Liberty®

Liberty 2023-2025 Wildfire Mitigation Plan

July 8, 2024

OEIS Docket Name: 2023 to 2025 Electrical Corporation Wildfire Mitigation Plans

OEIS Docket Number: #2023-2025-WMPs

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1. Executive Summary

Instructions[1]: In the opening section of the WMP, the electrical corporation must provide an executive summary that is no longer than 10 pages. The executive summary must provide brief narratives on each of the following topics.

Summary of the 2020–2022 WMP Cycle

The electrical corporation must provide a brief overview of its progress in achieving the goals, objectives, and targets specified in the previous WMP submissions. The overview must discuss areas of success, areas for improvement, and any major lessons learned.

Liberty's 2020-2022 Wildfire Mitigation Plans ("WMP") detailed Liberty's actionable plan and continued development across all WMP categories. Over the 2020-2022 WMP cycle, Liberty made significant progress to implement and integrate its wildfire mitigation planning into daily operations, maintenance and capital planning. Liberty's wildfire mitigation efforts have been an effective source to track risk reduction and improve efficiency through innovative system technologies.

Areas of focus include continued grid hardening initiatives, increased use of situational awareness tools, enhancement of data collection and analytics to inform reporting, risk modeling and decision-making, improvement of asset management and inspections processes, and increased preparedness for Public Safety Power Shutoff ("PSPS") events. As Liberty's wildfire mitigation efforts continue to advance, Liberty monitors and evaluates the implementation of its WMP initiatives to inform future planning. Table 1-1 provides areas of success, areas for improvement, and major lessons learned over the 2022-2023 WMP cycle.

Table 1-1. Liberty Areas of Success, Areas for Improvement and Major Lessons Learned over the 2020-2022 WMP Cycle

WMP Category	Areas of Success	Areas for Improvement and Major Lessons Learned
Risk Assessment and Mapping	Liberty's fire risk map and circuit risk analysis can be utilized as the baseline for Liberty's wildfire risk assessment. The designated high Reax wildfire areas can be used by operations and	Liberty will continue to participate in the Joint IOU Wildfire Risk Modeling Working Group to identify best practices across the California IOUs (*i.e.*, further

[1] Text in orange text boxes are instructions from OEIS Final Guidelines for 2023-2025 WMP.

WMP Category	Areas of Success	Areas for Improvement and Major Lessons Learned
	engineering for planning of wildfire mitigation work. Liberty has improved its reporting of outages and risk events to reduce occurrences in the “Other” and “Unknown” categories.	integration of community vulnerability, improvements to wildfire consequence modeling).
Situational Awareness	Continuous monitoring tools, such as Fire Potential Index (“FPI”), and installation of fault detection equipment has allowed Liberty to develop initial work processes and PSPS plans to monitor and adjust operations based on adverse conditions. Ongoing operational planning that fully utilizes real-time weather data, fault detection anomalies, and predictive wildfire assessment tools are in the early phases of full integration into Liberty work processes.	Planning and incorporating an effective situational awareness plan requires an interactive system of data collection, analysis, and work planning. Business processes are in the development phase for full integration of this system. Liberty faced delays in installing and deploying weather stations and distribution fault anticipation (“DFA”) technology. Liberty plans to assess its DFA Pilot Program in 2023 to determine if further investment in this program is prudent.
Grid Design and System Hardening	Liberty met or exceeded most grid hardening targets established in its 2022 WMP Update. Most notably, Liberty completed its targeted 9.6 miles of covered conductor projects and replaced 98% of the 231 poles targeted in 2022. Pre-WMP mandates, Liberty invested heavily in line rebuild projects (*e.g.*, 625/650 line, 7300 line, and Topaz) and other grid hardening efforts, particularly pole replacements and repairs, that are compliance-based remediation required of Liberty. Early covered conductor projects were planned using subject matter expert (“SME”) judgement on which circuit segments to rebuild.	Liberty did not meet all grid hardening targets over the 2020-2022 WMP cycle (*e.g.*, 2021 covered conductor, pole replacements, fuse replacements, and tree attachment removals) primarily because the Tamarack and Caldor fires in Liberty’s service territory significantly impacted line construction resource availability and supply chain issues impacted material availability. Rather than automatically rolling missed targets into the subsequent year, Liberty assesses its initiatives every year and makes decisions informed by its risk assessment, resource constraints and cost impacts.

WMP Category	Areas of Success	Areas for Improvement and Major Lessons Learned
Asset Management and Inspections	Liberty continues to work on repairs found during the 2020 full system survey, prioritizing repairs by G.O. 95 level and wildfire risk, where applicable. Liberty developed and implemented a QA/QC Program for asset inspections in 2022 that will be further developed in 2023.	The system survey that Liberty completed in 2020 generated a significant number of G.O. 95-related repairs that Liberty is working to complete. The survey also revealed that not all field changes had been tracked in an accurate or timely manner and that improvements to those processes needed to be made so the system maintains a high level of accuracy. In the future, if Liberty completes another full system survey, the system will be surveyed over two years instead of one. Ground-based inspections have limitations, which is why Liberty is considering other technologies, such as infrared inspections, to enhance inspection practices.
Vegetation Management and Inspections	Liberty's portfolio of vegetation management initiatives operates together to provide a defense in depth strategy to efficiently manage vegetation and risks associated along its system. Liberty has recognized the importance of utilizing emerging technology to make data-driven and risk-informed decisions to prioritize vegetation management work. In 2020, Liberty piloted LiDAR inspections on its South Lake Tahoe circuits to identify and mitigate encroachments. Liberty implemented LiDAR inspections on its entire service territory in 2021 and 2022 to continue to efficiently manage tree clearances. Liberty intends to explore use cases for tree health monitoring and further risk analysis utilizing LiDAR technology. Liberty successfully implemented its formalized QA/QC program to verify	Liberty intends to continue LiDAR inspections of vegetation around electric facilities on an annual basis to manage tree encroachments. Liberty is exploring using LiDAR technology to identify locations affected by tree mortality and other vegetation and location risk factors. Liberty will continue to monitor change detection on an annual basis to recognize workload trends and to inform program decisions. Liberty will continue to streamline efficiencies and the integration of its portfolio of vegetation initiatives to cooperatively manage vegetation along its system.

WMP Category	Areas of Success	Areas for Improvement and Major Lessons Learned
	effectiveness of vegetation management practices in 2021. Liberty made notable achievements in fuel management work by removing more than 2,100 tons of additional biomass from the landscape in 2021 and clearing 515 acres in 2022.	
Grid Operations and Protocols	Over the 2020-2022 WMP cycle, Liberty developed, implemented, and improved PSPS operations and communications protocols. These protocols, in combination with the development of the FPI and PSPS forecasting tools have helped to inform day-to-day operational decision-making. While Liberty did not initiate any PSPS events in 2020-2022, Liberty did activate its Emergency Operations Center ("EOC") in September 2021 to begin coordinating response operations associated with an elevated weather event with the potential for employment of Liberty's PSPS protocol. In addition to considering the input from Liberty's fire science consultant, Reax, which monitored available weather data, Liberty mobilized on-the-ground resources to patrol and assess local conditions. These circuit crews provided input based on real-time risk assessments in the field. In addition to real-time weather conditions, the EOC reviewed and considered local system conditions, input from public safety partners, alternatives to de-energization, and mitigation options.	Liberty will continue to work to improve FPI and PSPS forecast accuracy and will incorporate additional model forecast data into the existing tools where possible. Liberty continued to explore the use of fast trip/one-shot setting during high fire threat days to limit energy to overhead faults and minimize the chance of ignition. Liberty also continued its assessment for pursuing expanded use of fault detection with communications to determine more quickly the location of a fault when using fast trips to mitigate larger or longer outages.

WMP Category	Areas of Success	Areas for Improvement and Major Lessons Learned
Emergency Planning and Preparedness	In 2021, Liberty successfully implemented four major activations of its Emergency Operations Plan. Activations occurred in response to the Tamarack Fire on July 16, 2021, the Caldor Fire on August 30, 2021, a potential PSPS on September 16, 2021, and a winter storm response on December 23, 2021. Liberty developed and implemented a PSPS Playbook for communications and operation protocols during potential PSPS events. Liberty has made significant improvements to its Access and Functional Needs ("AFN") Plan.	Liberty streamlined Incident Command meetings by briefing operations first to develop an action plan prior to meeting with the entire Incident Management Team ("IMT").
Stakeholder Cooperation and Community Engagement	In 2021, Liberty launched a digital ad campaign specific to wildfire mitigation and PSPS preparation and awareness. Topics included defensible space, emergency preparedness, medical baseline program information, general PSPS information and preparation tips, communication of PSPS public workshops and the importance of updating contact information in Liberty systems to enable PSPS and emergency notifications.	A major lesson learned for Liberty throughout the 2020-2022 WMP cycle was that the engagement of Community-Based Organizations ("CBOs") and Public Safety Partners ("PSPs") are essential to reaching and preparing customers and stakeholders for potential PSPS events. An increased focus on these relationships and communication has driven Liberty to perform additional outreach, feedback collection, and networking. Additional positions were added in 2021 to expand CBO relationship networks and communications channels, including a bilingual Outreach Coordinator. CBO feedback gathered through surveys has informed the outreach and communications approach in a few ways, including highlighted effectiveness of increased use of email and local media driving website traffic to existing PSPS information. Increased messaging around preparation of emergency kits and readiness was also a focus for Liberty in 2022.

Summary of the 2023–2025 Base WMP

The electrical corporation must summarize the primary goal, plan objectives, and framework for the development of the WMP for the three-year cycle. The electrical corporation may use a combination of brief narratives and bulleted lists.

Liberty's primary goal for its WMP is to construct, maintain and operate its electrical lines and equipment in a manner that will minimize the risk of catastrophic wildfire posed by those electrical lines and equipment.

Liberty's wildfire mitigation strategy development and underlying risk assessment have advanced significantly since 2020, and Liberty plans to continue to improve its overall wildfire mitigation planning in the future and to continue to evolve and improve its risk modeling practices in accordance with the OEIS Technical Guidelines.

For its 2023 WMP, Liberty assessed grid hardening efforts, such as covered conductor projects, asset repairs, and replacements completed in recent years along with enhanced vegetation management work to review holistically what is effectively working system-wide to reduce wildfire risk. Liberty has collected risk-related data over the years that once consolidated in a risk-based decision-making framework, will enable Liberty to use data analytics to assess baseline risk at the circuit level. This assessment will have asset risk scores and tree risk scores at the location level for management to plan the best portfolio of mitigations - grid operations, asset inspections, situational awareness, vegetation management to reduce consequences of a fire or a PSPS event. To the extent possible, Liberty's risk mitigation planning in 2023 utilized updated risk metrics and analyses available in conjunction with subject matter expertise from operations, vegetation management, wildfire prevention, and engineering. This collaborative approach and information sharing between the various work groups is a significant improvement to Liberty's previous WMP submissions. Implementation of risk analytics and data consolidation will continue to improve Liberty's overall wildfire mitigation planning in the future.

Liberty's objectives over the 2023-2025 WMP cycle include:

<u>Risk Analysis</u>:

- Develop circuit segment wildfire and PSPS risk scores that factor in weighted asset risk of failure with vegetation contact risk to plan for effective mix of mitigations.
- Develop baseline risk scores at the circuit level and at the overall system level.
- Improve risk-based decision-making framework using risk models and analyses (*e.g.*, Technosylva's Wildfire Risk Reduction Model ("WRRM"), pole risk and investment

optimization models and process flow charts, wildfire and PSPS consequence models with social vulnerabilities factored, weather analytics for situational awareness and mitigation planning).

