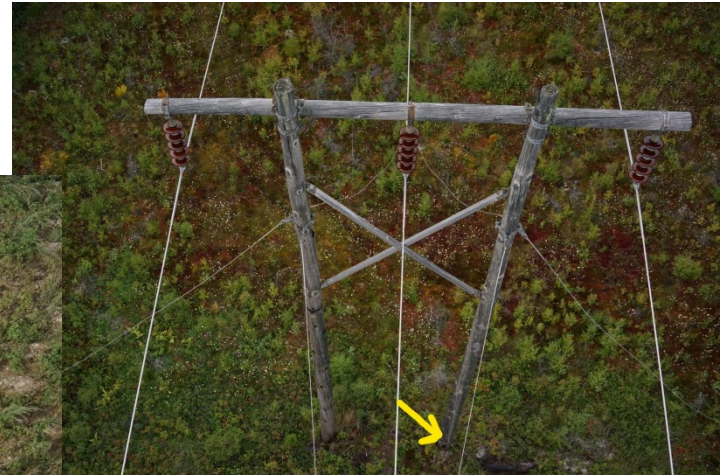
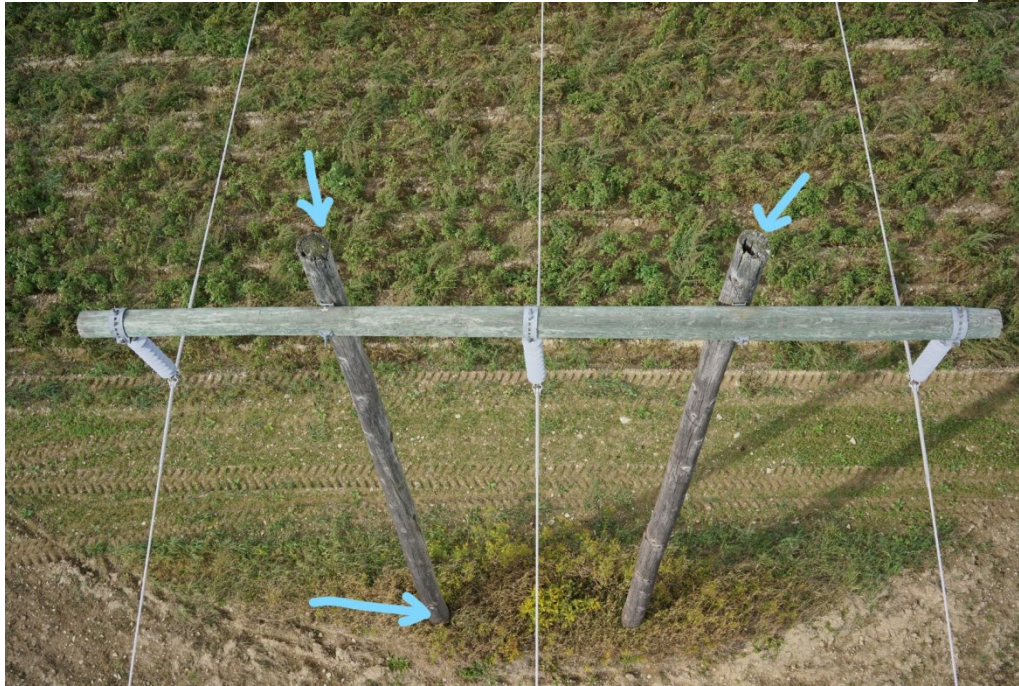


