

Tree Strike Risk Calculation for

Upper Lake 1101
Keswick 1101
Middletown 1102
Middletown 1103
Konocti 1102
Mariposa 2102
Bucks Creek 1101

*Calculate Tree Strike Residual Risk of Non-Hardened Circuits
Count Trees within 6 ft of Conductor Assuming Generic OH*

November 25, 2020



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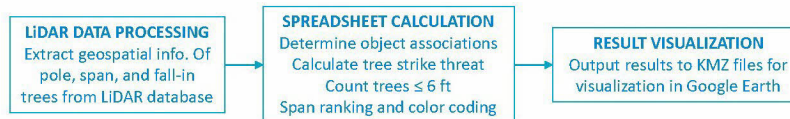
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CALCULATION WORKFLOW

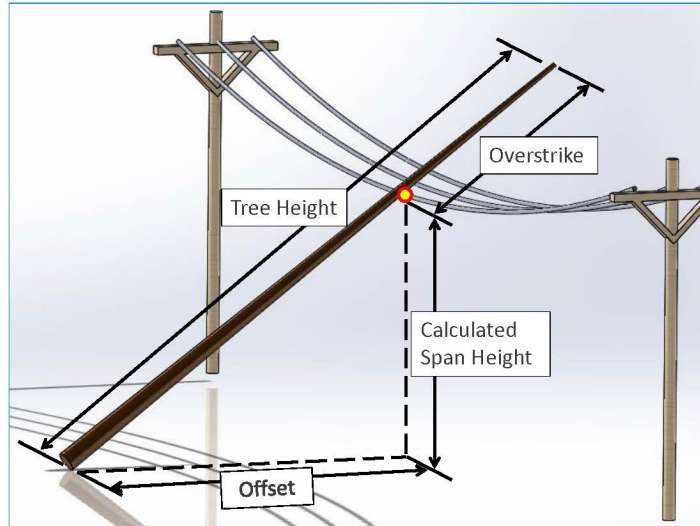
- LiDAR data processing
 - Extract pole, span, and fall-in tree geospatial information from LiDAR database
- Import processed data into Excel spreadsheet
 - Determine Tree–Span–Pole associations based on the LiDAR geospatial info
 - **Tree strike threat:** Calculate number of fall-in trees in each span that can touch the line
 - **Trees within 6 ft:** Calculate number of fall-in trees in each span that are within 6 ft from the line
 - Rank and color code the spans in each category based on the number of trees in each span
- Output results to Google Earth for visualization
 - For each circuit, span, pole, and tree results are output to separate KMZ files such that they are shown as different layers in Google Earth





Assumptions for Non-Hardened System

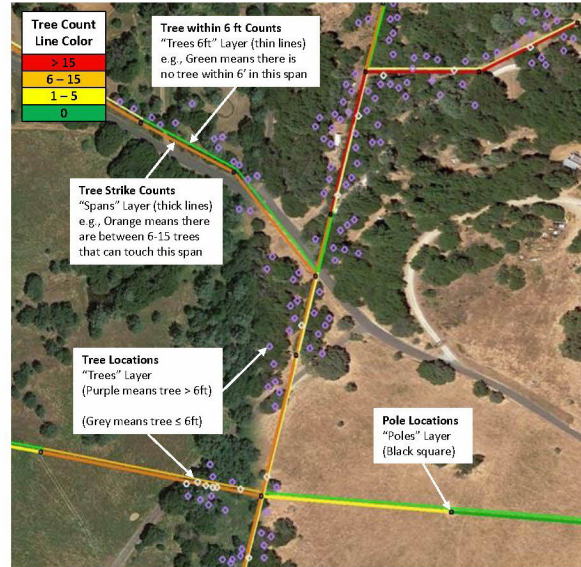
- Tree-Span relationship is tagged in LiDAR (see figure)
- All fall-in trees have potential to strike the span regardless of wind speed and wind direction
- Tree strike failure is counted as true when a tree is tagged as fall-in with non-zero Overstrike
- Spans are ranked based on the number of fall-in trees in each span