Grid Hardening:

- Continue compliance-based pole replacements and repairs and target new locations based on Technosylva's WRRM analyses.
- Evaluate the appropriate mitigations for the highest wildfire risk areas in Liberty's service territory. The evaluation process and risk assessment will consider:
    - The percentage of Liberty's system that is newly rebuilt, including the number of poles and line miles replaced since 2019 (*i.e.*, covered conductor projects, G.O. 165 survey repairs and replacements, fire-damage replacements, distribution line rebuilds).
    - The number of equipment repairs on overhead ("OH") poles since 2019 (*i.e.*, OH service failures, storms, G.O. 165 repairs).
    - Substation upgrades and rebuilds. Liberty has replaced oil-filled circuit breakers and wooden substructures and has improved its defensible vegetation clearance around substations.

Vegetation Management:

- Maintain current VM program.
- Complete effectiveness of enhanced clearances study.
- Complete vegetation risk modeling.
- Complete fall-in risk scoring model pilot.
- Implement Integrated Vegetation Management ("IVM") monitoring program.
- Develop Utility Arborist training program for Liberty's service area.

Situational Awareness:

- Determine optimal weather station network capacity.
- Implement maintenance program for weather stations.
- Research emerging technologies for future fault detection pilot programs.
- Partner with AlertWildfire to own and operate cameras to track smoke and fires.
- Implement new technologies, if available (*i.e.*, AI smoke detection), to identify ignitions more quickly.
- Improve weather forecasting capabilities as models improve or additional data becomes available.

<u>Emergency Management and Stakeholder Collaboration</u>:

- Update workforce training on incident Command System ("ICS").
- Maintain Emergency Response Plans.
- Engage with local stakeholders to prepare for and respond to fire-related events.
- Enhance documentation and use of lessons learned to update plans.
- Increase granularity and customization of response plans.
- Implement planned communication channels and technologies with customers, community, and stakeholders.
- Collaborate with CBO networks to support, educate, notify, and prepare AFN communities.
- Collaborate with public safety partners to support, educate, notify, and prepare AFN communities.
- Support bilingual outreach through the utilization of bilingual outreach coordinator.
- Identify improvements to overall accessibility of information available to AFN customers.
- Encourage self-identification of AFN customers through targeted outreach and communications.
- Hold regular PSPS coordination meetings with Tahoe Donner Public Utility District and NV Energy.
- Communicate effectively with stakeholders through tailored approaches for outreach, engagement, and information exchange with customers, communities, and stakeholders based on various groups' unique needs. Identify emerging channels and technologies to better communicate with customers, community, and stakeholders.

2. Responsible Persons

The electrical corporation must list those responsible for executing the WMP, including:

- Executive-level owner with overall responsibility
- Program owners with responsibility for each of the main components of the plan
- As applicable, general ownership for questions related to or activities described in the WMP

Titles, credentials, and components of responsible person(s) must be released publicly. Electrical corporations can reference the WMP Process and Evaluation Guidelines and California Code of Regulations Title 14 section 29200 for the submission process of any confidential information.

Executive-level owner with overall responsibility

- Name and title: Edward Jackson, President, California
- Email: Redacted
- Phone number: Redacted

Program owners specific to each section of the plan

Section 1: Executive Summary

- Name and title: Eliot Jones, Senior Manager, Wildfire Prevention
- Email: Redacted
- Phone number: Redacted
- Component: Wildfire Prevention

- Name and title: Lindsay Maruncic, Senior Director, Operations
- Email: Redacted
- Phone number: Redacted
- Component: Operations

- Name and title: Rick Dalton, Senior Director, Engineering
- Email: Redacted
- Phone number: Redacted
- Component: Grid Hardening

- Name and title: Jordan Parrillo, Manager, Rates and Regulatory Affairs
- Email: Redacted
- Phone number: Redacted
- Component: Regulatory

Section 2: Responsible Persons

- Name and title: Jordan Parrillo, Manager, Rates and Regulatory Affairs
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Section 3: Statutory Requirements Checklist

- Name and title: Jordan Parrillo, Manager, Rates and Regulatory Affairs
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Section 4: Overview of WMP

- Name and title: Eliot Jones, Senior Manager, Wildfire Prevention
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- Name and title: Lindsay Maruncic, Senior Director, Operations
- Email: Redacted
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- Component: Operations

- Name and title: Rick Dalton, Senior Director, Engineering
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- Phone number: Redacted
- Component: Grid Hardening

Section 5: Overview of Service Territory

- Name and title: Eliot Jones, Senior Manager, Wildfire Prevention
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- Phone number: Redacted
- Component: Wildfire Prevention

Section 6: Risk Methodology and Assessment

- Name and title: Eliot Jones, Senior Manager, Wildfire Prevention
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- Component: Wildfire Prevention

- Name and title: Cynthia Fisher, Manager, Rates and Regulatory Affairs
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- Component: Wildfire Risk

Section 7: Wildfire Mitigation Strategy Development

- Name and title: Eliot Jones, Senior Manager, Wildfire Prevention
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- Component: Operations

- Name and title: Rick Dalton, Senior Director, Engineering
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- Phone number: Redacted
- Component: Grid Hardening

Section 8: Wildfire Mitigations

- Name and title: Eliot Jones, Senior Manager, Wildfire Prevention
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- Name and title: Rick Dalton, Senior Director, Engineering
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- Phone number: Redacted
- Component: Grid Hardening

- Name and title: Blaine Ladd, Director, Operations
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- Component: Operations

- Name and title: Peter Stoltman, Manager, Vegetation Management
- Email: Redacted
- Phone number: Redacted
- Component: Vegetation Management

- Name and title: Leonard Kiolbasa, Manager, Emergency Management
- Email: Redacted
- Phone number: Redacted
- Component: Emergency Management

- Name and title: Kate Marrone, Manager, Business and Community Development
- Email: Redacted
- Phone number: Redacted
- Component: Emergency Planning and Preparedness; Stakeholder Cooperation and Community Engagement

- Name and title: Alison Vai, Senior Manager, Marketing and Communications
- Email: Redacted
- Phone number: Redacted
- Component: Stakeholder Cooperation and Community Engagement

Section 9: Public Safety Power Shutoff

- Name and title: Eliot Jones, Senior Manager, Wildfire Prevention
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- Component: Wildfire Prevention

- Name and title: Lindsay Maruncic, Senior Director, Operations
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- Component: Operations

- Name and title: Leonard Kiolbasa, Manager, Emergency Management
- Email: Redacted
- Phone number: Redacted
- Component: Emergency Management

- Name and title: Kate Marrone, Manager, Business and Community Development
- Email: Redacted
- Phone number: Redacted
- Component: Emergency Planning and Preparedness; Stakeholder Cooperation and Community Engagement

Section 10: Lessons Learned

- Name and title: Eliot Jones, Senior Manager, Wildfire Prevention
- Email: Redacted
- Phone number: Redacted
- Component: Wildfire Prevention

Section 11: Corrective Actions Program

- Name and title: Eliot Jones, Senior Manager, Wildfire Prevention
- Email: Redacted

- Phone number: Redacted
- Component: Wildfire Prevention

Section 12: Notice of Violation and Defect

- Name and title: Eliot Jones, Senior Manager, Wildfire Prevention
- Email: Redacted
- Phone number: Redacted
- Component: Wildfire Prevention

Appendix A: Definitions

- Name and title: Jordan Parrillo, Manager, Rates and Regulatory Affairs
- Email: Redacted
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- Component: Regulatory

Appendix B: Supporting Documentation for Risk Assessment

- Name and title: Eliot Jones, Senior Manager, Wildfire Prevention
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- Phone number: Redacted
- Component: Wildfire Prevention

- Name and title: Cynthia Fisher, Manager, Rates and Regulatory Affairs
- Email: Redacted
- Phone number: Redacted
- Component: Wildfire Risk

Appendix C: Additional Maps

- Name and title: Eliot Jones, Senior Manager, Wildfire Prevention
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- Component: Wildfire Prevention

Appendix D: Areas for Continued Improvement

- Name and title: Eliot Jones, Senior Manager, Wildfire Prevention
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- Phone number: Redacted
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- Name and title: Jordan Parrillo, Manager, Rates and Regulatory Affairs
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- Component: Regulatory

Appendix E: Referenced Regulations, Codes and Standards

- Name and title: Jordan Parrillo, Manager, Rates and Regulatory Affairs
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- Component: Regulatory

3. Statutory Requirements Checklist

This section provides a checklist of the statutory requirements for a WMP as detailed in Public Utilities Code section 8386(c). By completing the checklist, the electrical corporation affirms that its WMP addresses each requirement.

For each statutory requirement, the checklist must include a reference and hyperlink to the relevant section and page number in the WMP. Where multiple WMP sections provide the information for a specific requirement, the electrical corporation must provide references and hyperlinks to all relevant sections. Unique references must be separated by semicolons, and each must include a brief summary of the contents of the referenced section (*e.g.*, Section 5, pp. 30–32 [workforce]; Section 7, p. 43 [mutual assistance]).

Liberty provides its statutory requirements checklist in Table 3-1.

Table 3-1. Liberty Statutory Requirements Checklist

Public Utilities Code section 8386	Description	WMP Section/Page
(c)(1)	An accounting of the responsibilities of persons responsible for executing the plan.	Section 2, pp. 9-15 (responsible persons)
(c)(2)	The objectives of the WMP	Section 4.1, p. 27 (Primary goal of WMP) Section 4.2, pp. 27-29 (WMP objectives over the 2023-2025 WMP cycle) Section 8.1.1.1, pp. 145-155 (grid design, operations, and maintenance objectives) Section 8.2.1.1, pp. 204-206 (vegetation management objectives)

Public Utilities Code section 8386	Description	WMP Section/Page
		Section 8.3.1.1, pp. 257-258 (situational awareness and forecasting objectives) Section 8.4.1.1, pp. 284-286 (emergency preparedness objectives) Section 8.5.1.1, pp. 346-349 (community outreach objectives) Section 9.1.3, pp. 373-375 (PSPS objectives)
(c)(3)	A description of the preventive strategies and programs to be adopted by the electrical corporation to minimize the risk of its electrical lines and equipment causing catastrophic wildfires, including consideration of dynamic climate change risks.	Section 4.4, pp. 31-32 (risk-informed framework) Section 5.3.4, pp. 44-51 (climate change) Section 6, pp. 64-110 (risk methodology and assessment) Section 7, pp. 111-144 (Wildfire mitigation strategy development) Section 8.1.1.1, pp. 145-155 (grid design, operations, and maintenance objectives) Section 8.2.1.1, pp. 204-206 (vegetation management objectives)

Public Utilities Code section 8386	Description	WMP Section/Page
		Section 8.3.1.1, pp. 257-258 (situational awareness and forecasting objectives) Section 8.4.1.1, pp. 284-286 (emergency preparedness objectives) Section 8.5.1.1, pp. 346-349 (community outreach objectives) Section 9.1.3, pp. 373-375 (PSPS objectives)
(c)(4)	A description of the metrics the electrical corporation plans to use to evaluate the plan's performance and the assumptions that underlie the use of those metrics.	Section 6.4.3, pp. 96-97 (risk analysis results – other key metrics) Section 8.1.1.3, pp. 154-155 (grid design, operations, and maintenance performance metrics) Section 8.2.1.3, pp. 210--211 (vegetation management performance metrics) Section 8.3.1.3, p. 261 (situational awareness and forecasting performance metrics) Section 8.4.1.3, pp. 289-290 (emergency preparedness performance metrics)