Emerging Issues

System Condition

- *Line 6905 – Madawaska to Limestone*
- *Line 6909 – Madawaska to Fort Kent*

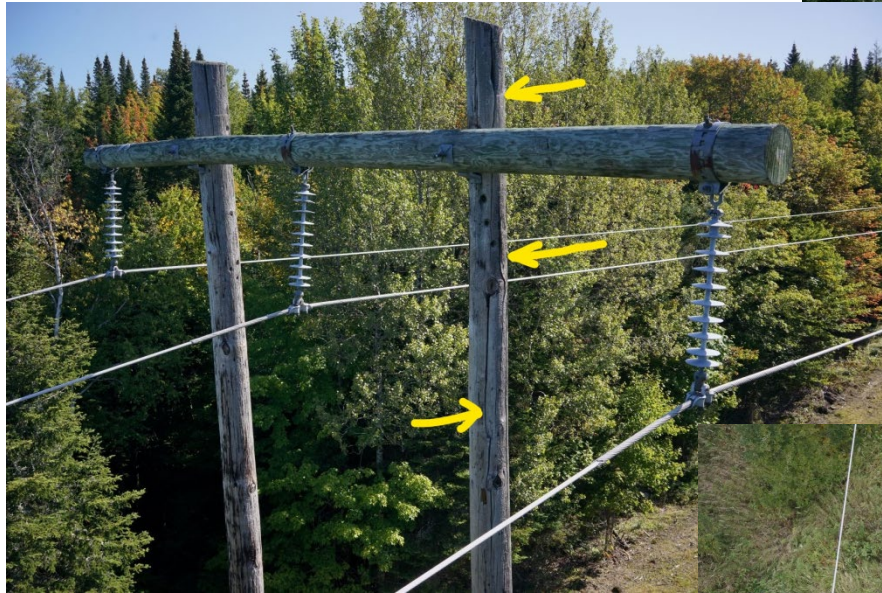
Line 6905 Condition



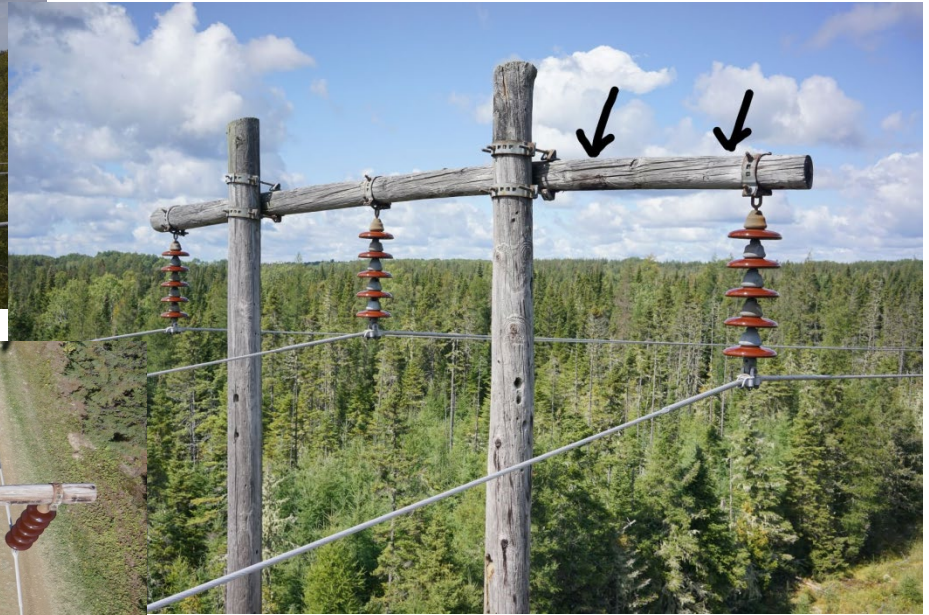
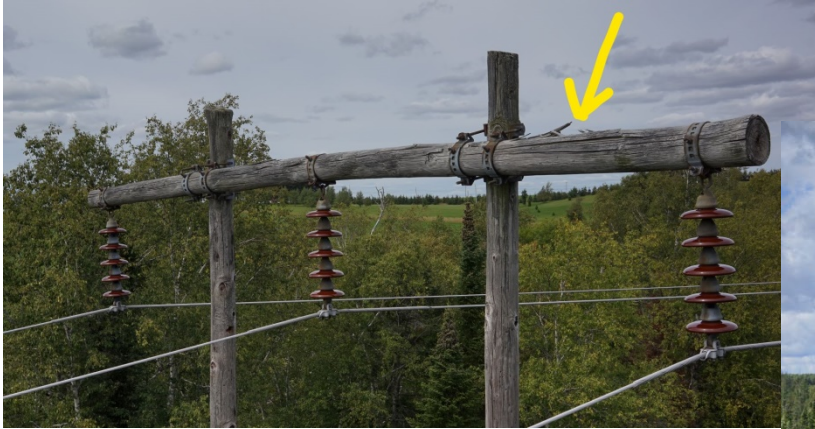
Line 6905 continued...



Line 6905 Condition continued...



Line 6905 Condition continued...



Line 6909 Condition

GIS Line no.	Str/Pole Number	City	Latitude	Longitude	Inspection Result	Original Circumference	Effective Circumference	Result Strength	Shell Decay Condition	Manufacture Year	Height	Class	Material	Species	Survey Date
6909	23	Fort Kent	47.24750160	-68.52800688	Reject	41.00	33.00	43.79	Decay Above and Below	1961	60	3	Wood	EC	10/6/19 8:59
6909	36	Fort Kent	47.24763900	-68.49986720	Reject	44.00	36.00	48.16	Good	1961	50	3	Wood	WRC	10/12/19 14:11
6909	36	Fort Kent	47.24766640	-68.49986740	Reject	46.00	38.00	50.22	Good	1961	50	3	Wood	WRC	10/12/19 14:13
6909	37	Fort Kent	47.24764150	-68.49724880	Reject	45.00	37.00	49.24	Good	1961	50	3	Wood	WRC	10/12/19 13:24
6909	37	Fort Kent	47.24766890	-68.49724910	Reject	46.00	38.00	50.22	Good	1961	50	3	Wood	WRC	10/12/19 13:25
6909	38	Fort Kent	47.24759943	-68.49454057	Reject	48.00	39.00	46.50	Good	1961	50	3	Wood	WRC	10/12/19 11:54
6909	38	Fort Kent	47.24761262	-68.49452969	Reject	45.00	37.00	49.24	Good	1961	50	3	Wood	WRC	10/12/19 11:57
6909	40	Fort Kent	47.24767014	-68.48922541	Reject	46.00	37.00	43.56	Good	1961	50	3	Wood	WRC	10/12/19 11:33
6909	40	Fort Kent	47.24768528	-68.48923371	Reject	46.00	37.00	43.56	Good	1961	50	3	Wood	WRC	10/12/19 11:35
6909	43	Fort Kent	47.24767720	-68.48101249	Reject	42.00	32.00	35.44	Decay Above and Below	1961	75	3	Wood	SP	10/4/19 8:44
6909	44	Fort Kent	47.24674628	-68.47904180	Priority Reject	44.00	30.00	21.82	Decay Above and Below	1961	70	3	Wood	SP	10/4/19 7:58
6909	44	Fort Kent	47.24674215	-68.47903285	Reject	42.00	36.00	57.08	Decay Below	1961	70	2	Wood	SP	10/4/19 8:05
6909	48	Fort Kent	47.24683845	-68.46992030	Reject	50.00	42.00	53.47	Decay Below	1961	60	2	Wood	WRC	10/8/19 14:58
6909	48	Fort Kent	47.24683339	-68.46988138	Reject	45.00	38.00	54.44	Decay Below	1961	60	2	Wood	WRC	10/8/19 14:59
6909	51	Fort Kent	47.24719084	-68.46094037	Reject	47.00	40.00	55.84	Good	1961	55	2	Wood	WRC	10/4/19 13:50
6909	51	Fort Kent	47.24719691	-68.46092313	Reject	50.00	42.00	53.47	Good	1961	50	2	Wood	WRC	10/4/19 13:52
6909	52	Fort Kent	47.24749978	-68.45798810	Reject	54.00	45.00	51.96	Decay Above and Below	1961	65	2	Wood	WRC	10/8/19 14:10
6909	62	Frenchville	47.24776510	-68.43361367	Reject	44.00	35.00	39.66	Decay Above and Below	1961	50	2	Wood	WRC	10/9/19 9:06
6909	64	Frenchville	47.24887179	-68.42966723	Priority Reject	39.00	28.00	28.71	Decay Above	1975	55	3	Wood	SP	10/9/19 9:47
6909	68	Frenchville	47.25292354	-68.42196795	Reject	42.00	34.00	45.54	Decay Below	1961	55	2	Wood	WRC	10/10/19 13:06
6909	68	Frenchville	47.25290593	-68.42191799	Reject	50.00	42.00	53.47	Decay Below	1961	55	2	Wood	WRC	10/10/19 13:08
6909	115	Frenchville	47.30913964	-68.35633058	Priority Reject	51.00	38.00	33.12	Decay Above	1961	70	2	Wood	WRC	10/14/19 13:59
6909	115	Frenchville	47.30912540	-68.35613160	Reject	50.00	40.00	40.20	Decay Below	1961	70	3	Wood	WRC	11/8/19 12:39
6909	120	Frenchville	47.31809242	-68.35609031	Visual Reject	0.00	0.00	0.00	Decay Above	1961	60	3	Wood	WRC	10/14/19 14:22
6909	120	Frenchville	47.31816896	-68.35625571	Reject	50.00	40.00	40.20	Decay Below	1961	60	3	Wood	WRC	10/14/19 14:24
6909	121	Frenchville	47.32008627	-68.35620533	Reject	50.00	42.00	53.47	Good	1961	55	3	Wood	WRC	10/15/19 8:49
6909	121	Frenchville	47.32007892	-68.35625120	Reject	50.00	42.00	53.47	Good	2002	55	3	Wood	WRC	10/15/19 8:52
6909	123	Frenchville	47.32259281	-68.35626510	Reject	41.00	35.00	56.37	Decay Below	1961	60	3	Wood	WRC	9/30/19 14:55
6909	128	Madawaska	47.32802920	-68.34543470	Reject	48.00	35.00	16.28	Decay Below	1961	65	2	Wood	WRC	9/30/19 12:57
6909	145	Madawaska	47.33637861	-68.31794832	Reject	45.00	36.00	40.20	Good	1961	60	2	Wood	SP	10/18/19 14:02
6909	148	Madawaska	47.34014742	-68.31494033	Reject	50.00	38.00	35.19	Decay Above	1961	60	2	Wood	WRC	10/16/19 9:59