Definition of KMZ Layer Symbols and Line Colors

- Tree strike threat color coding
 - Thick red lines: Spans that have more than 15 fall-in trees that can touch the line
 - Thick orange lines: Spans that have 6 to 15 fall-in trees that can touch the line
 - Thick yellow lines: Spans that have 1 to 5 fall-in trees that can touch the line
 - Thick green lines: Spans that have zero fall-in tree that can touch the line
- Tree distance color coding
 - Thin red lines: Spans that have more than 15 fall-in trees within 6 ft of the line
 - Thin orange lines: Spans that have 6 to 15 fall-in trees within 6 ft of the line
 - Thin yellow lines: Spans that have 1 to 5 fall-in trees within 6 ft of the line
 - Thin green lines: Spans that have zero 15 fall-in tree within 6 ft of the line





RESULTS 1/2

- Tree strike threat calculation
 - Tree counts that can touch the non-hardened line
- Residual risk calculation

$$= \frac{\text{No. of Spans in Threat Level}}{\text{Total Spans}} \times \text{Weight Factor}$$

Upper Lake 1101

Threat Level	Trees Touching Non-Hardened (No. of spans)	Linear Span Length (miles)	Tree Strike Residual Risk	
			Weight Factor	Non-Hardened
High (15+ trees)	75	4.76	1	0.087
Medium (5-15 trees)	228	13.30	0.75	0.199
Low (1-5 trees)	333	18.44	0.50	0.194
None	223	11.10	0	0.000
Total:	859	47.61		0.480

Keswick 1101

Threat Level	Trees Touching Non-Hardened (No. of spans)	Linear Span Length (miles)	Tree Strike Residual Risk	
			Weight Factor	Non-Hardened
High (15+ trees)	17	1.04	1	0.014
Medium (5-15 trees)	133	6.04	0.75	0.079
Low (1-5 trees)	459	19.36	0.50	0.182
None	650	24.84	0	0.000
Total:	1,259	51.28		0.275

Konocti 1102

Threat Level	Trees Touching Non-Hardened (No. of spans)	Linear Span Length (miles)	Tree Strike Residual Risk	
			Weight Factor	Non-Hardened
High (15+ trees)	540	28.01	1	0.208
Medium (5-15 trees)	629	30.78	0.75	0.182
Low (1-5 trees)	775	36.46	0.50	0.150
None	647	29.90	0	0.000
Total:	2,591	125.15		0.540

Mariposa 2102

Threat Level	Trees Touching Non-Hardened (No. of spans)	Linear Span Length (miles)	Tree Strike Residual Risk	
			Weight Factor	Non-Hardened
High (15+ trees)	110	7.99	1	0.024
Medium (5-15 trees)	1,063	61.44	0.75	0.174
Low (1-5 trees)	2,382	123.21	0.50	0.260
None	1,032	52.18	0	0.000
Total:	4,587	244.82		0.457



RESULTS 2/2

- Tree strike threat calculation
 - Tree counts that can touch the non-hardened line
- Residual risk calculation

$$= \frac{\text{No. of Spans in Threat Level}}{\text{Total Spans}} \times \text{Weight Factor}$$

Bucks Creek 1101

Threat Level	Trees Touching Non-Hardened (No. of spans)	Linear Span Length (miles)	Tree Strike Residual Risk	
			Weight Factor	Non-Hardened
High (15+ trees)	13	0.74	1	0.078
Medium (5-15 trees)	51	2.35	0.75	0.229
Low (1-5 trees)	60	2.36	0.50	0.180
None	43	1.78	0	0.000
Total:	167	7.23		0.487