Public Utilities Code section 8386	Description	WMP Section/Page
		Section 8.5.1.3, pp. 353-354 (community outreach and engagement performance metrics) Section 9.1.5, pp. 379-381 (PSPS performance metrics)
(c)(5)	A discussion of how the application of previously identified metrics to previous plan performances has informed the plan.	Section 8, pp. 145-370 (wildfire mitigations) Section 10, pp. 392-397 (WMP lessons learned)
(c)(6)	A description of the electrical corporation's protocols for disabling reclosers and deenergizing portions of the electrical distribution system that consider the associated impacts on public safety. As part of these protocols, each electrical corporation shall include protocols related to mitigating the public safety impacts of disabling reclosers and deenergizing portions of the electrical distribution system that consider the impacts on all of the following:	Section 8.1.2.8, pp. 169 (installation of system automation equipment) Section 8.1.8, pp. 191-196 (grid operations and procedures)
(c)(6)(A)	Critical first responders.	Section 8.1.2.8, p. 169 (installation of system automation equipment) Section 8.1.8, pp. 191-196 (grid operations and procedures)

Public Utilities Code section 8386	Description	WMP Section/Page
(c)(6)(B)	Health and communication infrastructure.	Section 8.1.2.8, p. 169 (installation of system automation equipment) Section 8.1.8, pp. 191-196 (grid operations and procedures)
(c)(6)(C)	Customers who receive medical baseline allowances pursuant to subdivision (c) of Section 739. The electrical corporation may deploy backup electrical resources or provide financial assistance for backup electrical resources to a customer receiving a medical baseline allowance for a customer who meets all of the following requirements:	Section 8.1.2.8, p. 169 (installation of system automation equipment) Section 8.1.8, pp. 191-196 (grid operations and procedures)
(c)(6)(C)(i)	The customer relies on life-support equipment that operates on electricity to sustain life.	Section 8.1.2.8, p. 169 (installation of system automation equipment) Section 8.1.8, pp. 191-196 (grid operations and procedures)
(c)(6)(C)(ii)	The customer demonstrates financial need, including through enrollment in the California Alternate Rates for Energy program continued pursuant to Section 739.1.	Section 8.1.2.8, p. 169 (installation of system automation equipment) Section 8.1.8, pp. 191-196 (grid operations and procedures)

Public Utilities Code section 8386	Description	WMP Section/Page
(c)(6)(C)(iii)	The customer is not eligible for backup electrical resources provided through medical services, medical insurance, or community resources.	Section 8.1.2.8, p. 169 (installation of system automation equipment) Section 8.1.8, pp. 191-196 (grid operations and procedures)
(c)(6)(D)	Subparagraph (C) shall not be construed as preventing an electrical corporation from deploying backup electrical resources or providing financial assistance for backup electrical resources under any other authority.	Section 8.1.2.8, p. 169 (installation of system automation equipment) Section 8.1.8, pp. 191-196 (grid operations and procedures)
(c)(7)	A description of the electrical corporation's appropriate and feasible procedures for notifying a customer who may be impacted by the deenergizing of electrical lines, including procedures for those customers receiving medical baseline allowances as described in paragraph (6). The procedures shall direct notification to all public safety offices, critical first responders, health care facilities, and operators of telecommunications infrastructure with premises within the footprint of potential de energization for a given event. The procedures shall comply with any orders of the commission regarding notifications of de energization events.	Section 8.4.4, pp. 328-337 (public emergency communication strategy) Section 9, pp. 371-391 (Public Safety Power Shutoff)

Public Utilities Code section 8386	Description	WMP Section/Page
(c)(8)	Identification of circuits that have frequently been deenergized pursuant to a de energization event to mitigate the risk of wildfire and the measures taken, or planned to be taken, by the electrical corporation to reduce the need for, and impact of, future de energization of those circuits, including, but not limited to, the estimated annual decline in circuit de energization and de energization impact on customers, and replacing, hardening, or undergrounding any portion of the circuit or of upstream transmission or distribution lines.	Section 9.1.2, p.372 (identification of frequently de energized circuits)
(c)(9)	Plans for vegetation management.	Section 8.2, pp. 204-255 (vegetation management and inspections)
(c)(10)	Plans for inspections of the electrical corporation’s electrical infrastructure.	Section 8.1.3, pp. 173-180 (asset inspections)
(c)(11)	A description of the electrical corporation’s protocols for the de energization of the electrical corporation’s transmission infrastructure, for instances when the de energization may impact customers who, or entities that, are dependent upon the infrastructure. The protocols shall comply with any order of the commission regarding de energization events.	Section 9, pp. 371-391 (Public Safety Power Shutoff)

Public Utilities Code section 8386	**Description**	**WMP Section/Page**
(c)(12)	A list that identifies, describes, and prioritizes all wildfire risks, and drivers for those risks, throughout the electrical corporation’s service territory, including all relevant wildfire risk and risk mitigation information that is part of the commission’s Safety Model Assessment Proceeding (A.15-05-002, et al.) and the Risk Assessment Mitigation Phase filings. The list shall include, but not be limited to, both of the following:	Section 6, pp. 64-110 (risk methodology and assessment)
(c)(12)(A)	Risks and risk drivers associated with design, construction, operations, and maintenance of the electrical corporation’s equipment and facilities.	Section 6, pp. 64-110 (risk methodology and assessment)
(c)(12)(B)	Particular risks and risk drivers associated with topographic and climatological risk factors throughout the different parts of the electrical corporation’s service territory.	Section 6, pp. 64-110 (risk methodology and assessment)
(c)(13)	A description of how the plan accounts for the wildfire risk identified in the electrical corporation’s Risk Assessment Mitigation Phase filing.	Section 6, pp. 64-110 (risk methodology and assessment)
(c)(14)	A description of the actions the electrical corporation will take to ensure its system will achieve the highest level of safety, reliability, and resiliency, and to ensure that its system is prepared for a major event, including hardening and modernizing its infrastructure	Section 8.1, pp. 145-203 (grid design, operations, and maintenance)

Public Utilities Code section 8386	**Description**	**WMP Section/Page**
	with improved engineering, system design, standards, equipment, and facilities, such as undergrounding, insulating of distribution wires, and replacing poles.	
(c)(15)	A description of where and how the electrical corporation considered undergrounding electrical distribution lines within those areas of its service territory identified to have the highest wildfire risk in a commission fire threat map.	Section 8.1, pp. 145-203 (grid design, operations, and maintenance)
(c)(16)	A showing that the electrical corporation has an adequately sized and trained workforce to promptly restore service after a major event, taking into account employees of other utilities pursuant to mutual aid agreements and employees of entities that have entered into contracts with the electrical corporation.	Section 8.1, pp. 145-203 (grid design, operations, and maintenance)
(c)(17)	Identification of any geographic area in the electrical corporation's service territory that is a higher wildfire threat than is currently identified in a commission fire threat map, and where the commission should consider expanding the high fire threat district based on new information or changes in the environment.	Section 6.4.1, pp. 92-95 (risk analysis results and presentation – top risk areas within the HFRA)
(c)(18)	A methodology for identifying and presenting enterprise-wide safety risk and wildfire-related risk that is consistent with the methodology used by other electrical	Section 6, pp. 64-110 (risk methodology and assessment)

Public Utilities Code section 8386	Description	WMP Section/Page
	corporations unless the commission determines otherwise.	
(c)(19)	A description of how the plan is consistent with the electrical corporation's disaster and emergency preparedness plan prepared pursuant to Section 768.6, including both of the following:	Section 8.4, pp. 284-345 (emergency preparedness)
(c)(19)(A)	Plans to prepare for, and to restore service after, a wildfire, including workforce mobilization and prepositioning equipment and employees.	Section 8.4, pp. 284-345 (emergency preparedness)
(c)(19)(B)	Plans for community outreach and public awareness before, during, and after a wildfire, including language notification in English, Spanish, and the top three primary languages used in the state other than English or Spanish, as determined by the commission based on the United States Census data.	Section 8.5, pp. 345-370 (community outreach and engagement)
(c)(20)	A statement of how the electrical corporation will restore service after a wildfire.	Section 8.4.5, pp. 338-342 (preparedness and planning for service restoration)
(c)(21)	Protocols for compliance with requirements adopted by the commission regarding activities to support customers during and after a wildfire, outage reporting, support for low-income customers, billing adjustments, deposit waivers, extended payment plans,	Section 8.4.6, pp. 343-345 (customer support in wildfire and PSPS emergencies)

Public Utilities Code section 8386	Description	WMP Section/Page
	suspension of disconnection and nonpayment fees, repair processing and timing, access to electrical corporation representatives, and emergency communications.	Section 8.5, pp. 345-370 (community outreach and engagement)
(c)(22)	A description of the processes and procedures the electrical corporation will use to do all of the following:	Not applicable; header row
(c)(22)(A)	Monitor and audit the implementation of the plan.	Section 1, pp. 1-8 (executive summary) Section 10, pp. 392-397 (lessons learned) Section 11, pp. 398-402 (corrective action program)
(c)(22)(B)	Identify any deficiencies in the plan or the plan's implementation and correct those deficiencies.	Section 12, p. 403 (notices of violation and defect)
(c)(22)(C)	Monitor and audit the effectiveness of electrical line and equipment inspections, including inspections performed by contractors, carried out under the plan and other applicable statutes and commission rules.	Section 8.1, pp. 145-203 (grid design, operations, and maintenance)
(c)(23)	Any other information that the Wildfire Safety Division may require.	No additional information

4. Overview of WMP

4.1 Primary Goal

Each electrical corporation must state the primary goal of its WMP. At a minimum, the electrical corporation must affirm its compliance with California Public Utilities Code section 8386(a):

> *Each electrical corporation shall construct, maintain, and operate its electrical lines and equipment in a manner that will minimize the risk of catastrophic wildfire posed by those electrical lines and equipment.*

The primary goal of Liberty's WMP is to construct, maintain and operate its electrical lines and equipment in a manner that will minimize the risk of catastrophic wildfire posed by its electrical lines and equipment.

4.2 Plan Objectives

In this section, the electrical corporation must summarize its plan objectives over the 2023-2025 WMP cycle. Plan objectives are determined by the portfolio of mitigation initiatives proposed in the WMP.

Liberty's WMP objectives over the 2023-2025 WMP cycle include:

<u>Risk Analysis</u>:

- Develop circuit segment wildfire and PSPS risk scores that factor in weighted asset risk of failure with vegetation contact risk to plan for effective mix of mitigations.
- Develop baseline risk scores at the circuit level and at the overall system level.
- Improve risk-based decision-making framework using risk models and analyses (*e.g.*, Technosylva Wildfire Risk Reduction Model ("WRRM"), pole risk and investment optimization models and process flow charts, wildfire and PSPS consequence models with social vulnerabilities factored, weather analytics for situational awareness and mitigation planning).