Line 6909 built in 1961, comprised of 160 wood pole structures.

13% rejected in 2019 due to insufficient shell thickness, this quantity will continue to climb as this line ages

Line 6909 Condition continued...



Three pole light angle wood pole structure - top of right pole burned off by lightning strike, middle pole rejected due to insufficient shell strength caused by internal decay/rot

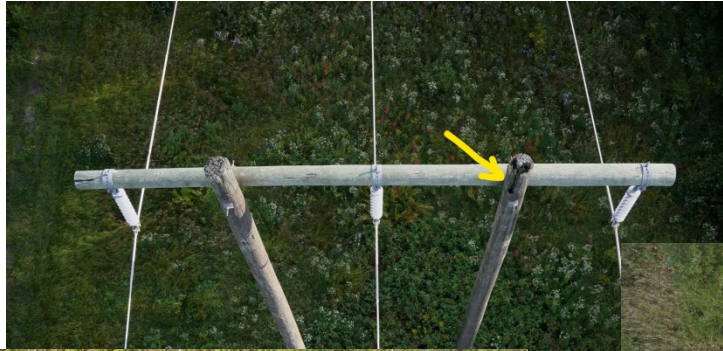
A UAS (drone) inspection is planned for 2020 to further assess above ground structure condition

Enhanced Inspection Methods

Visual inspections performed by drone technology are providing engineers with a new and different view of asset condition



Line 6905 Drone Inspection Findings



Rotting crossarm and pole tops identified by drone inspection



Enhanced Inspection Methods continued...Wood Pole Strength Assessment using Resistograph



Using a long thin needle the electric power consumption of the resistograph drilling device is measured and recorded. The resistance data gathered provides a high linear correlation between the measured values and the density of the penetrated wood.



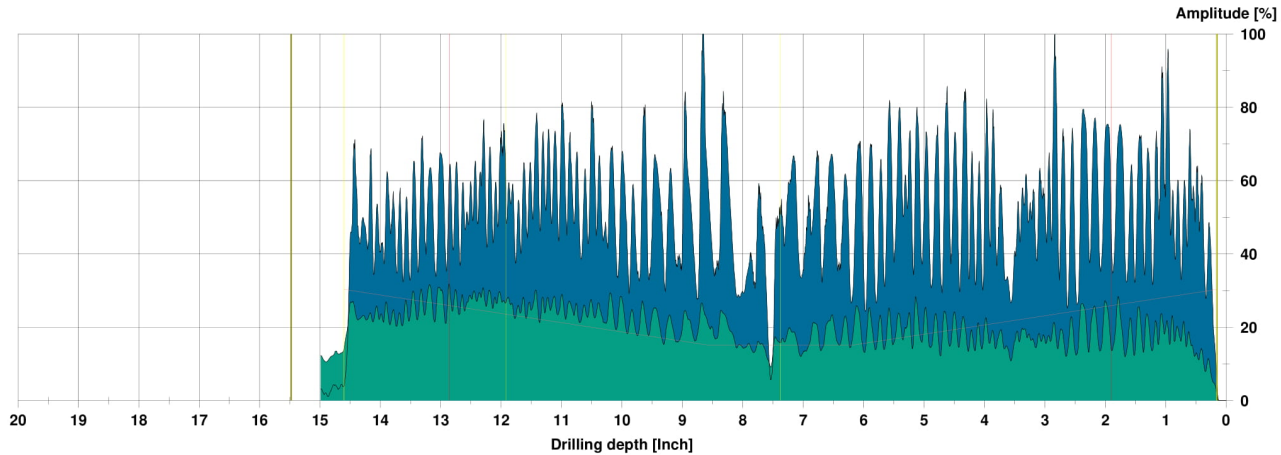
Resistograph Plot - Wood Pole in good condition

Measuring / object data

Measurement no.:	47	Speed	: 3000 r/min	Diameter:	13,25 in
ID number	: 20694	Needle state:	---	Level	:
Drilling depth	: 14,99 in	Tilt	: -30°	Direction:	
Date	: 01/15/2019	Offset	: 56 / 289	Species	:
Time	: 11:33:03	Avg. curve	: off / off	Location:	
Feed	: 10 in/min	Name	:		

WoodInspector

Program	: Pole - EMERA 1.00	Sum decay	: 0,0% 0,0% 0,0%
Pole type	:	Heart rot	: 0,0% 0,0% 0,0%
Measurement	: Below soil level	Shell rot	: No No
Defect pattern	: No decay	Remaining wall	: 50,0% 50,0% 50,0%
Result (auto)	: PASS	Strength	: 100,0% 100,0% 100,0%



