

Tree Strike Risk Calculation for

Upper Lake 1101
Keswick 1101
Middletown 1102
Middletown 1103
Konociti 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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a Better California

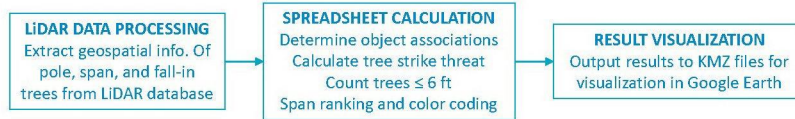
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CALCULATION WORKFLOW

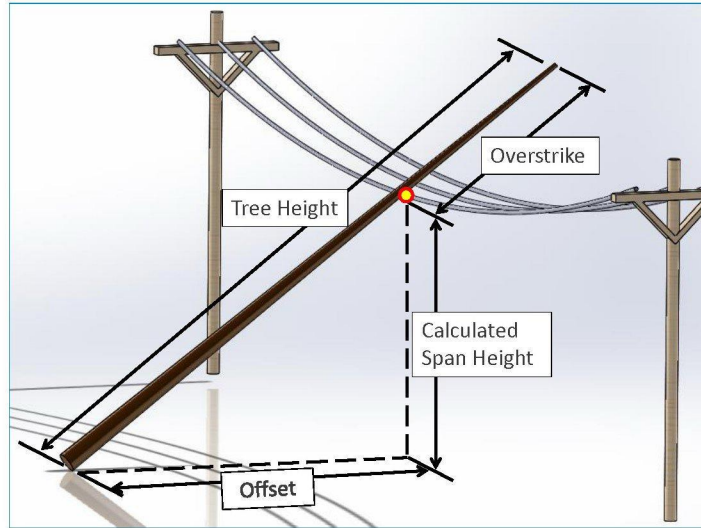
- LiDAR data processing
 - Extract pole, span, and fall-in tree geospatial information from LiDAR database
- Import processed data into Excel spreadsheet
 - Determine Tree–Span–Pole associations based on the LiDAR geospatial info
 - **Tree strike threat:** Calculate number of fall-in trees in each span 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

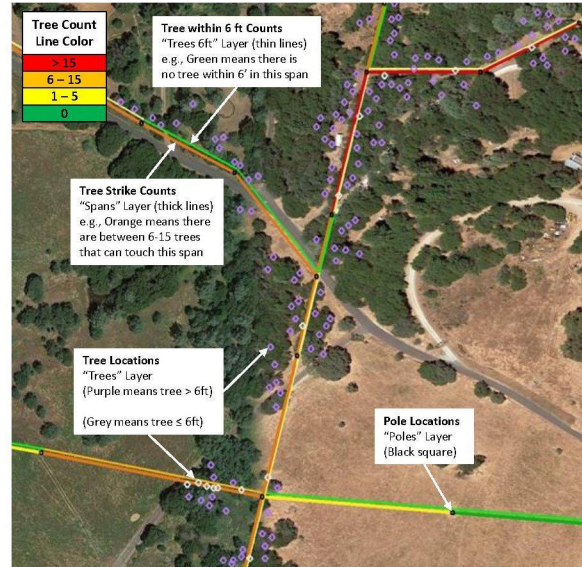
- Tree-Span relationship is tagged in LiDAR (see figure)
- All fall-in trees have potential to strike the span regardless of wind speed and wind direction
- Tree strike failure is counted as true when a tree is tagged as fall-in with non-zero Overstrike
- Spans are ranked based on the number of fall-in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



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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 |