<u>Grid Hardening</u>:

- Continue compliance-based pole replacements and repairs and target new locations based on Technosylva's WRRM analyses.
- Evaluate the appropriate mitigations for the highest wildfire risk areas in Liberty's service territory. The evaluation process and risk assessment will consider:

- The percentage of Liberty's system that is newly rebuilt, including the number of poles and line miles replaced since 2019 (*i.e.*, covered conductor projects, G.O. 165 survey repairs and replacements, fire-damage replacements, distribution line rebuilds).
- The number of equipment repairs on overhead ("OH") poles since 2019 (*i.e.*, OH service failures, storms, G.O. 165 repairs).
- Substation upgrades and rebuilds. Liberty has replaced oil-filled circuit breakers and wooden substructures and has improved its defensible vegetation clearance around substations.

Vegetation Management:

- Maintain current VM program.
- Complete effectiveness of enhanced clearances study.
- Complete vegetation risk modeling.
- Complete fall-in risk scoring model pilot.
- Implement Integrated Vegetation Management ("IVM") monitoring program.
- Develop utility arborist training program for Liberty's service area.

Situational Awareness:

- Determine weather station network capacity.
- Implement maintenance program for weather stations.
- Research emerging technologies for future fault detection pilot programs.
- Work with AlertWildfire to own and operate cameras to track smoke and fires.
- Implement new technologies if available (*i.e.*, AI smoke detection) to identify ignitions more quickly.
- Improve weather forecasting capabilities as models improve or additional data becomes available.

Emergency Management and Stakeholder Collaboration:

- ~~Update workforce training on incident Command System ("ICS").~~
- Maintain Emergency Response Plans.
- Engage with local stakeholders to prepare for and respond to fire-related events.
- Enhance documentation and use of lessons learned to update plans.
- ~~Increase granularity and customization of response plans.~~
- Implement planned communication channels and technologies with customers, community, and stakeholders.

- Collaborate with CBO networks to support, educate, notify, and prepare AFN communities.
- Collaborate with public safety partners to support, educate, notify, and prepare AFN communities.
- Support bilingual outreach through the utilization of bilingual outreach coordinator.
- Identify improvements to overall accessibility of information available to AFN customers.
- Encourage self-identification of AFN customers through targeted outreach and communications.
- Hold regular PSPS coordination meetings with Tahoe Donner Public Utility District and NV Energy.
- Communicate effectively with stakeholders through tailored approaches for outreach, engagement, and information exchange with customers, communities, and stakeholders based on various groups' unique needs. Identify emerging channels and technologies to better communicate with customers, community, and stakeholders.

4.3 Proposed Expenditures

Each electrical corporation must summarize its projected expenditures in thousands of U.S. dollars per year for the next three-year WMP cycle, as well as the planned and actual expenditures from the previous three-year WMP cycle (*e.g.*, 2020–2022), in both tabular and graph form.

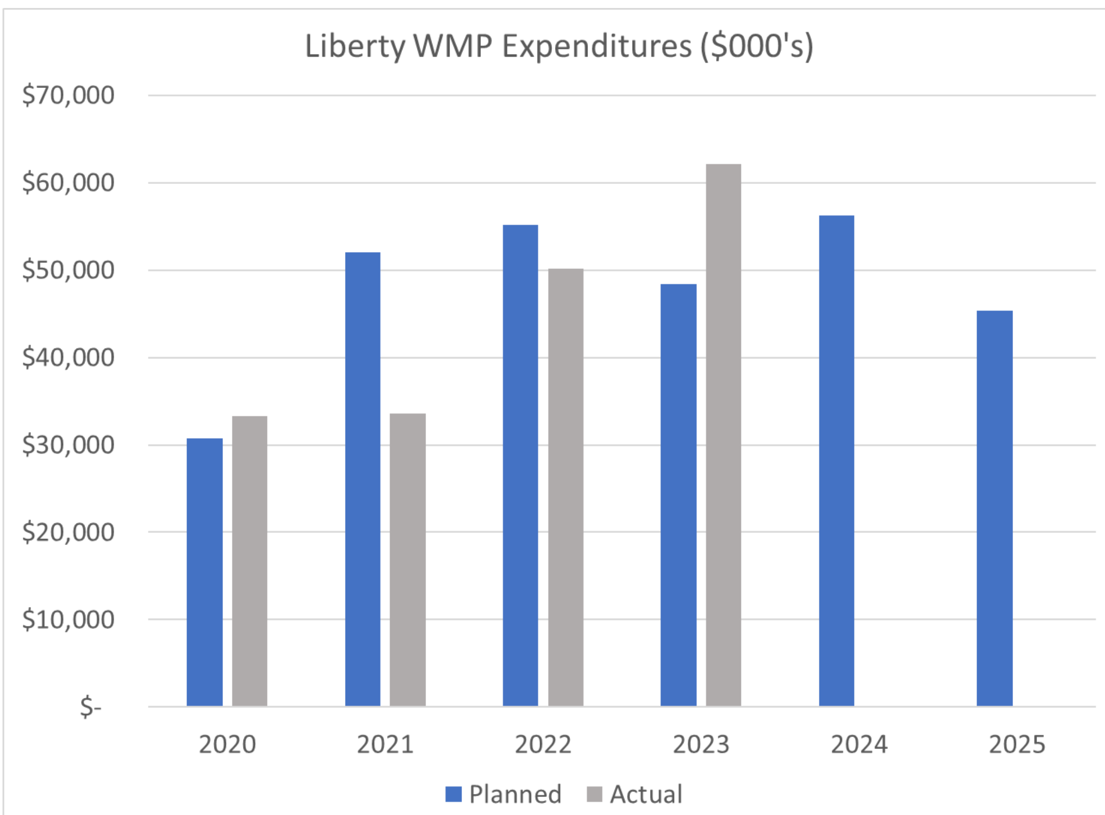
In Table 4-1, Liberty provides its actual expenditures from the previous 2020-2022 WMP cycle and planned expenditures for the 2023-2025 WMP cycle. In Figure 4-1, Liberty provides this information in graph form.

Table 4-1. Liberty WMP Expenditures

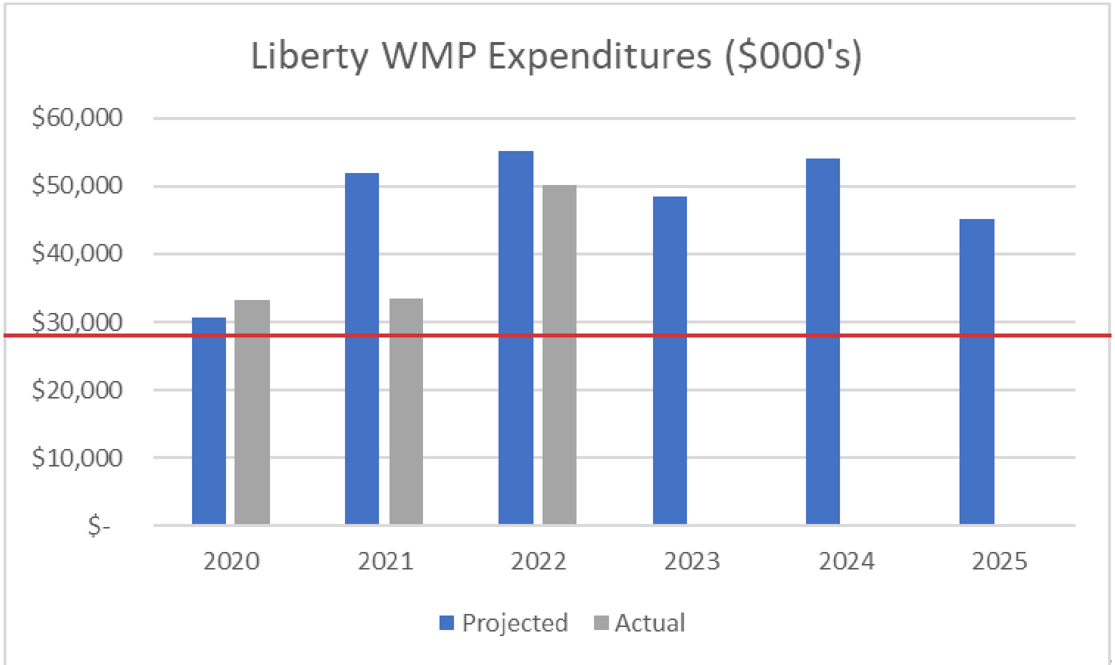
Year	**Spend ($ thousands)**
2020	Planned (as reported in the 2020 WMP) = $30,699 Actual = $33,331 ±△ = ~~-~~$2,632
2021	Planned (as reported in the 2021 WMP Update) = $52,007 Actual = $33,567 ±△ = -$18,440

Year	Spend ($ thousands)
2022	Planned (as reported in the 2022 WMP Update) = $55,126 Actual = $50,132 ±△ = -$4,994
2023	Planned = $48,391 Actual = $62,143 ±△ = $13,752
2024	Planned = $~~54,180~~56,262[2]
2025	Planned = $~~45,078~~45,346

Figure 4-1: Liberty WMP Expenditures



[2] Revised 2024 expenditures per Energy Safety Decision on Liberty Change Order Request in relation to its 2023-2025 Base WMP, July 1, 2024, p.6.



4.4 Risk-Informed Framework

The electrical corporation must adopt a risk-informed approach to developing its WMP. The purposes of adopting this approach are as follows:

- To develop a WMP that achieves an optimal level of life safety, property protection, and environmental protection, while also being in balance with other performance objectives (*e.g.*, reliability and affordability)
- To integrate risk modeling outcomes with a range of other performance objectives, methods, and subject matter expertise to inform decision-making processes and the spatiotemporal prioritization of mitigations
- To target mitigation efforts that prioritize the highest-risk equipment, wildfire environmental settings, and assets-at-risk (*e.g.*, people, communities, critical infrastructure), while still satisfying other performance objectives defined by the California Public Utilities Commission (CPUC) (*e.g.*, reliability and affordability)
- To provide a decision-making process that is clear and transparent to internal and external stakeholders, including clear evaluation criteria and visual aids (such as flow charts or decision trees)

The risk-informed approach adopted by the electrical corporation must, at a minimum, incorporate several key components, described below. In addition, the evaluation and management of risk must include consideration of a broad range of performance objectives (*e.g.*, life safety, property protection, reduction of social vulnerability, reliability, resiliency, affordability, health, environmental protection, public perception, etc.), integrate cross-disciplinary expertise, and engage various stakeholder groups as part of the decision-making process.

Liberty's risk-informed approach is described in Table 4-2.

Table 4-2. Risk-Informed Approach Components

Risk-Informed Approach Component	**Brief Description**
1. Goals and plan objectives	Sections 4.1 and 4.2 identify the primary goal(s) and plan objectives of Liberty's WMP.
2. Scope of application (*i.e.*, electrical corporation service territory)	Section 5 through Section 5.4 presents Liberty's electrical infrastructure, wildfire environmental characteristics, and potential assets at risk in its service territory.
3. Hazard identification	Section 6.2.1 identifies hazards and determines their likelihood.
4. Risk scenario identification	Section 6.3 provides risk scenario identification.
5. Risk analysis (*i.e.*, likelihood and consequences)	Section 6.2.2 evaluates the likelihood and consequences of the identified risk scenarios to understand the potential impact on the desired goal(s) and plan objectives. The consequences are based on an array of risk components that are fundamental to overall utility risk, wildfire risk, and PSPS risk given the electrical corporation's scope of application and portfolio of wildfire mitigation initiatives.
6. Risk presentation	Section 6.4 considers how the risk analysis is presented to the various stakeholders involved.
7. Risk evaluation	Section 7 includes identification of criteria and procedures for identifying critical risk both spatially and temporally. Risk

Risk-Informed Approach Component	Brief Description
	evaluation also includes evaluating the seriousness, manageability, urgency, and growth potential of the wildfire hazard/risk. Risk evaluation should be used to determine whether the individual hazard/risk should be mitigated. .
8. Risk mitigation and management	Section 8 provides Liberty’s strategy for mitigating risk at the initiative and portfolio view that prioritizes by time and location reductions to risk.