Assessment

Comment

20694M047 (PASS).rgp

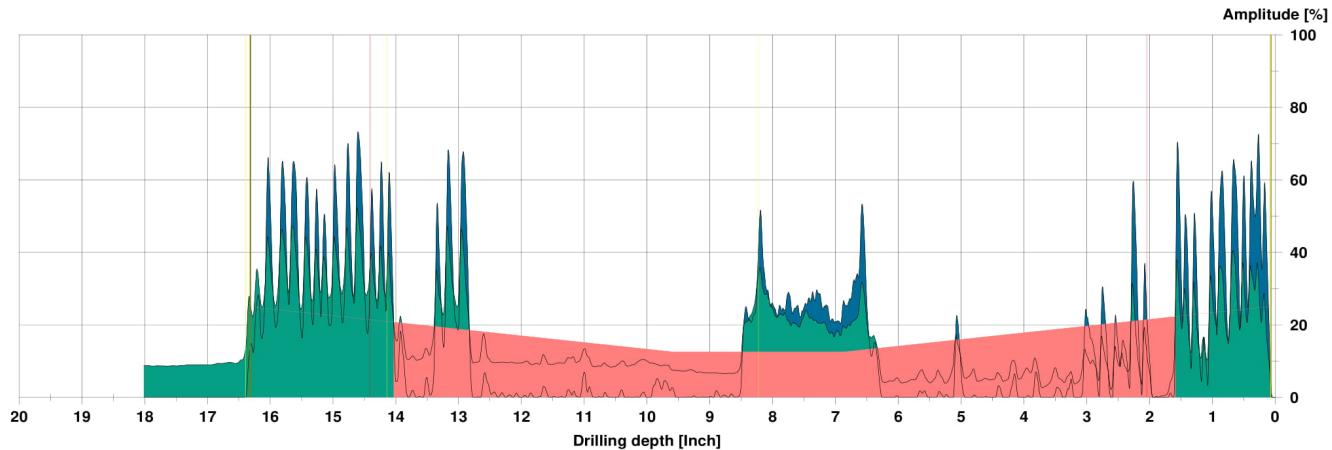
Rejected Wood Pole – Heart Rot

Measuring / object data

Measurement no.:	13	Speed	: 3000 r/min	Diameter:	16,25 in
ID number	: 20781	Needle state:	---	Level	:
Drilling depth	: 18,01 in	Tilt	: -1°	Direction:	
Date	: 10/23/2018	Offset	: 93 / 388	Species	:
Time	: 09:24:24	Avg. curve	: off / off	Location	:
Feed	: 40 in/min	Name	:		

WoodInspector

Program	: Pole - EMERA 1.00	Sum decay	: 40,7% 35,6% 76,3%
Pole type	:	Heart rot	: 40,7% 35,6% 76,3%
Measurement	: Auto diameter	Shell rot	: No No
Defect pattern	: Heart rot	Remaining wall:	9,3% 14,4% 11,8%
Result (auto)	: REJECT	Strength	: 56,1% 74,3% 65,2%



Assessment

Comment

20781M013 (REJECT).rgp

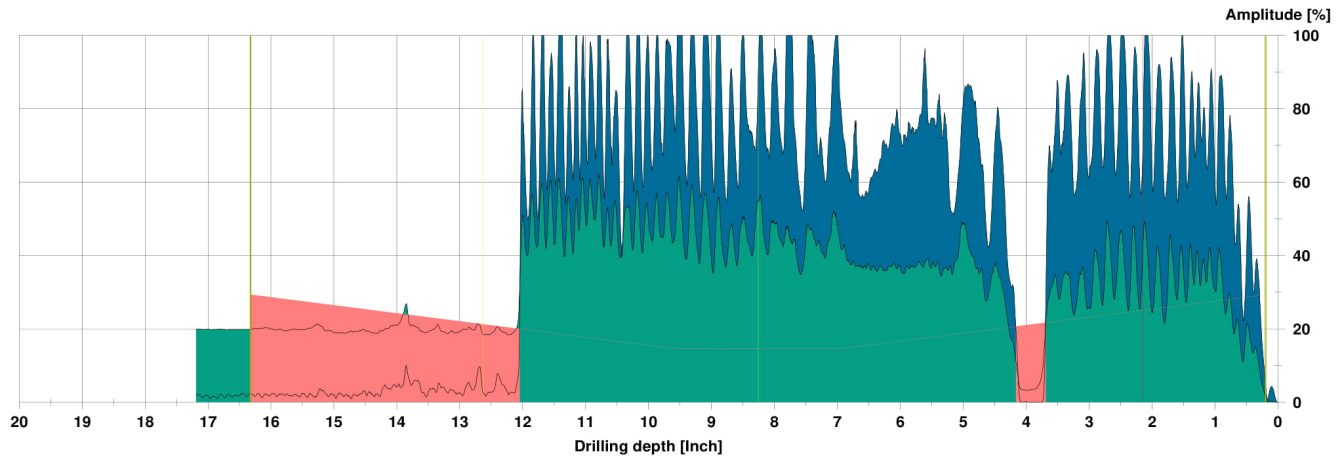
Rejected Wood Pole – Heart Rot & Shell Rot

Measuring / object data

Measurement no.:	46	Speed	: 3000 r/min	Diameter:	14,00 in
ID number	: 20705	Needle state:	---	Level	:
Drilling depth	: 17,19 in	Tilt	: -30°	Direction:	
Date	: 01/17/2019	Offset	: 111 / 415	Species	:
Time	: 10:57:14	Avg. curve	: off / off	Location	:
Feed	: 40 in/min	Name	:		

WoodInspector

Program	: Pole - EMERA 1.00	Sum decay	: 2,9% 0,0% 2,9%
Pole type	:	Heart rot	: 2,9% 0,0% 2,9%
Measurement	: Below soil level	Shell rot	: No Yes
Defect pattern	: Heart+shell rot	Remaining wall	: 21,7% ---
Result (auto)	: REJECT	Strength	: 89,7% ---