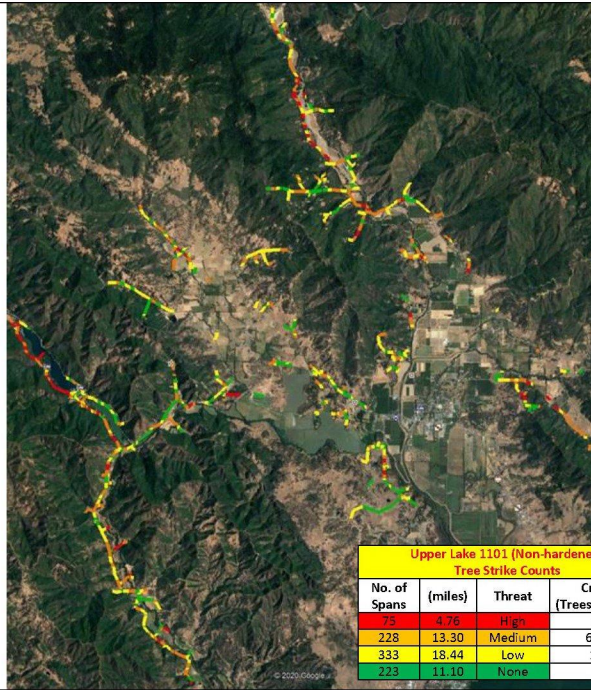
Middletown 1103

| 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 |



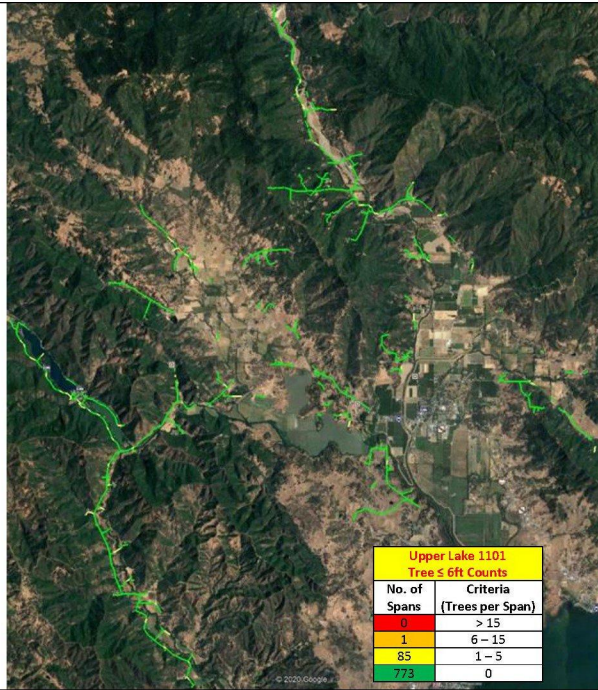
Upper Lake 1101

- * - 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



| Upper Lake 1101 (Non-hardened) Tree Strike Counts | | | |
|--|---------|--------|---------------------------|
| No. of Spans | (miles) | Threat | Criteria (Trees per Span) |
| 75 | 4.76 | High | > 15 |
| 228 | 13.30 | Medium | 6 – 15 |
| 333 | 18.44 | Low | 1 – 5 |
| 223 | 11.10 | 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
 - 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