Middletown 1102

Threat Level	Trees Touching Non-Hardened (No. of spans)	Linear Span Length (miles)	Tree Strike Residual Risk	
			Weight Factor	Non-Hardened
High (15+ trees)	4	0.34	1	0.005
Medium (5-15 trees)	47	2.61	0.75	0.042
Low (1-5 trees)	325	14.39	0.50	0.192
None	471	19.61	0	0.000
Total:	847	36.95		0.238

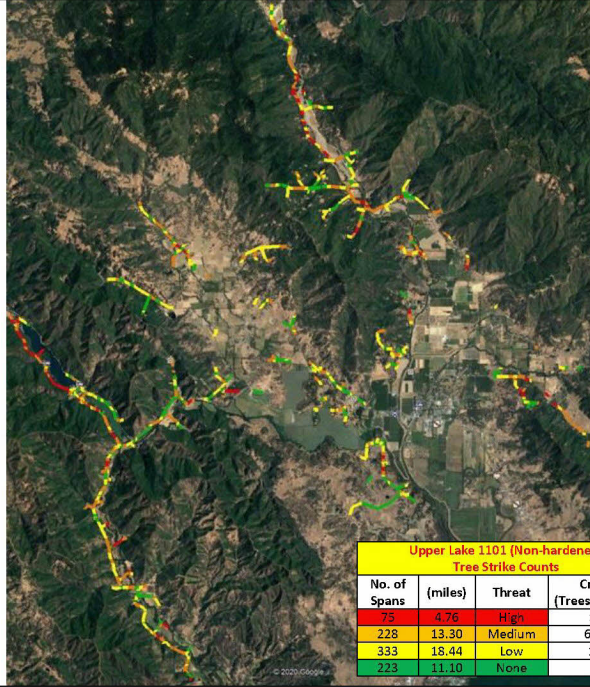
Middletown 1103

Threat Level	Trees Touching Non-Hardened (No. of spans)	Linear Span Length (miles)	Tree Strike Residual Risk	
			Weight Factor	Non-Hardened
High (15+ trees)	15	1.44	1	0.045
Medium (5-15 trees)	60	4.33	0.75	0.136
Low (1-5 trees)	115	7.11	0.50	0.174
None	141	8.54	0	0.000
Total:	331	21.43		0.355

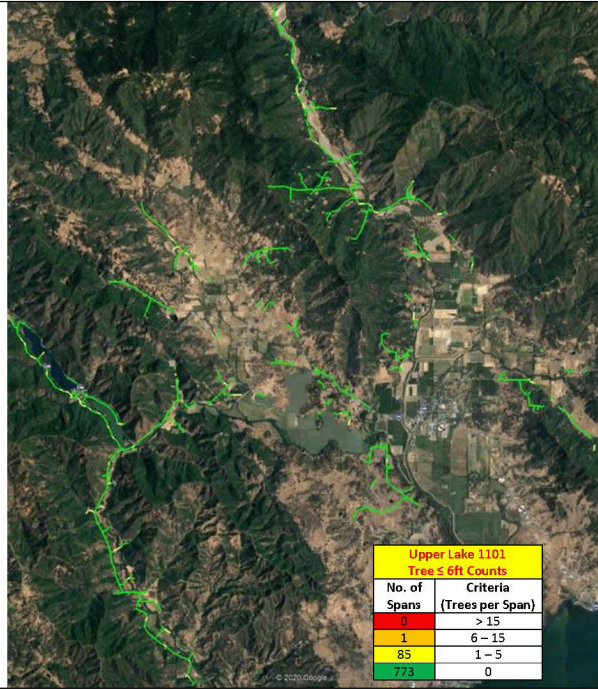


Upper Lake 1101

- * - Spans.kmz
- Based on 2019 LiDAR
- Trees that can touch the line
 - 75 spans have more than 15 trees in each span that can strike
 - 228 spans have 6 – 15 trees in each span that can strike
 - 333 spans have 1 – 5 trees in each span that can strike
 - 223 spans have zero tree in each span that can strike