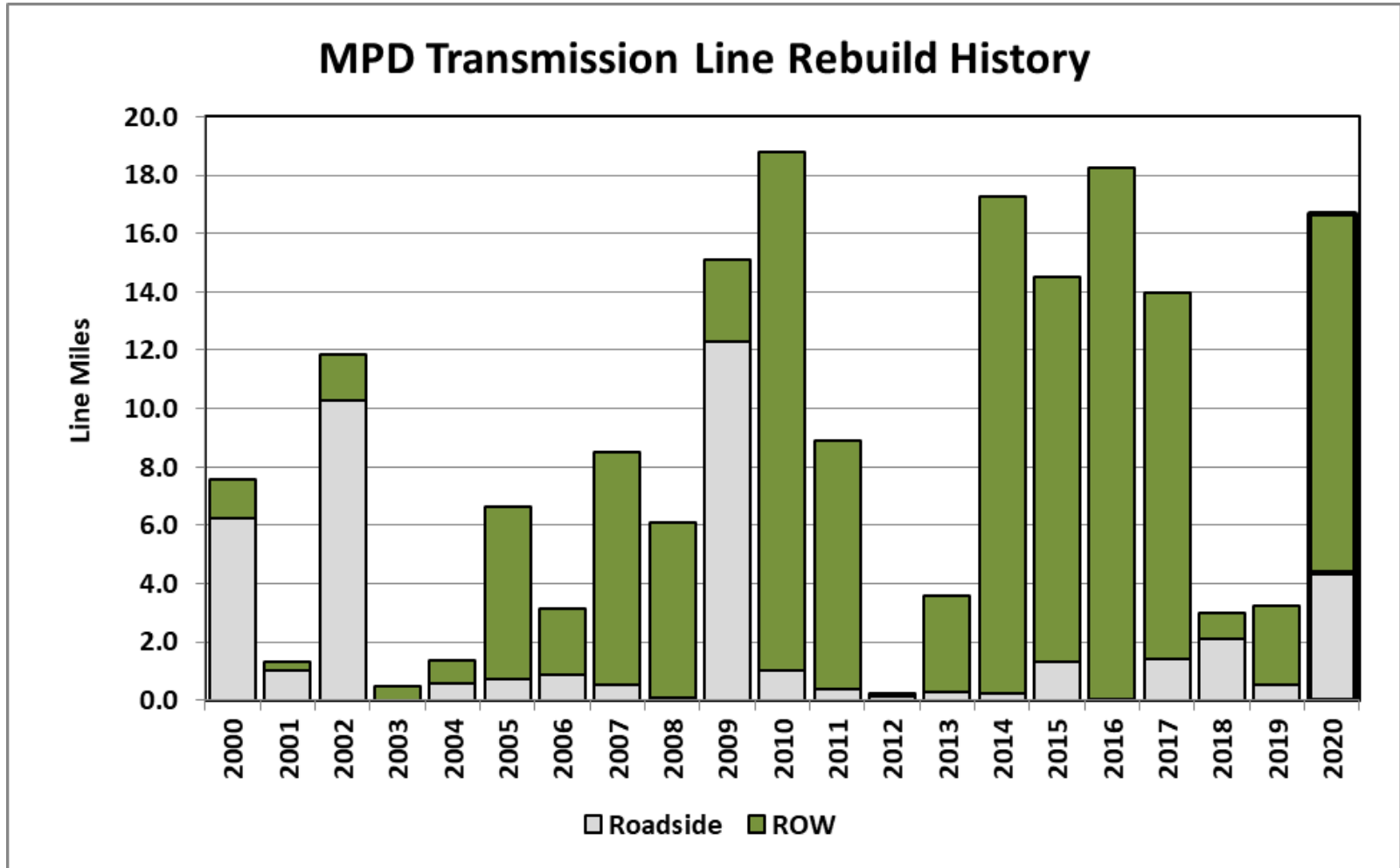


Assessment

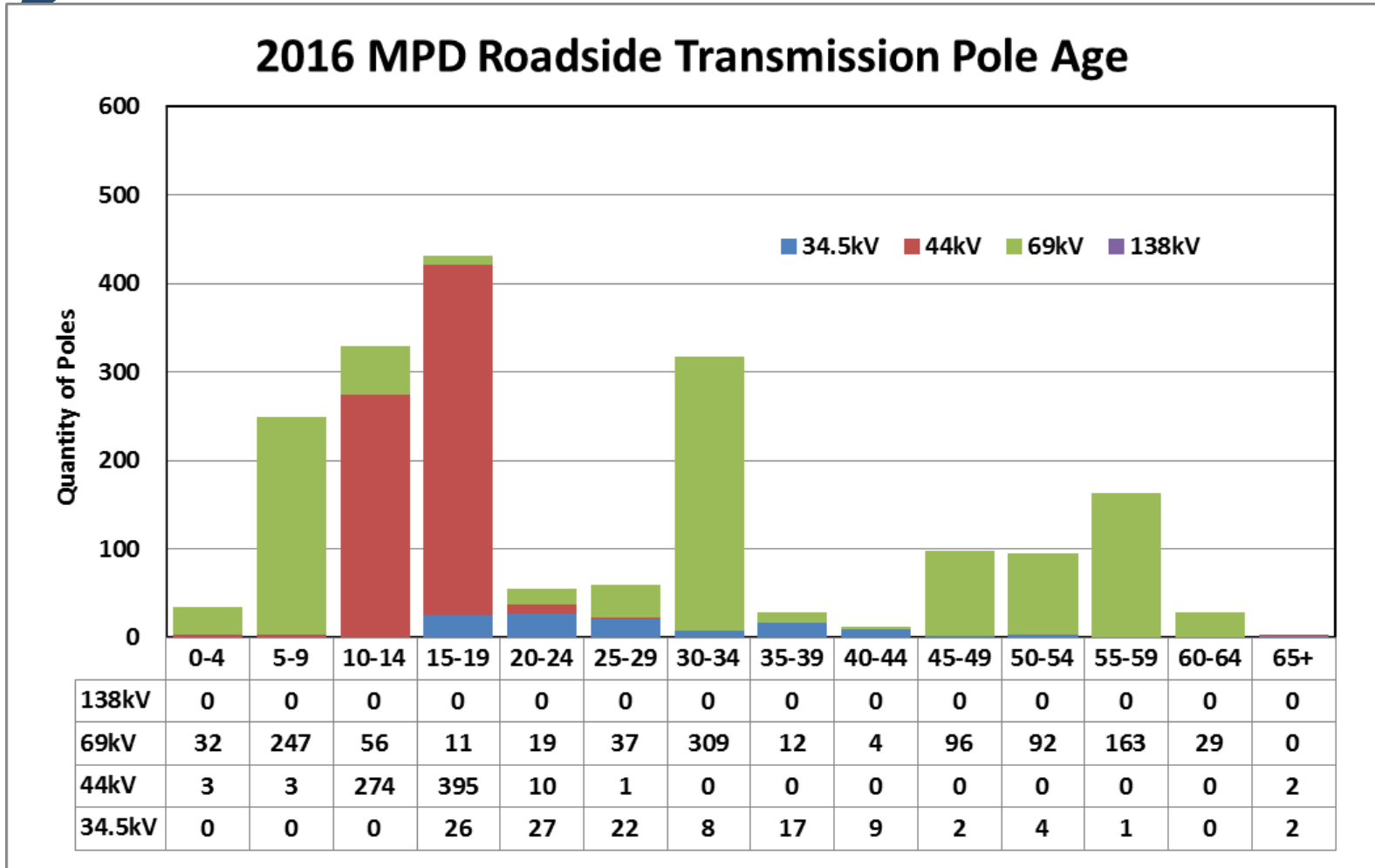
Comment