5. Overview of the Service Territory

In this section of the WMP, the electrical corporation must provide a high-level overview of its service territory and key characteristics of its electrical infrastructure. This information is intended to provide the reader with an understanding of the physical and technical scope of the electrical corporation's WMP. Sections 5.1 - 5.4 below provide detailed instructions.

5.1 Service Territory

The electrical corporation must provide a high-level description of its service territory, addressing the following components:[3]

- Area served (in square miles)
- Number of customers served

The electrical corporation must provide a geospatial map that shows its service territory (polygons) and distribution of customers served (raster or polygons). This map should appear in the main body of the report.

Liberty operates electrical infrastructure across 1,482 square miles of service territory, serving 47,954 total customers in Mono, Alpine, El Dorado, Placer, Nevada, Sierra, and Plumas counties. The main component of this service area consists of the 1,471 square miles adjacent to Lake Tahoe, from Topaz in the south, to South Lake Tahoe, North Lake Tahoe, and Loyalton. A much smaller section, consisting of 11 square miles, does not connect directly to the rest of the service area and serves only the Portola area in Plumas County.

Liberty's service territory consists mostly of rural communities with a few urban centers. Most residential customers served live in single-family homes, town homes, and duplexes. Terrain varies from flat land in South Lake Tahoe to slopes, ridges, and canyons in the western and northern areas of the service territory, with trees, brush, and timber throughout. Liberty's entire service territory is more than 5,000 feet above sea level. All of these factors present unique challenges to maintaining efficient and reliable service.

Table 5-1 provides high-level service territory statistics and Figure 5-1 is a map of Liberty's service territory and the distribution of customers.

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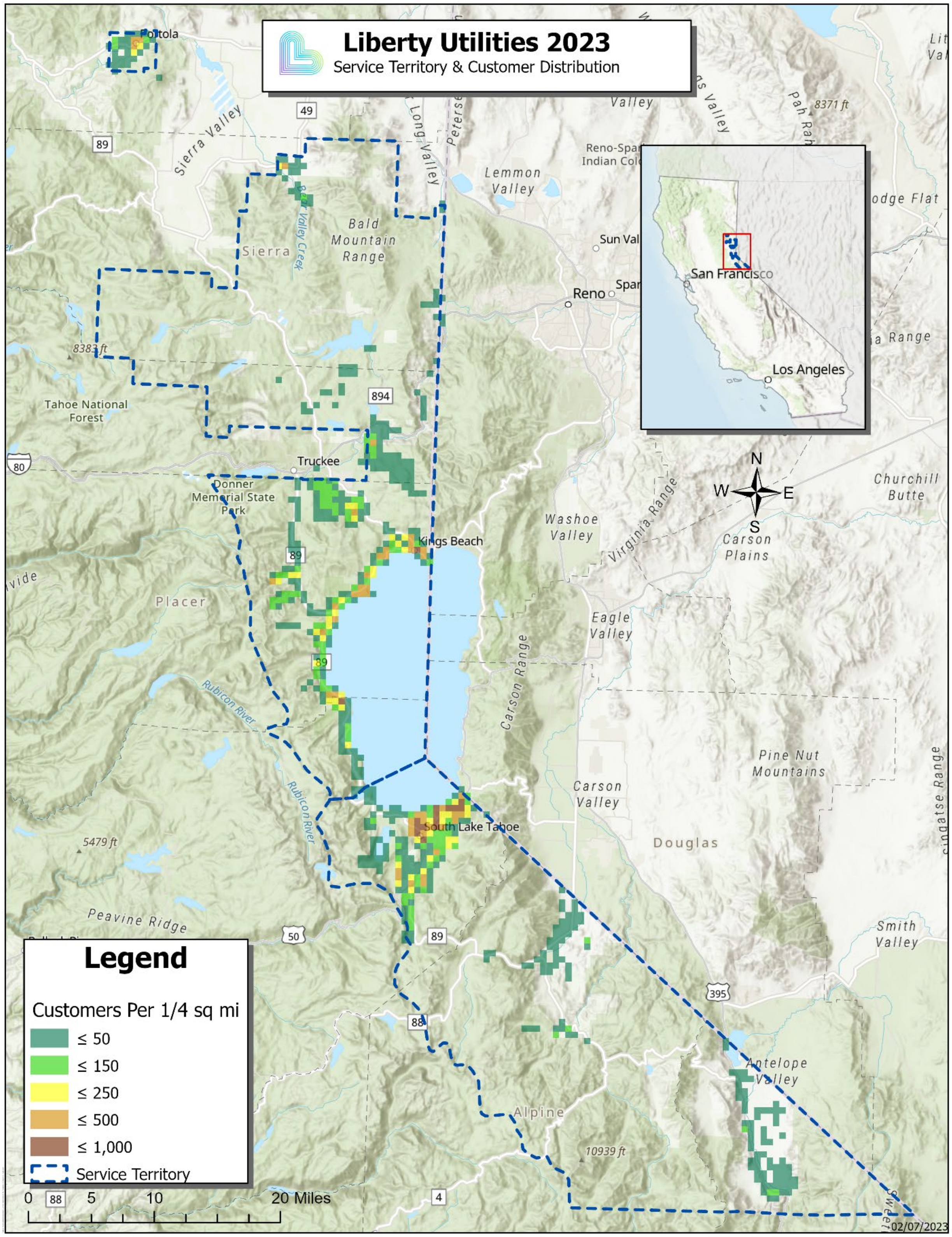
[3] Annual information included in this section must align with Table 7 of the QDR.

Table 5-1. Liberty Service Territory High-Level Statistics

Characteristic	**#**
Area served (sq. mi.)	1,482
Area of service territory with electrical equipment and infrastructure (sq. mi.)	464
Number of customers served	47,954

Figure 5-1. Liberty Service Territory and Customer Distribution, 2023



5.2 Electrical Infrastructure

The electrical corporation must provide a high-level description of its infrastructure, including all power generation facilities, transmission lines and associated equipment, distribution lines and associated equipment, substations, and any other major equipment.[4]

Liberty's electrical infrastructure consists of 24,728 electrical poles and 1,047.5 total circuit miles of distribution and transmission lines. Liberty utilizes 5,580 overhead transformers, and 20.3 circuit miles of Liberty's overhead lines have been hardened with covered conductor. Liberty owns and operates one microgrid in its service territory.

Liberty designs, constructs, and maintains facilities in accordance with G.O. 95, as well as in accordance with known local conditions that require a higher standard than specified in G.O. 95 to enable the furnishing of safe, proper, and adequate service. Specifically, because Liberty's service territory is over 5,000 feet above sea level, Liberty adheres to Grade A - Heavy Loading District construction, per G.O. 95, Rule 43.1.

Table 5-2 provides an overview of key Liberty electrical equipment.

Table 5-2. Overview of Key Liberty Electrical Equipment

Type of Equipment	**HFTD**	**Non-HFTD**	**Total**
Substations (#)	10	2	12
Power generation facilities (#)	0	0	0
Overhead transmission lines (circuit miles)	30.75	2.09	32.84
Overhead distribution lines (circuit miles)	628.96	42.93	671.89
Overhead secondary distribution lines (circuit miles)	741.84	49.54	791.38
Hardened overhead distribution lines (circuit miles)	20.3	0	20.3

[4] Annual information included in this section must align with Table 7 of the QDR.

Type of Equipment	**HFTD**	**Non-HFTD**	**Total**
Hardened overhead transmission lines (circuit miles)	0	0	0
Underground transmission lines (circuit miles)	1.29	0	1.29
Underground distribution lines (circuit miles)	269.44	16.31	285.75
Underground secondary distribution lines (circuit miles)	265.92	22.18	288.1
Distribution transformers (#)	7,482	631	8,113
Reclosers (#)	32	3	35
Poles (#)	22,852	1,889	24,741
Towers (#)	0	0	0
Microgrids (#)	1	0	1

5.3 Environmental Settings

The electrical corporation must provide a high-level overview of the wildfire environmental settings within its service territory.

5.3.1 Fire Ecology

The electrical corporation must provide a brief narrative describing the fire ecology or ecologies across its service territory. This includes a brief description of how ecological features, such as the following, influence the propensity of the electrical corporation's service territory to experience wildfires: generalized climate and weather conditions, ecological regions and associated vegetation types, and fire return intervals.

The electrical corporation must provide tabulated statistics of the vegetative coverage across its service territory. The tabulated data must include a breakdown of the vegetation types, total acres per type, and percentage of service territory per type. The electrical corporation must identify the vegetative database used to characterize the vegetation (*e.g.*, CALVEG).

Climate in the Sierra Nevada range is derivative of the Mediterranean climate of California. Precipitation on the western slopes can range from 20 to 80 inches with much of this precipitation falling as snow above 6,000 ft. The eastern slope of the Sierra crest receives significantly less rain annually, typically less than 25 inches. Dry summer days with temperatures averaging 90°F contrast against mild winters with temperatures low enough to sustain heavy snowpack. Liberty's service territory includes montane and subalpine forests with white fir, Douglas fir, ponderosa pine, and Jeffrey pine transitioning to red fir and lodgepole pine at higher elevations.

Table 5-3 provides the existing vegetation types and percentages in Liberty's service territory.[5]

Table 5-3. Existing Vegetation Types in the Liberty Service Territory

Vegetation Type – Society of American Foresters Species	Acres	Percentage of Service Territory
Not forest or woodland	341,493	36.52
Red fir	59,746	6.39
Whitebark pine	2,530	0.27

[5] https://www.fs.usda.gov/detail/r5/landmanagement/resourcemanagement/?cid=fsbdev3_046815.

Vegetation Type – Society of American Foresters Species	Acres	Percentage of Service Territory
White fir	205,684	22.00
Western white pine	1,584	0.17
Aspen	4,742	0.51
Lodgepole pine	28,517	3.05
Cottonwood - willow	770	0.08
Interior ponderosa pine	107,096	11.45
Western juniper	348	0.04
Pinyon - juniper	34,382	3.68
Mesquite	1,372	0.15
Jeffrey pine	28,576	3.06
California mixed subalpine	20,736	2.22
Hard chaparral	97,403	10.42

Fire return interval is a more difficult metric to determine. Historically, fire return intervals in the Sierra Nevada ranged from five to 11 years. However, these patterns have been significantly disrupted. Regions can now go decades without a fire. Recent fire history indicates, at the lower end of the spectrum, a fire return interval of approximately 20 years.

5.3.2 Catastrophic Wildfire History

The electrical corporation must provide a brief narrative summarizing its wildfire history for the past 20 years (2002-2022) as recorded by the electrical corporation, CAL FIRE, or another authoritative sources. For this section, wildfire history must be limited to electrical corporation ignited catastrophic fires (*i.e.*, fires that caused at least one death, damaged over 500 structures, or burned over 5,000 acres). This includes catastrophic wildfire ignitions reported to the CPUC that may be attributable to facilities or equipment owned by the electrical corporation and where the cause of the ignition is still under investigation.[6] Electrical corporations must clearly denote those ignitions as still under investigation. In addition, the electrical corporation must provide catastrophic wildfire statistics in tabular form, including the following key metrics:

- Ignition date
- Fire name
- Official cause (if known)
- Size (acres)
- Number of fatalities
- Number of structures damaged
- Estimated financial loss (U.S. dollars)

The electrical corporation must provide an authoritative government source (*e.g.*, CPUC, CAL FIRE, U.S. Forest Service, or local fire authority) for its reporting of wildfire history data and loss/damage estimates, to the extent this information is available.