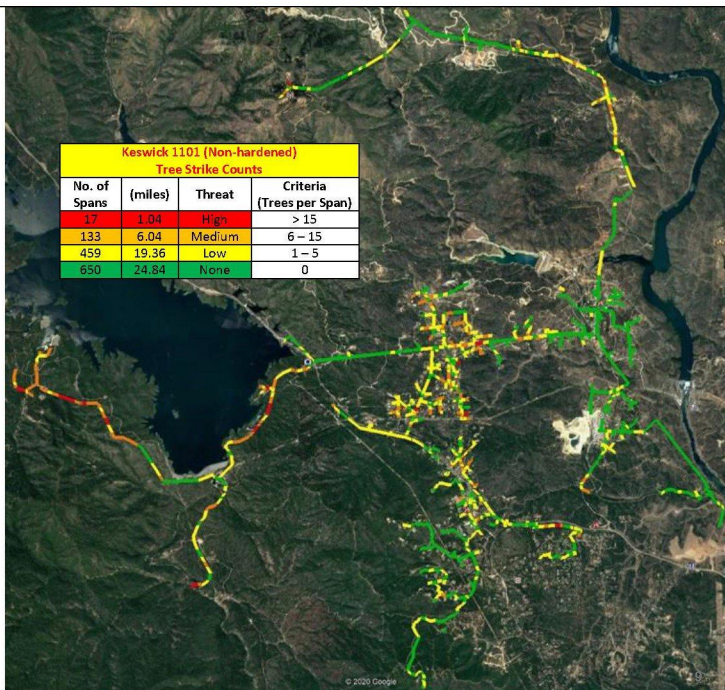




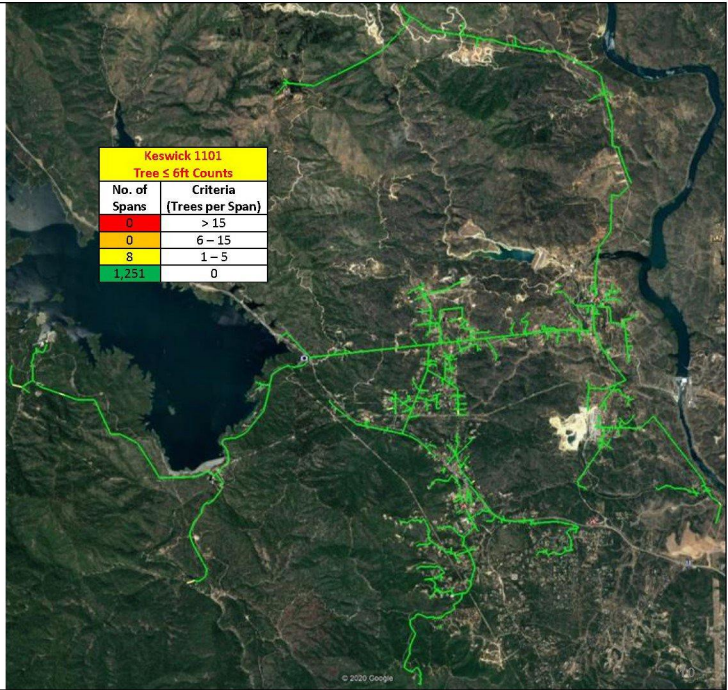
Keswick 1101

- * - 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

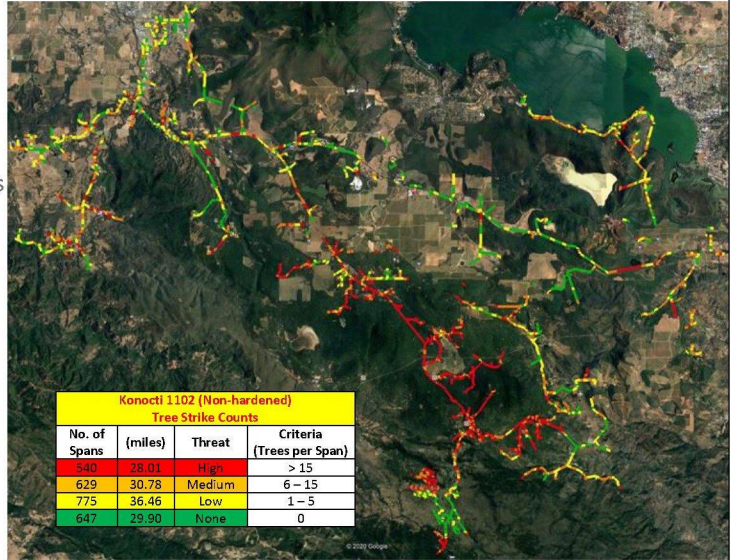


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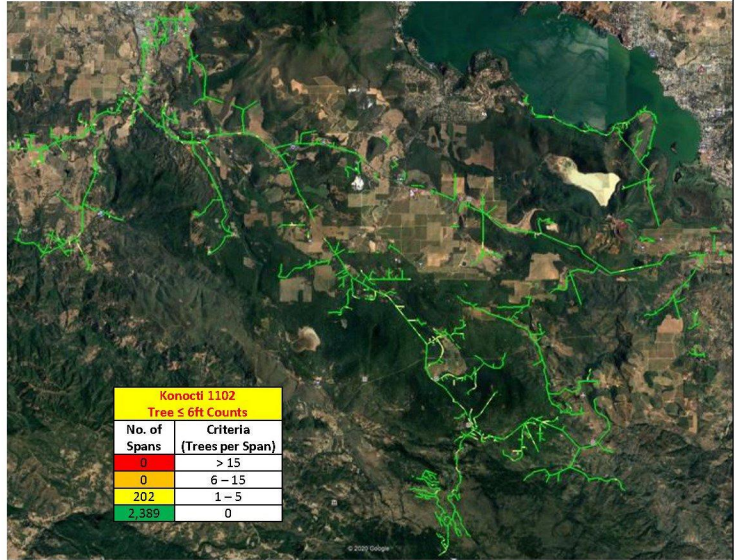