20705M046 (REJECT).rgp

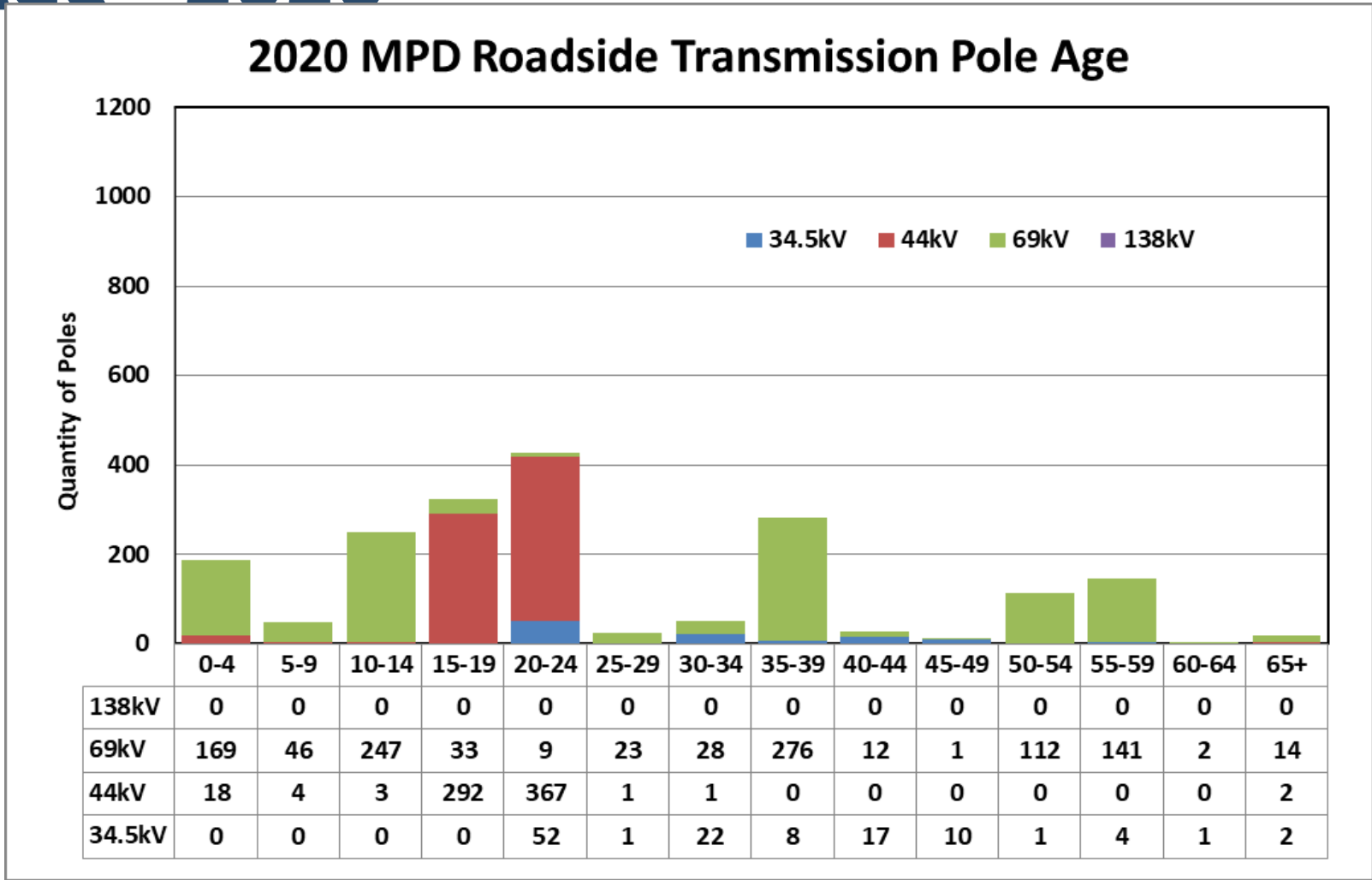
20-Year MPS Transmission Line Rebuild History