In the past 20 years, Liberty has experienced one catastrophic wildfire in its service territory, the Mountain View Fire in 2020, that fits the criteria defined by the Office of Energy Infrastructure Safety. The cause of ignition for the Mountain View Fire is still under investigation. Refer to Table 5-4 for statistics on the Mountain View Fire.[7]

Table 5-4. Mountain View Wildfire Statistics[8]

Ignition Date	Fire Name	Official Cause	Fire Size (acres)	No. of Fatalities	No. of Structures Destroyed and Damaged	Financial Loss (US$)
11/17/2020	Mountain View Fire	Under investigation	20,385	1	80 destroyed	Unknown

[6] CPUC emergency reporting instructions: https://www.cpuc.ca.gov/regulatory-services/safety/emergency-reporting.

[7] The Mountain View Fire is still under investigation and thus is not included in Liberty's QDR reporting.

[8] Source: https://ready.mono.ca.gov/pages/mountainview-fire.

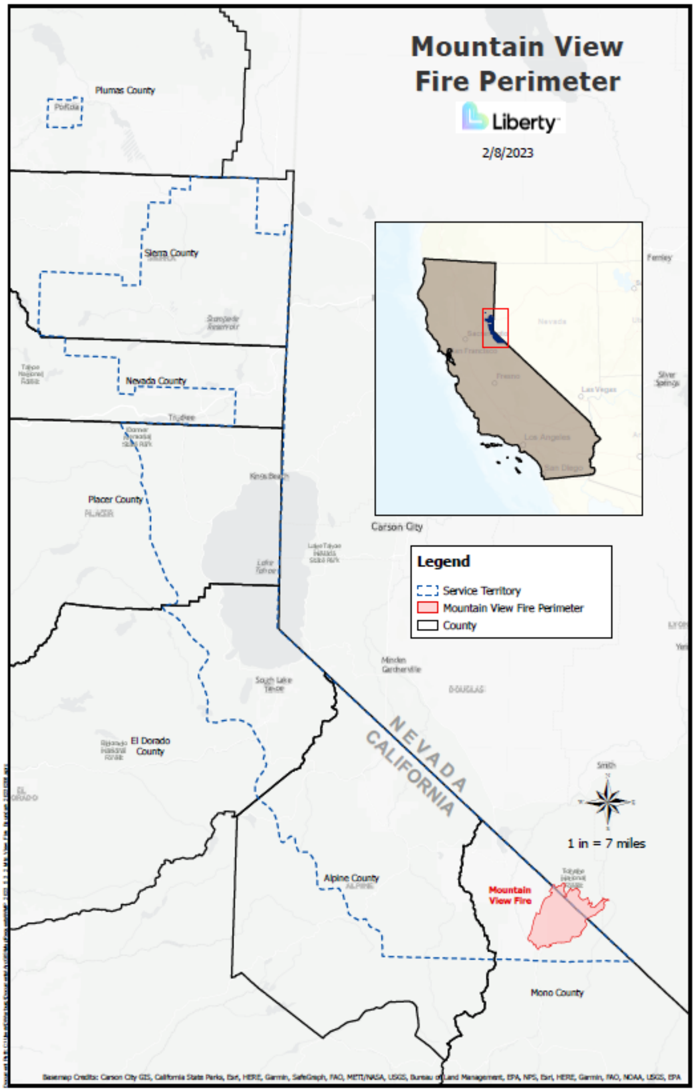
The electrical corporation must also provide a map or set of maps illustrating the catastrophic wildfires. One representative map must appear in the main body of the WMP, with supplemental or detailed maps provided in Appendix C as needed. The maps must include the following:

- Fire perimeters
- Legend and text labeling each fire perimeter
- County lines

Figure 5-2 provides a map of catastrophic wildfires in Liberty's service territory, including the Mountain View Fire area.[9]

[9] The Mountain View Fire is still under investigation.

Figure 5-2. Catastrophic Wildfire Map in Liberty Service Territory



5.3.3 High Fire Threat Districts

The electrical corporation must provide a brief narrative identifying the CPUC-defined HFTD across its territory. The electrical corporation must also provide a map of its service territory overlaid with the HFTD. The map must be accompanied by tabulated statistics on the CPUC-defined HFTD including the following minimum information:

- Total area of the electrical corporation's service territory in the HFTD (sq. mi.)
- The electrical corporation's service territory in the HFTD as a percentage of its total service territory (%)

For the HFTD map, the HFTD layer(s) (raster or polygon) must cover the electrical corporation's service territory and the HFTD layer must match the latest boundaries as published by the CPUC.

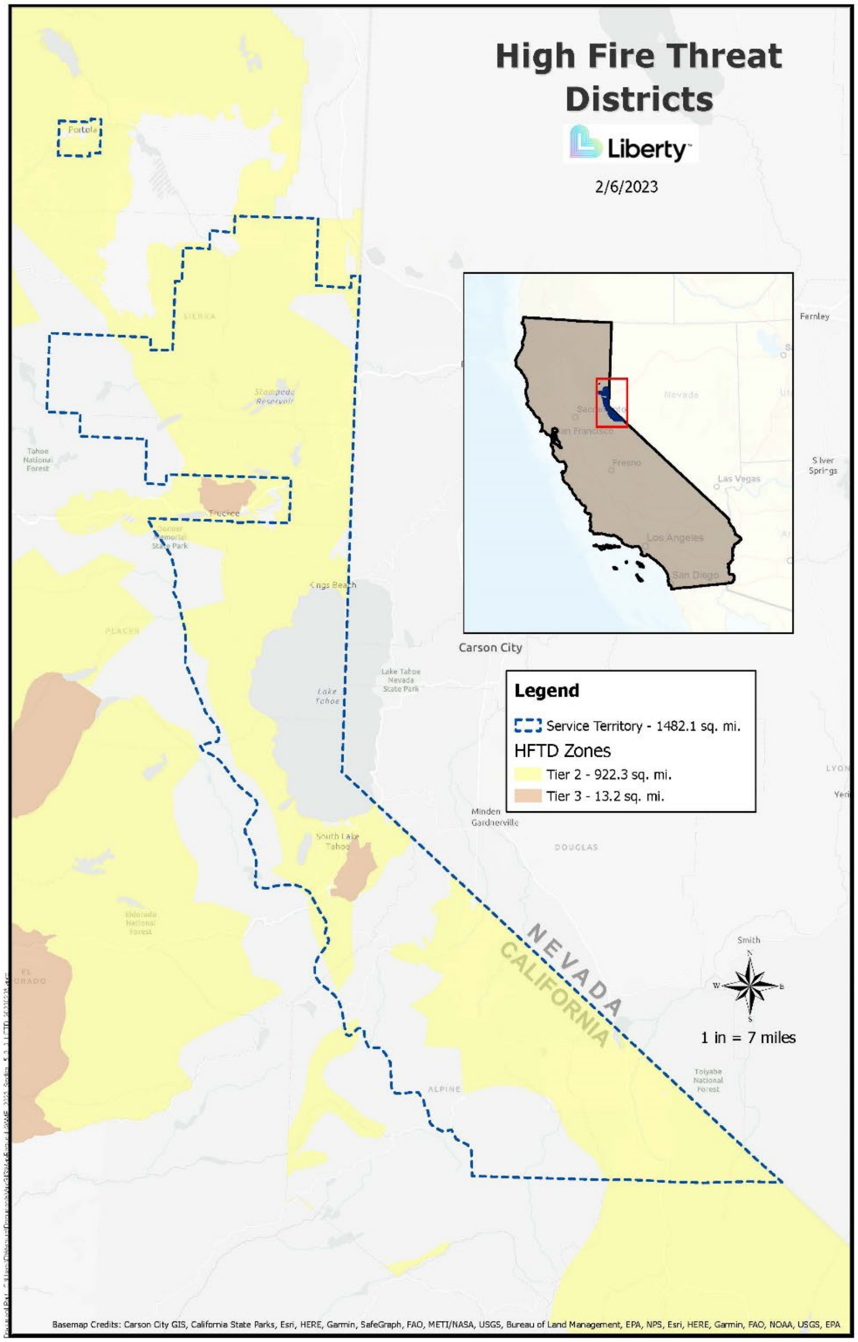
A significant amount of Liberty's service territory falls within High Fire Threat Districts. Approximately 93% of Liberty's electrical equipment and infrastructure lies within HFTD Tiers 2 and 3 areas. In terms of total square miles, there are 935.5 square miles of Liberty's service territory that fall within High Fire Threat Districts, which equates to 63% of the total service territory square miles.[10] Table 5-5 provides Liberty's HFTD statistics and Figure 5-3 shows Liberty's HFTD map.

Table 5-5. Liberty's HFTD Statistics

High Fire Threat District	**Total Area of Individual District (sq. mi.)**	**% of Liberty's Electrical Equipment and Infrastructure that Lies Within HFTD**	**% of Total Service Territory**
Non-HFTD	546.6	6%	37%
Tier 2	922.3	87%	62%
Tier 3	13.2	6%	1%
Total =	1,482.1	100%	100%

[10] Approximately 68.7% of Liberty's total service territory includes land and water (*e.g.*, Lake Tahoe) that is more than one mile from any Liberty equipment.

Figure 5-3: Liberty's HFTD Map, 2023



5.3.4 Climate Change

It is critical for the electrical corporation to understand general climate conditions and how climate change impacts the frequency and the intensity of extreme weather events and the vegetation that fuels fires.

5.3.4.1 General Climate Conditions

The electrical corporation must provide an overview of the general weather conditions and climate across its service territory in the past 30- to 40-year period.[11] The narrative must include, at a minimum, the following:

- Average temperatures throughout the year
- Extreme temperatures that may occur and when and where they may occur
- Precipitation throughout the year

The electrical corporation must also provide a graph of the average precipitation and maximum and minimum temperatures for each distinct climatic region of its service territory. At a minimum, it must provide one graph in the main body of the report. Figure 5-4 provides an example of the climate/weather graph.

Liberty's service territory and the Lake Tahoe area as a whole experience warm, dry summers that range from an average minimum temperature of 45 degrees Fahrenheit to average maximum temperatures around 80 degrees. During winters, temperatures reach an average minimum of 20 degrees Fahrenheit and an average maximum of 42 degrees. Most of the annual precipitation occurs between the months of November through March, with an average of two to four inches of precipitation per month. Summer months typically see one inch or less of precipitation per month. The annual mean climatology for Liberty's service territory is shown in Figure 5-4.

Daily mean relative humidity, averaged across approximately 25 weather stations in Liberty's service territory, is plotted in Figure 5-5. The lowest daily mean relative humidity occurs around September 1, although relative humidity below 20% can occur at almost any time of year.