- * - Trees 6ft.kmz
- Trees that are within 6 ft of line
 - 0 span have more than 15 trees in each span that are within 6 ft
 - 1 span have 6 – 15 trees in each span that are within 6 ft
 - 85 spans have 1 – 5 trees in each span that are within 6 ft
 - 773 spans have zero tree in each span that are within 6 ft

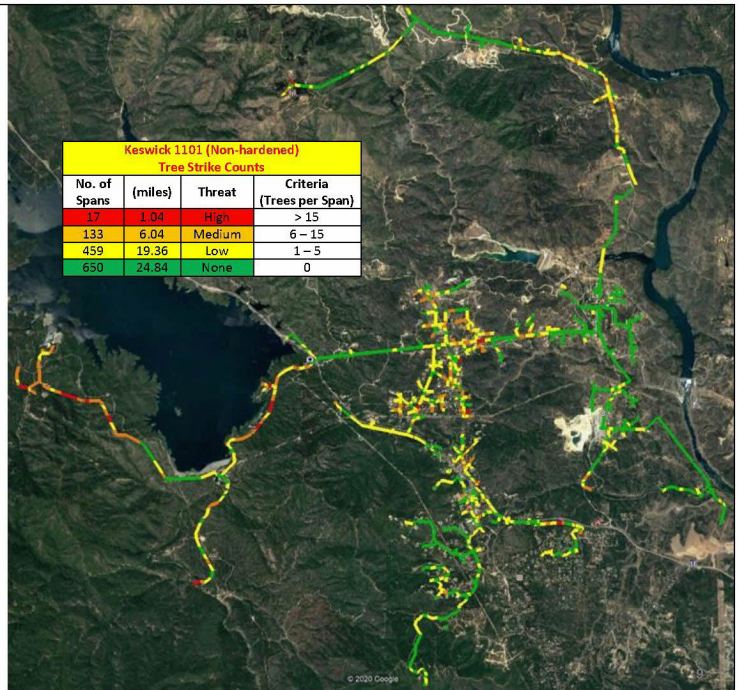




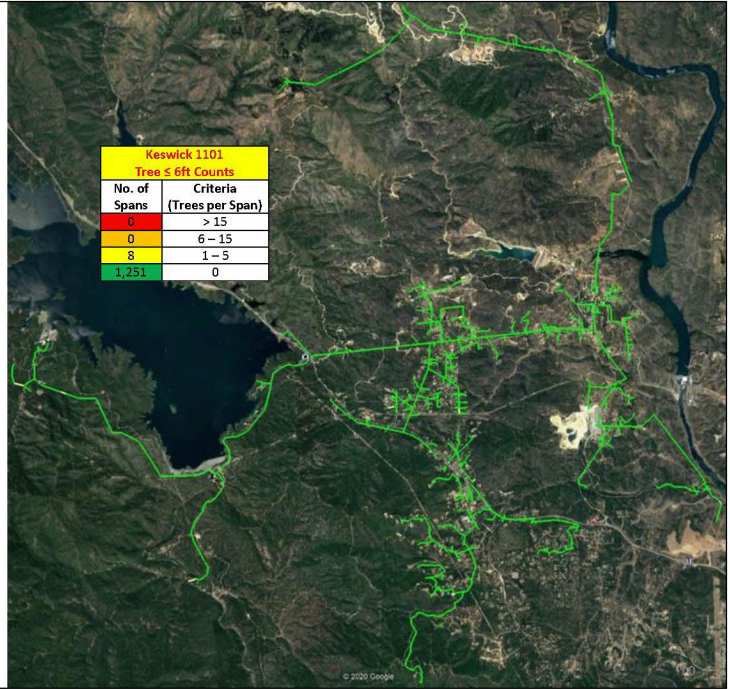
Keswick 1101

- * - Spans.kmz
- Based on 2019 LiDAR
- Trees that can touch the line
 - 17 spans have more than 15 trees in each span that can strike
 - 133 spans have 6 – 15 trees in each span that can strike
 - 459 spans have 1 – 5 trees in each span that can strike
 - 650 spans have zero tree in each span that can strike