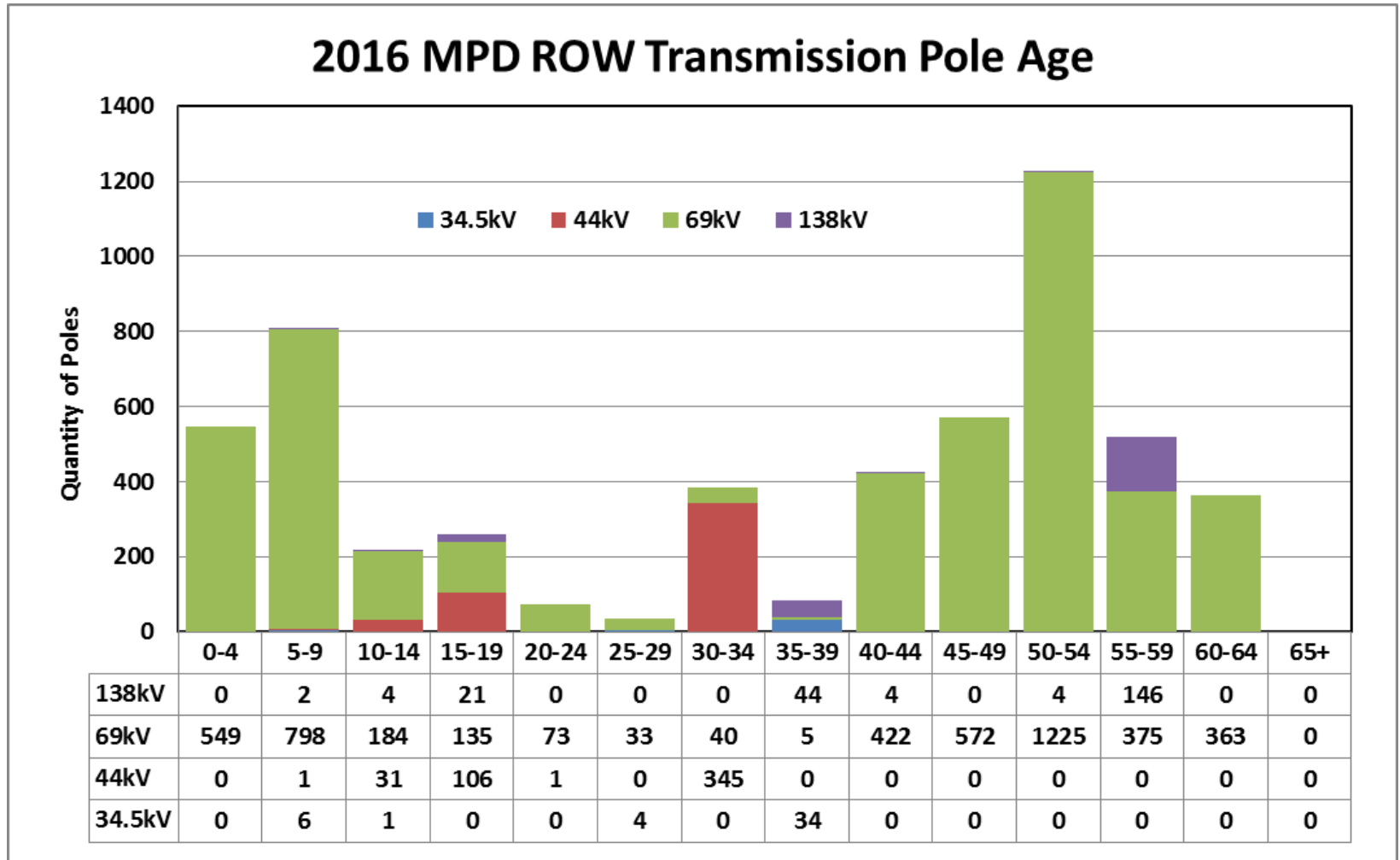
MPD Roadside Transmission Line Pole Age - 2016



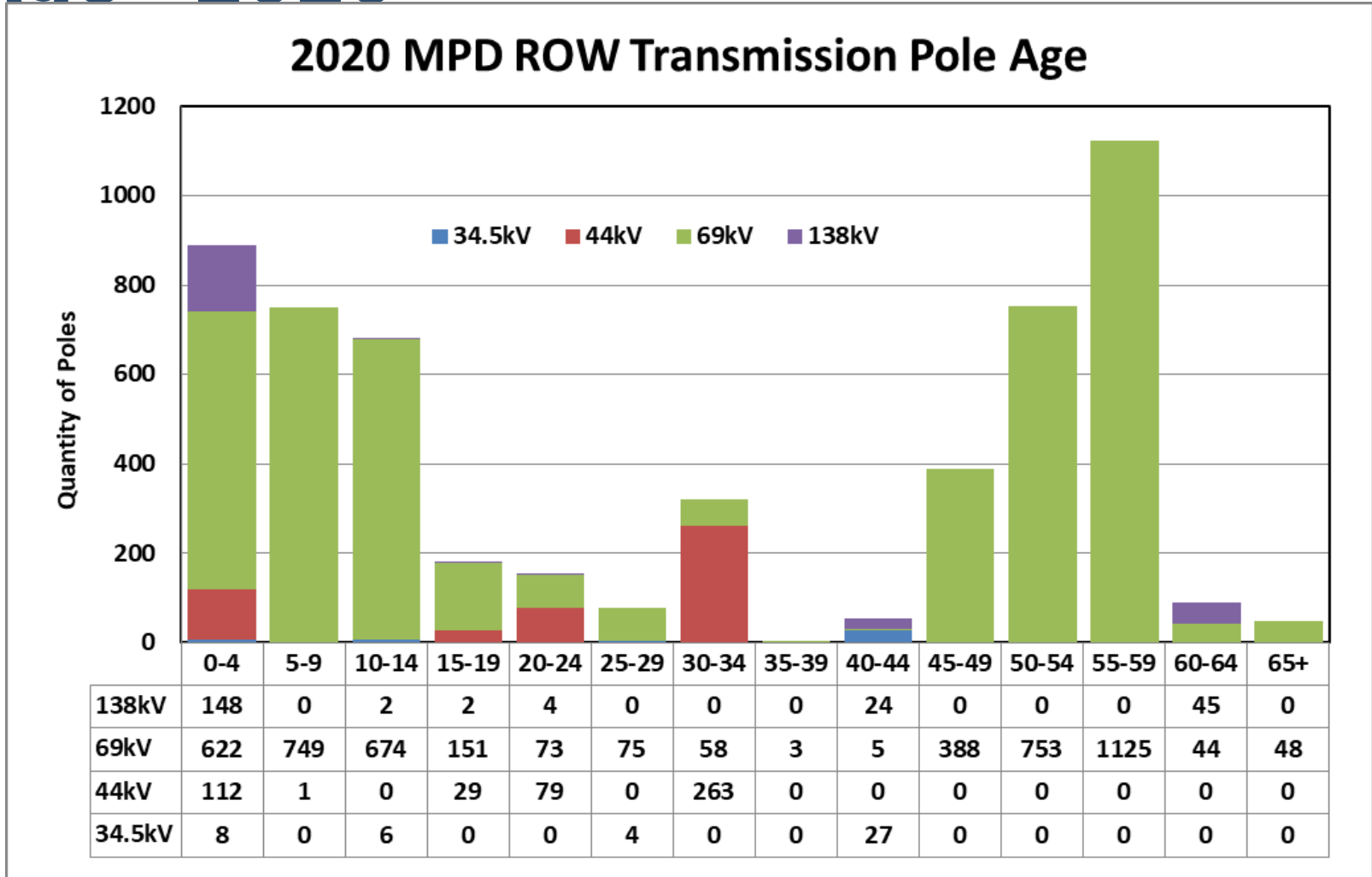
MPD Roadside Transmission Line Pole Age - 2020