In Liberty's service territory, wind patterns of significance from a fire weather standpoint occur primarily due to frontal passages and Washoe Zephyr winds. Ahead of frontal passages, winds typically increase out of the west or southwest before shifting to the north and northeast behind the front. Both wind directions can lead to significant fire weather concerns, but west/southwest winds tend to be more problematic due to the potential for down-sloping winds on the east slope of the Sierra. Frontal passages can lead to fire weather concerns at any time of the year where antecedent moisture or snow cover do not preclude the possibility of fire ignition and spread. During summer months, Washoe Zephyr winds may lead to elevated

[11] Annual information included in this section must align with Table 4 of the QDR.

wind speeds that are typically strongest from early afternoon to late evening. Frontal passages can also lead to enhanced Zephyr winds with higher wind speeds than would occur in the absence of a frontal passage.

Figure 5-4: Annual Mean Climatology for Liberty's Service Territory[12]

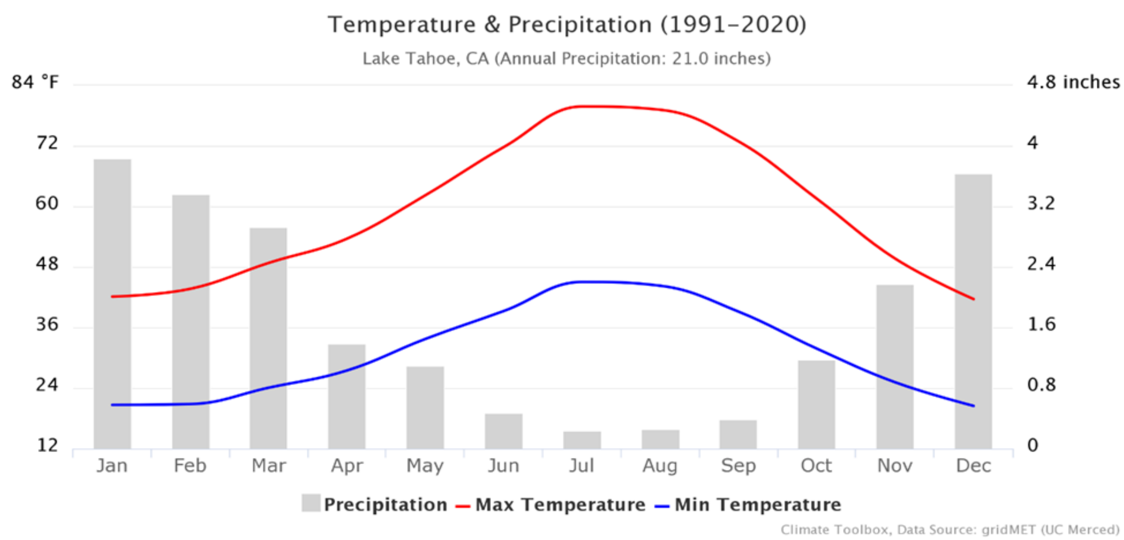
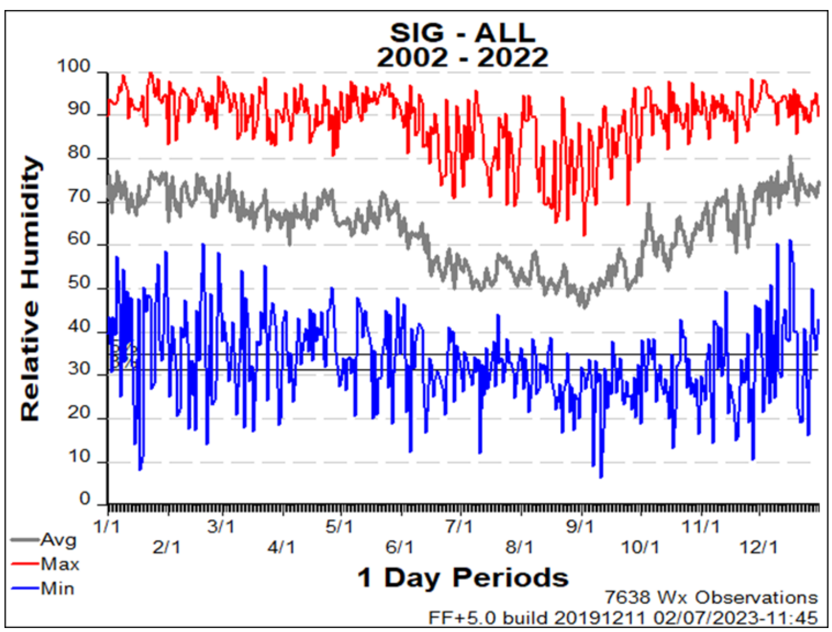


Figure 5-5: Daily Mean Relative Humidity for Liberty's Service Territory



12 Source: Hegewisch, K.C., Abatzoglou, J.T., 'Future Time Series' web tool. Climate Toolbox (https://climatetoolbox.org/) accessed on 02-01-2023.

5.3.4.2 Climate Change Phenomena and Trends

The electrical corporation must provide a brief discussion of the local impacts of anticipated climate change phenomena and trends across its service territory. In addition, the electrical corporation must provide graphs/charts illustrating:

- Mean annual temperature (Figure 5-6)
- Mean annual precipitation (Figure 5-7)
- Projected changes in minimum and maximum daily temperatures (Figure 5-8)

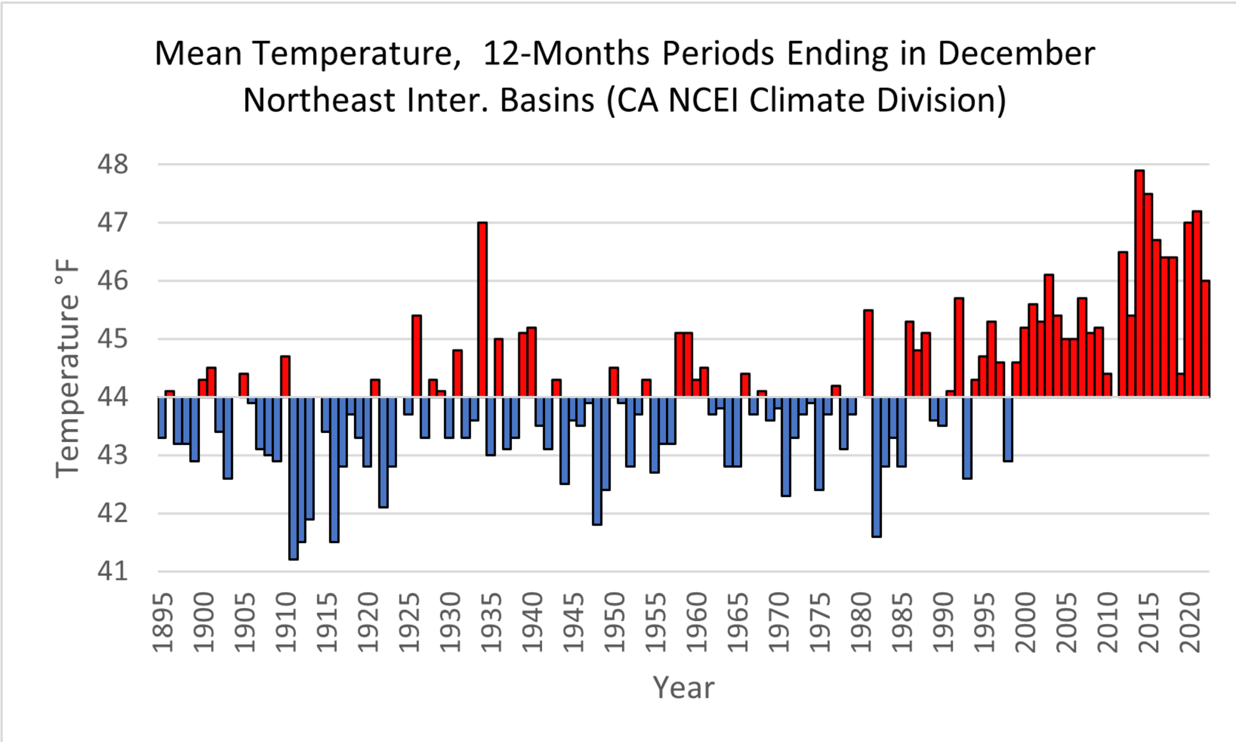
The electrical corporation must also indicate the increase in extreme fire danger days (historic 95th-percentile conditions) due to climate change, considering (at a minimum) the combination of warmer temperatures, drier vegetation, and changes in high-wind events (*e.g.*, Santa Ana winds, Diablo winds, Sundowners) for both winter/spring and summer/fall periods throughout the electrical corporation service territory.

The 2039 Higher Emission Model forecast predicts more extreme summer temperatures in several areas of Liberty's service territory—Portola and Loyalton areas in the north and the City of South Lake Tahoe and Markleeville in the south. The Topaz area is forecasted to be most acutely impacted by increasing temperatures.

Warmer and drier conditions increase the risk of wildfires. Mean annual temperatures in Liberty's service territory have only increased since 2000, and by 2055 the number of extreme fire danger days is forecast to increase by 37% for summer months and 66% for fall months. Fuel moisture content is expected to decrease as temperatures rise, meaning drier and more easily burnt vegetation during fire season. Climate change is expected to impact annual precipitation totals, causing more extreme fluctuations, which may lead to droughts and flooding. Rising temperatures also increase the rate at which snowpack melts, which may also increase the risk of flooding.

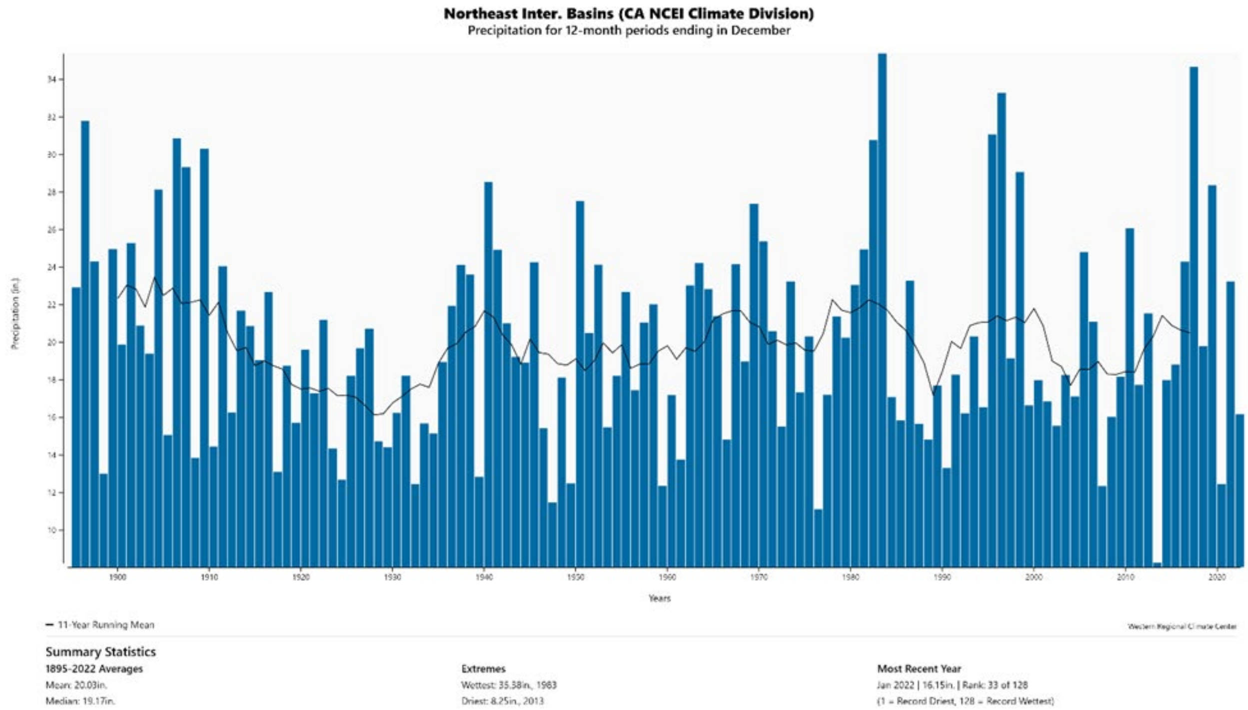
In forested parts of Liberty's service territory, climate change is likely to accelerate tree mortality. The 2022 USDA Forest Service Aerial Detection Survey ("ADS") shows there is already significant tree mortality in Liberty's service territory, particularly west of Lake Tahoe. The implications of this for fire behavior potential are not yet completely understood by the fire science community, but such mortality is likely to increase coarse fuel loading which increases the potential for plume dominated fires.