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- * - Trees 6ft.kmz
- Trees that are within 6 ft of line
 - 0 span have more than 15 trees in each span that are within 6 ft
 - 0 span have 6 – 15 trees in each span that are within 6 ft
 - 8 spans have 1 – 5 trees in each span that are within 6 ft
 - 1,251 spans have zero tree in each span that are within 6 ft

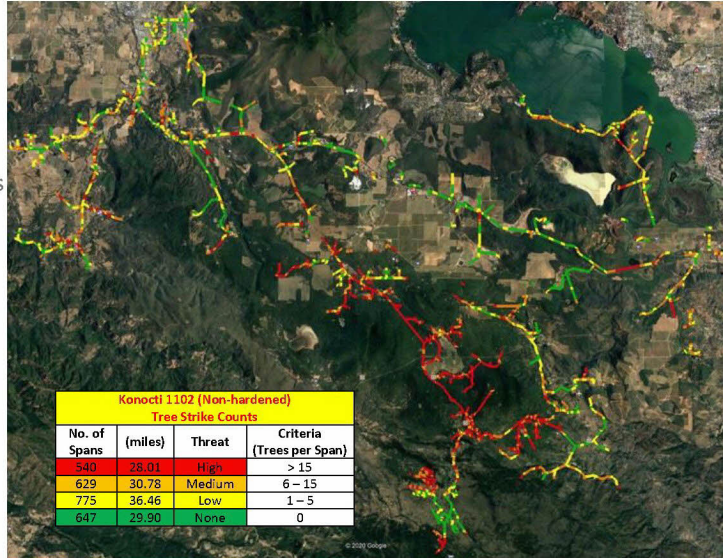


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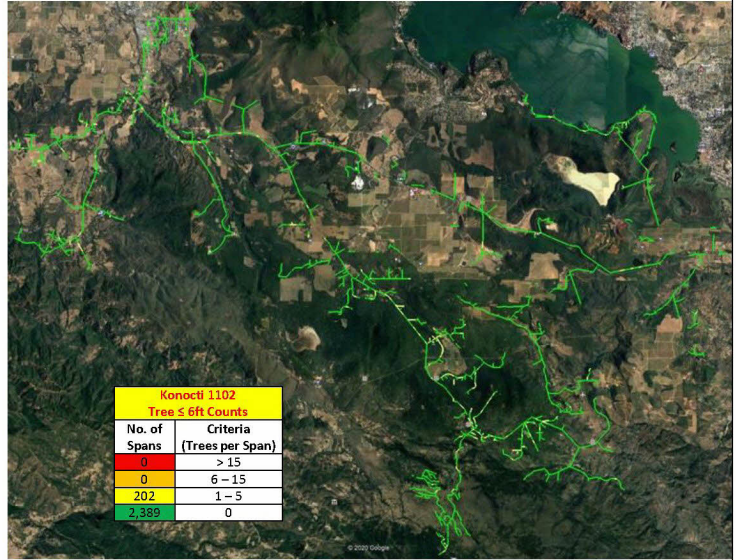


Konocti 1102

- * - Spans.kmz
- Based on 2019 LiDAR
- Trees that can touch the line
 - 540 spans have more than 15 trees in each span that can strike
 - 629 spans have 6 – 15 trees in each span that can strike
 - 775 spans have 1 – 5 trees in each span that can strike
 - 647 spans have zero tree in each span that can strike



- * - Trees 6ft.kmz
- Trees that are within 6 ft of line
 - 0 span have more than 15 trees in each span that are within 6 ft
 - 0 span have 6 – 15 trees in each span that are within 6 ft
 - 202 spans have 1 – 5 trees in each span that are within 6 ft
 - 2,389 spans have zero tree in each span that are within 6 ft