Konocti 1102

- * - 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

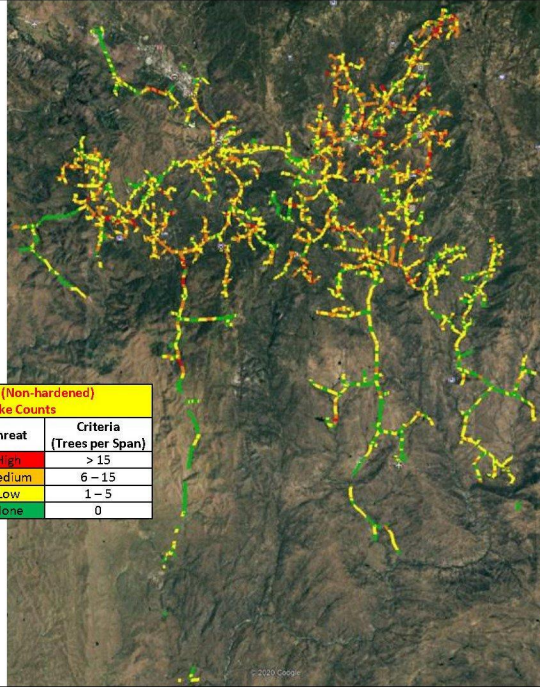




Mariposa 2102

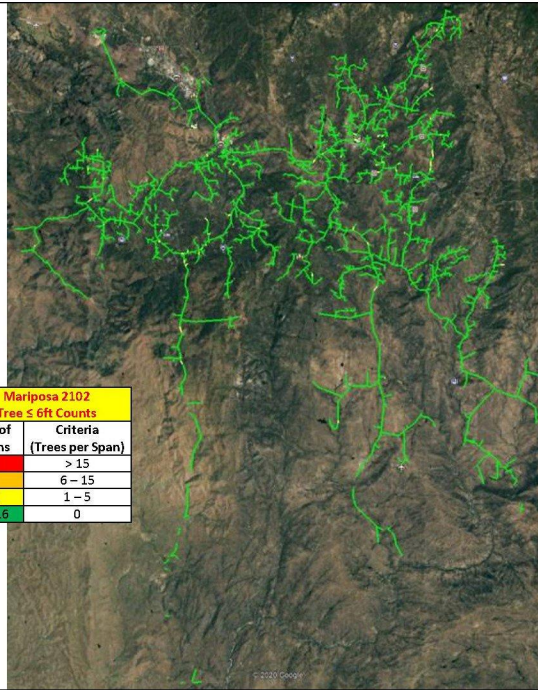
- * - Spans.kmz
- Based on 2019 LiDAR
- Trees that can touch the line
 - 110 spans have more than 15 trees in each span that can strike
 - 1,063 spans have 6 – 15 trees in each span that can strike
 - 2,382 spans have 1 – 5 trees in each span that can strike
 - 1,032 spans have zero tree in each span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

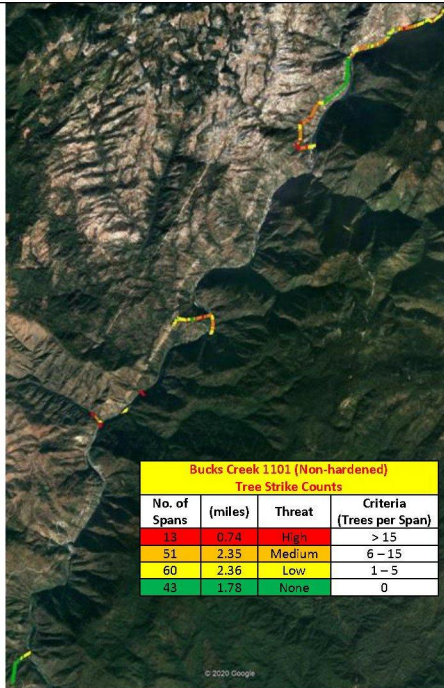
| Mariposa 2102 Tree ≤ 6ft Counts | |
|------------------------------------|---------------------------|
| No. of Spans | Criteria (Trees per Span) |
| 0 | > 15 |
| 0 | 6 – 15 |
| 71 | 1 – 5 |
| 4,516 | 0 |