MPD ROW Transmission Line Pole Age - 2016



MPD ROW Transmission Line Pole Age - 2020



Chapter 330 Financial Summary

<i>2020</i>	<i>\$8.8 - 9.8 M</i>
<i>2021</i>	<i>\$5.1 - 6.2 M</i>
<i>2022</i>	<i>\$1.8 - 2.6 M</i>
<i>2023</i>	<i>\$3.1 - 3.7 M</i>
<u><i>2024</i></u>	<u><i>\$4.5 - 5.5 M</i></u>
<i>Total</i>	<i>\$23 - 28 M</i>

Chapter 330 Project Summary

2020 Chapter 330 Plan			
Year	Miles	Cost Range (\$M)	Comments/Projects
2020	11	\$8.8 - 9.8	Smaller 6903 project, 1176 Ph. I & II
2021	7.8	\$5.1 - 6.2	1176 Ph. III, 6930
2022	2.8	\$1.8 - 2.6	Lines 69051 and 69201
2023	5.6	\$3.1 - 3.7	Lines 6903 and 6905
<u>2024</u>	<u>6.4</u>	<u>\$4.5- 5.5</u>	<u>Lines 6915 and 6950</u>
Total	33.6	\$23- 28	
Average	6.7	\$5.1	

Final Points

- *Updated inspection information indicates Capital Plan modifications are likely required*
- *Lines from Madawaska to Fort Kent (6909) and Madawaska to Limestone (6905) will require segment rebuilds (our preference for best efficiency)*
- *Likely that will occur in 2022 and 2023*

Appendix

Chapter 330 Project Summary Table

Summary of Emera Maine Chapter 330 Reportable Projects										
Chapter 330 Attributes	Line 6903	Line 1176	Line 6930	Line 1176	Line 69053	Line 69201	Line 6903	Line 6905	Line 6915	Line 6950
Objective	Rebuild Pole 57 to 126	Rebuild Str 42 to US/Canada Border	Rebuild Dow Siding Road to Maysville Siding Road	Rebuild Str 3 to 41	Rebuild Van Buren Tap	Rebuild Mars Hill Tap in ROW	Rebuild Loring Tap	Rebuild	Rebuild Flos Inn to North Presque Isle	Rebuild Westfield to Mars Hill Switching Station
Year Budegeted	2020	2020	2021	2021	2022	2022	2023	2023	2024	2024
Proj Type	Rebuild/Rerate	Rebuild/Rerate	Rebuild/Rerate	Rebuild/Rerate	Rebuild	Rebuild/rerate	Rebuild	Rebuild	Rebuild/Rerate	Rebuild/Rerate
PTF	No	No	No	No	No	No	No	No	No	No
Proj Status	Planned	Planned	Proposed	Proposed	Conceptual	Conceptual	Conceptual	Conceptual	Conceptual	Conceptual
Cost Range	\$2.85M to \$3.8M	\$5.5M to \$6.0M	\$2.0M to \$2.4M	\$3.1M to \$3.8M	\$800K to \$1.2M	\$1.0M to \$1.4M	\$880K to \$1.1M	\$2.2M to \$2.6M	\$1.5M to \$2.0M	\$3.0M to \$3.5M
Regulatory Activity	None	MPUC Docket 2014-00048	None	MPUC Docket 2014-00048	None	None	None	None	None	None
Line Identification	6903	1176	6930	1176	69051	69201	6903 Tap	6905	6915	6950
Project Location	Caibou & Limestone	Easton	Dow Siding Road to Maysville Siding Road	Presque Isle & Easton	Van Buren	Mars Hill	Limestone	Limestone & Caswell	Presque Isle	Westfield to Mars Hill Switching Station
Line Length	3.8 miles	7.2 miles	3.0 miles	4.8 miles	1.2 Miles	1.6 miles	1.6 Miles	4.0 Miles	3.0 Miles	3.4 miles
Peak Load	25 MVA	72 MVA	16 MVA	72 MVA	3 MVA	4 MVA	2 MVA	4 MVA	26 MVA	28 MVA
Voltage Level	69kV	138kV	69kV	138kV	69kV	69kV	69kV	69kV	69kV	69kV
Year Constructed	1961	1957	1955	1957	1964	1964	1953/1961	1964	1963	1964
Existing Design	Single pole wood with horizontal wood crossarms	Wood Pole H-frame structures with wood pole crossarms	Single pole with wood crossarm	Wood Pole H-frame structures with wood pole crossarms	Single wood pole with horizontal crossarm and porcelain insulators	Single wood pole with horizontal crossarm and porcelain post insulators	Single wood pole with horizontal crossarm and porcelain insulators	H-Frame wood pole structures with wood pole crossarms and suspension insulators	H-Frame wood pole structures with wood pole crossarms and suspension insulators	Wood pole H-Frame structures with wood pole crossarms and suspension insulators
Existing Conductor	336.4 Linnet ACSR	266.8 ACSR Partridge	336.4 ACSR	266.8 ACSR Partridge	3/0 ACSR Pigeon	1/0 F Copperweld	3/0 ACSR	336.4 ACSR	336.4 ACSR	336.4 ACSR
New Conductor	795 ACSR Drake	795 ACSR Drake	477 ACSR	795 ACSR Drake	3/0 ACSR Pigeon	336.4 ACSR	3/0 ACSR	336.4 ACSR	795 ACSR Drake	795 ACSR Drake
Impact on Generators	May increase system ATC/TTC limits when combined with other system upgrades	May increase ATC and TTC ratings to New Brunswick Power. May impact all generators with export. May provide additional capacity for Northern Maine generators.	None	May increase ATC and TTC ratings to New Brunswick Power. May impact all generators with export. May provide additional capacity for Northern Maine generators.	None	None	None	None	None	None
Potential Alternatives	None	None	None	None	None	None	None	None	None	None
New Design	Single wood poles with polymer horizontal line post insulators	Single wood poles with polymer horizontal line post insulators	Single wood pole with polymer horizontal line post (HLP) insulators	Single wood poles with polymer horizontal line post insulators	Single wood poles with polymer horizontal line post insulators and lightning protection	Single wood pole with fiberglass crossarms and polymer post insulators	Single wood poles with polymer horizontal line post insulators and lightning protection	Single wood pole with horizontal polymer insulators	Single wood pole with horizontal polymer insulators	Single wood pole with polymer horizontal line post insulators