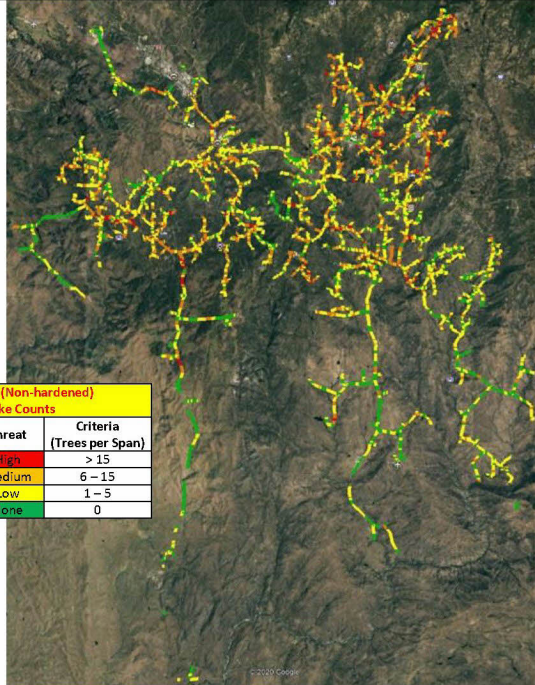




Mariposa 2102

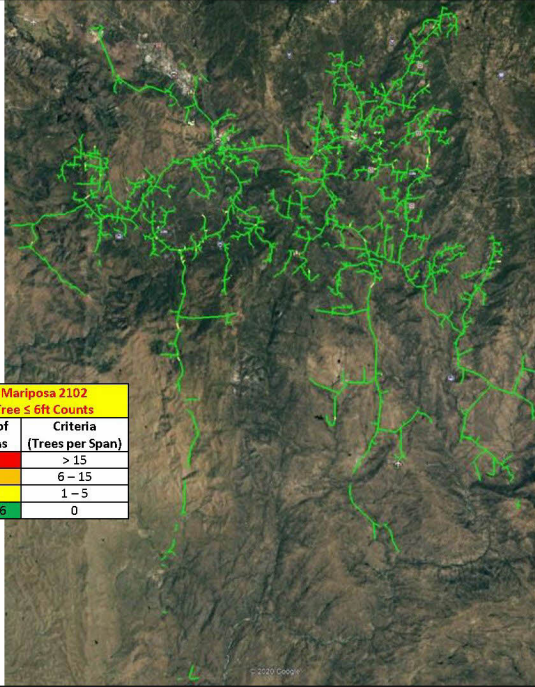
- * - Spans.kmz
- Based on 2019 LiDAR
- Trees that can touch the line
 - 110 spans have more than 15 trees in each span that can strike
 - 1,063 spans have 6 – 15 trees in each span that can strike
 - 2,382 spans have 1 – 5 trees in each span that can strike
 - 1,032 spans have zero tree in each span that can strike

Mariposa 2102 (Non-hardened)			
Tree Strike Counts			
No. of Spans	(miles)	Threat	Criteria (Trees per Span)
110	7.99	High	> 15
1,063	61.44	Medium	6–15
2,382	123.21	Low	1–5
1,032	52.18	None	0



- * - Trees 6ft.kmz
- Trees that are within 6 ft of line
 - 0 span have more than 15 trees in each span that are within 6 ft
 - 0 span have 6 – 15 trees in each span that are within 6 ft
 - 71 spans have 1 – 5 trees in each span that are within 6 ft
 - 4,516 spans have zero tree in each span that are within 6 ft