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



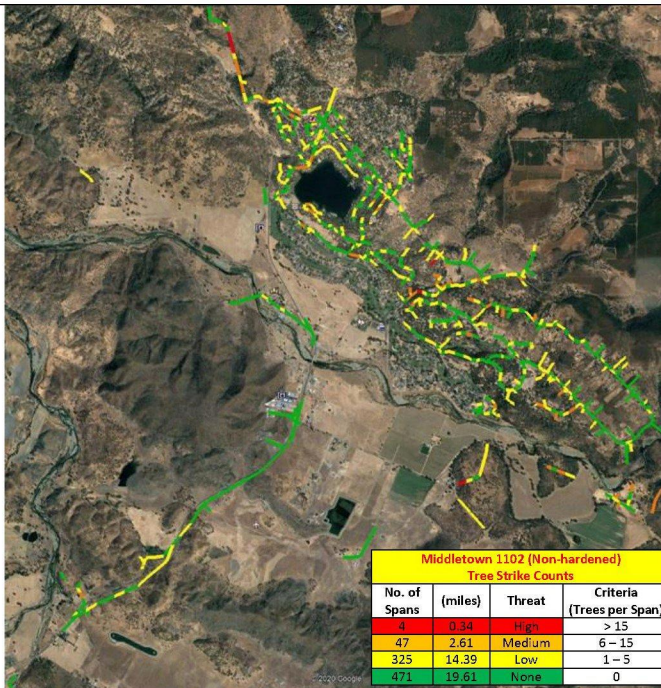
- * - Trees 6ft.kmz
- Trees that are within 6 ft of line
 - 0 span have more than 15 trees in each span that are within 6 ft
 - 0 span have 6 – 15 trees in each span that are within 6 ft
 - 4 spans have 1 – 5 trees in each span that are within 6 ft
 - 163 spans have zero tree in each span that are within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



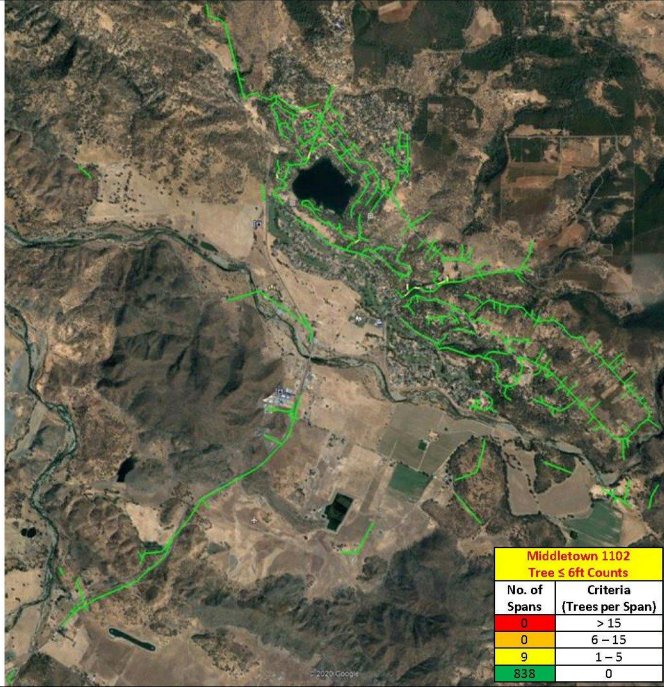


Middletown 1102

- * - 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



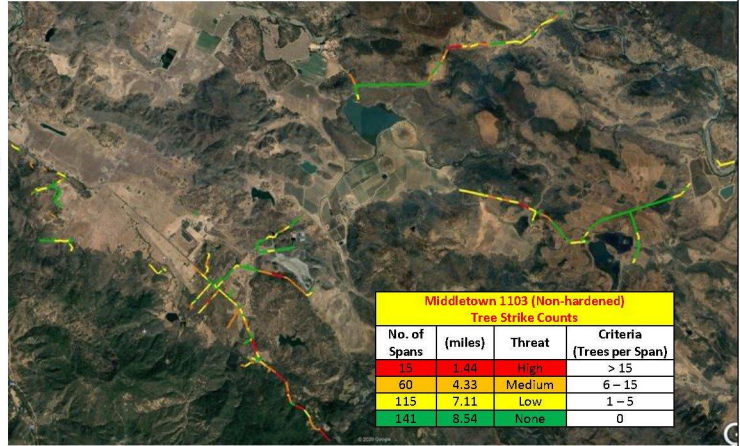
- * - Trees 6ft.kmz
- Trees that are within 6 ft of line
 - 0 span have more than 15 trees in each span that are within 6 ft
 - 0 span have 6 – 15 trees in each span that are within 6 ft
 - 9 spans have 1 – 5 trees in each span that are within 6 ft
 - 838 spans have zero tree in each span that are within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