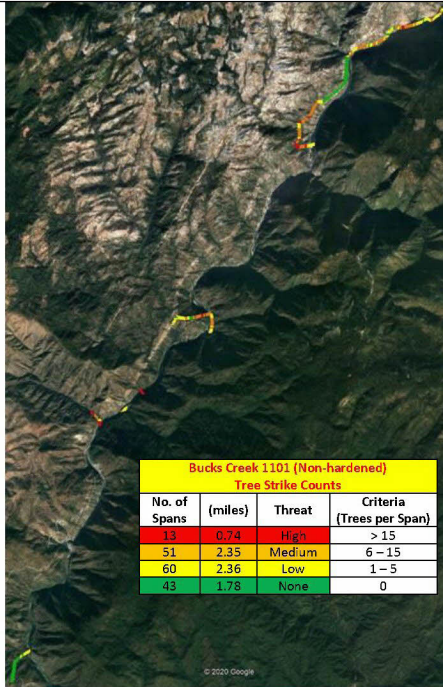
Mariposa 2102 Tree 6ft Counts	
No. of Spans	Criteria (Trees per Span)
0	> 15
0	6 – 15
71	1 – 5
4,516	0



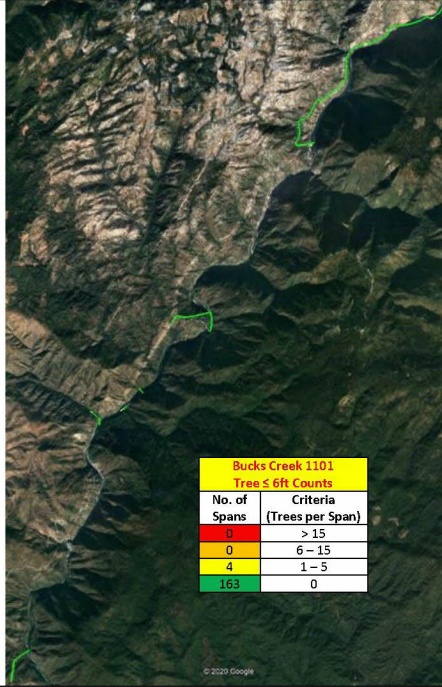


Bucks Creek 1101

- * - Spans.kmz
- Based on 2019 LiDAR
- Trees that can touch the line
 - 13 spans have more than 15 trees in each span that can strike
 - 51 spans have 6 – 15 trees in each span that can strike
 - 60 spans have 1 – 5 trees in each span that can strike
 - 43 spans have zero tree in each span that can strike



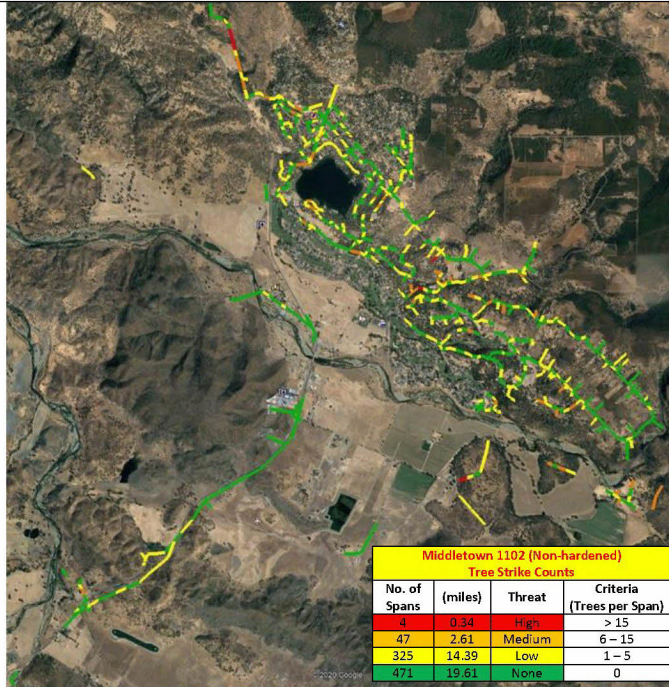
- * - Trees 6ft.kmz
- Trees that are within 6 ft of line
 - 0 span have more than 15 trees in each span that are within 6 ft
 - 0 span have 6 – 15 trees in each span that are within 6 ft
 - 4 spans have 1 – 5 trees in each span that are within 6 ft
 - 163 spans have zero tree in each span that are within 6 ft



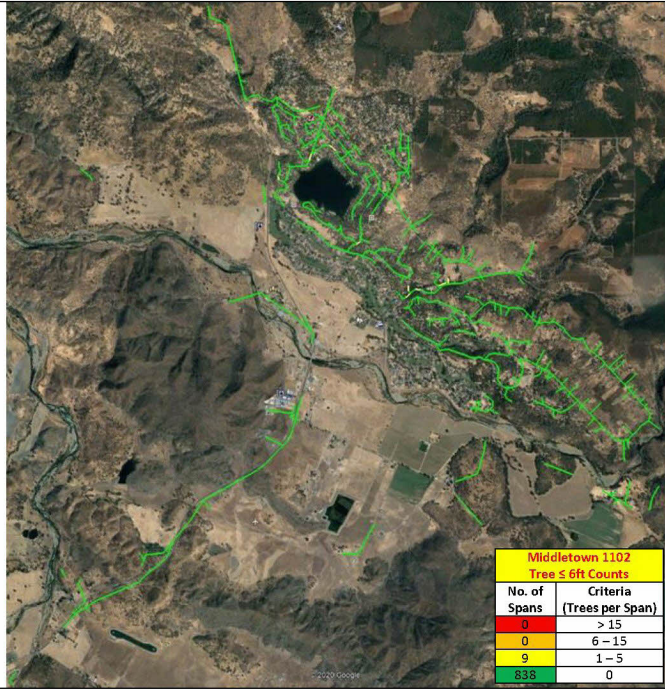


Middletown 1102

- * - Spans.kmz
- Based on 2019 LiDAR
- Trees that can touch the line
 - 4 spans have more than 15 trees in each span that can strike
 - 47 spans have 6 – 15 trees in each span that can strike
 - 325 spans have 1 – 5 trees in each span that can strike
 - 471 spans have zero tree in each span that can strike



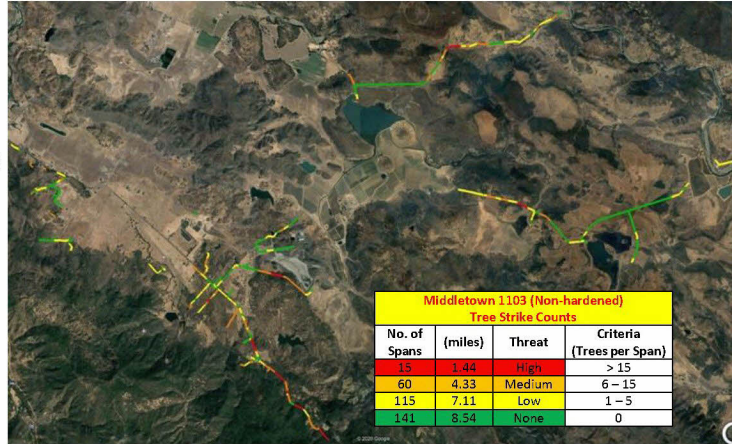
- * - Trees 6ft.kmz
- Trees that are within 6 ft of line
 - 0 span have more than 15 trees in each span that are within 6 ft
 - 0 span have 6 – 15 trees in each span that are within 6 ft
 - 9 spans have 1 – 5 trees in each span that are within 6 ft
 - 838 spans have zero tree in each span that are within 6 ft





Middletown 1103

- * - Spans.kmz
- Based on 2019 LiDAR
- Trees that can touch the line
 - 15 spans have more than 15 trees in each span that can strike
 - 60 spans have 6 – 15 trees in each span that can strike
 - 115 spans have 1 – 5 trees in each span that can strike
 - 141 spans have zero tree in each span that can strike



- * - Trees 6ft.kmz
- Trees that are within 6 ft of line
 - 0 span have more than 15 trees in each span that are within 6 ft
 - 0 span have 6 – 15 trees in each span that are within 6 ft
 - 5 spans have 1 – 5 trees in each span that are within 6 ft
 - 326 spans have zero tree in each span that are within 6 ft