Figure 5-6. Mean Annual Temperature for Liberty's Service Territory, 1900s–2020s[13]



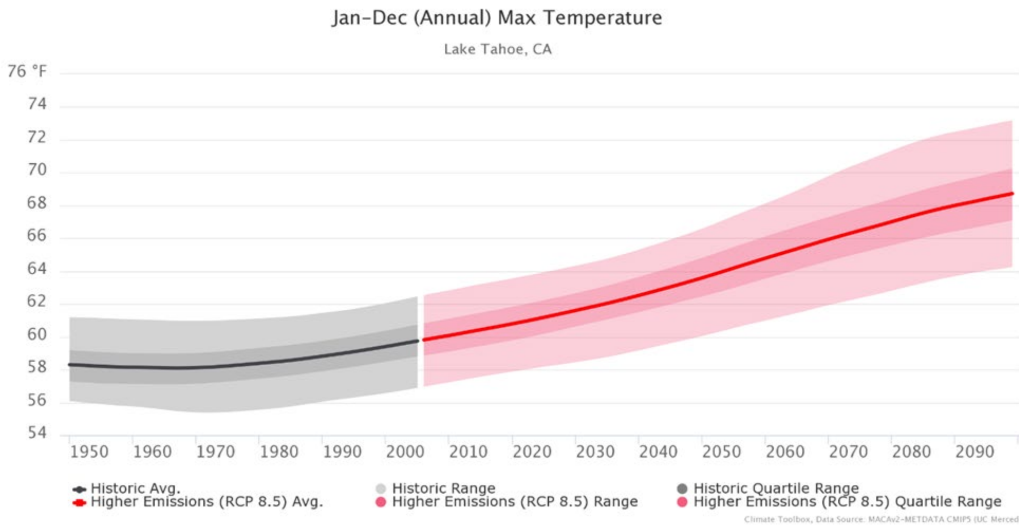
13 Source: Climate Dashboard, Western Regional Climate Center, 2023. 02-01-2023 https://wrcc.dri.edu/my/climate/tracker/CA

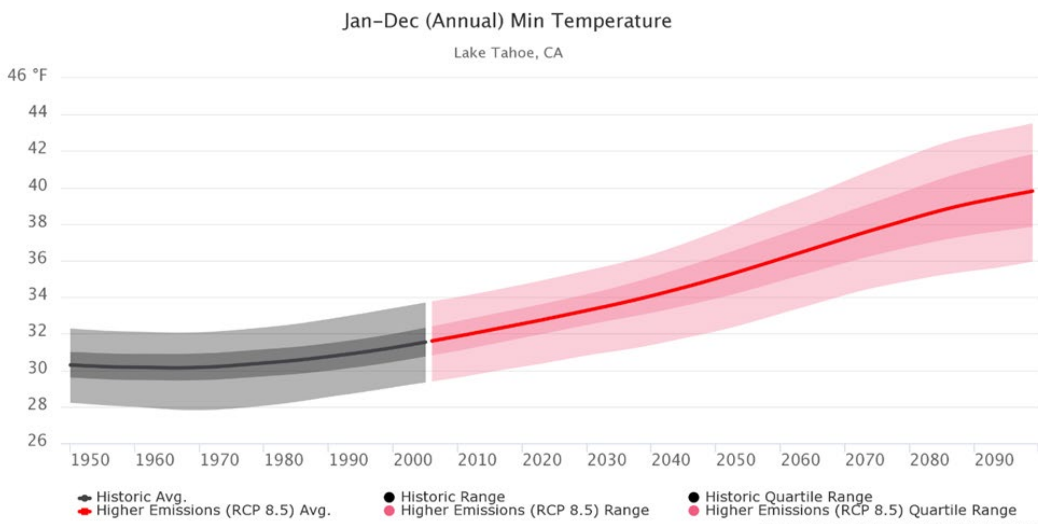
Figure 5-7. Mean Annual Precipitation for Liberty's Service Territory, 1900s–2020s[14]



[14] Source: Climate Dashboard, Western Regional Climate Center, 2023. 02-01-2023 https://wrcc.dri.edu/my/climate/tracker/CA

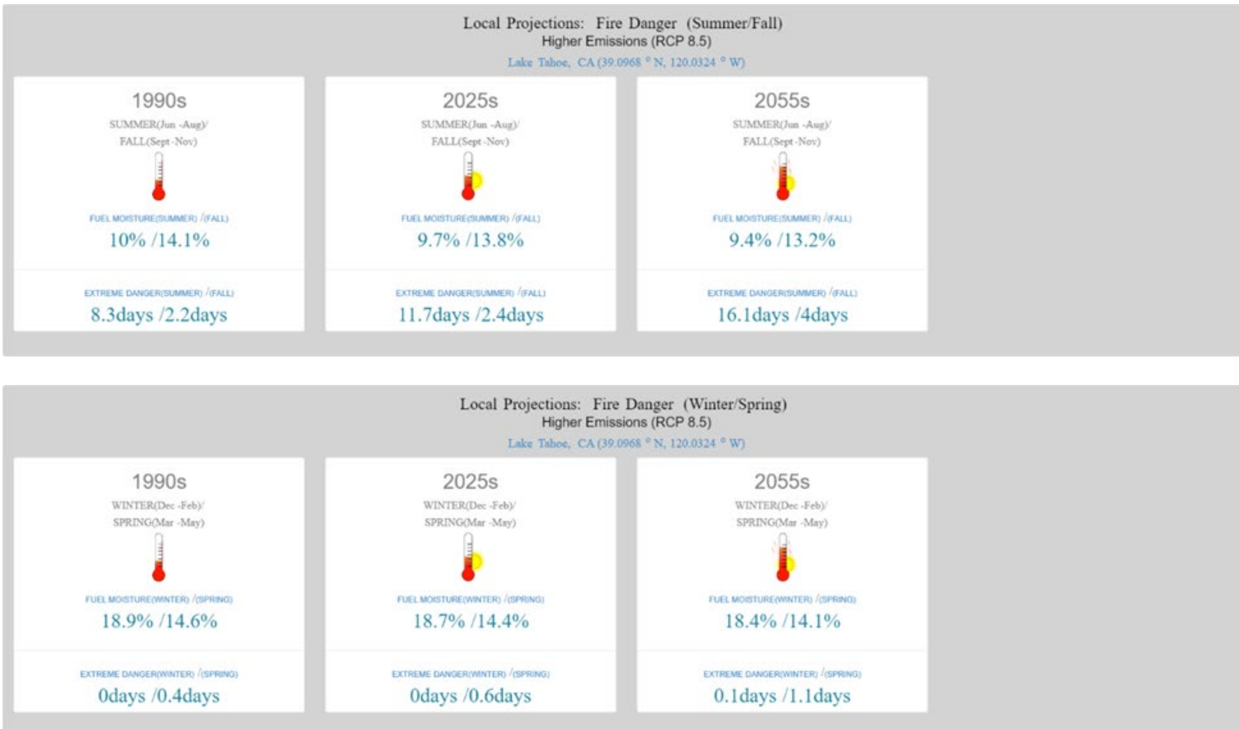
Figure 5-8. Projected Change in Maximum Temperature (Daytime Highs) and Minimum Temperature (Nighttime Lows) Through 2100 for Liberty's Service Territory[15]





[15] Source: Hegewisch, K.C., Abatzoglou, J.T., 'Future Time Series' web tool. Climate Toolbox (https://climatetoolbox.org/) accessed on 02-01-2023.

Figure 5-9. Example of Projected Changes in Average Fuel Moisture and Average Number of Days of Extreme Fire Danger for Winter/Spring and Summer/Fall Periods for Liberty's Service Territory Based on Global Climate Model Outputs[16]



5.3.5 Topography

The electrical corporation must provide an overview and brief description of the various topographic conditions across its service territory.

Liberty's service territory lies within the Sierra Nevada Mountain Range along the California-Nevada State boundary. Liberty's entire service territory is more than 5,000 ft above sea level and contains steep mountains with heavily forested areas. In the central region of the territory lies Lake Tahoe, which sits at an elevation of 6,225 ft. Liberty's service territory encompasses approximately two-thirds of the lake. Due to the topography of Liberty's service territory, many locations only have a few means of access.

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[16] Source: Hegewisch, K.C., Abatzoglou, J.T., 'Future Climate Dashboard' web tool. Climate Toolbox (https://climatetoolbox.org/) accessed on 02-01-2023.

5.4 Community Values at Risk

In this section of the WMP, the electrical corporation must identify the community values at risk across its service territory. Sections 5.4.1–5.4.5 provide detailed instructions.[17]

5.4.1 Urban, Rural, and Highly Rural Customers

The electrical corporation must provide a brief narrative describing the distribution of urban, rural, and highly rural areas and customers across its service territory. Refer to Appendix A for definitions.

Liberty's service territory consists mostly of rural communities with a few urban centers. Urban areas include Kings Beach and the City of South Lake Tahoe, with a concentration of 17,581 customers. The majority, 26,275 customers, reside in rural areas, spread mostly across the western shore of Lake Tahoe. In the northern and southern portions of Liberty's service territory, approximately 4,000 customers are spread across highly rural areas of the service territory, including Portola, Loyalton, Markleeville, Topaz, and Verdi Sierra Pines.

5.4.2 Wildland-Urban Interfaces

The electrical corporation must provide a brief narrative describing the wildland-urban interfaces (WUIs) across its service territory. Refer to Appendix A for definitions.

Liberty serves 18,444 customers in high density wildland-urban interfaces ("WUI"), with the largest concentrations in urban centers, specifically King's Beach and the City of South Lake Tahoe. There are also pockets of high-density interfaces along the west shore of Lake Tahoe. Medium-density interfaces are found in all areas of the service territory and contain 24,181 customers. Low-density interfaces, which contain 2,962 customers, are spread sparsely across the service territory, and are mostly in rural areas on the fringes of larger population centers. Of the 47,954 total customers Liberty serves, 95% of customers are within WUIs.

5.4.3 Communities at Risk from Wildfire

In this section of the WMP, an electrical corporation must provide a high-level overview of communities at risk from wildfire as defined by the electrical corporation (*e.g.*, within the HFTD and HFRA). This includes an overview of individuals at risk, AFN customers, social vulnerability,

[17] Annual information included in these sections must align with Table 7 of the QDR.

and communities vulnerable because of single access/egress conditions within its service territory. Detailed instructions are provided below.

5.4.3.1 Individuals at Risk from Wildfire

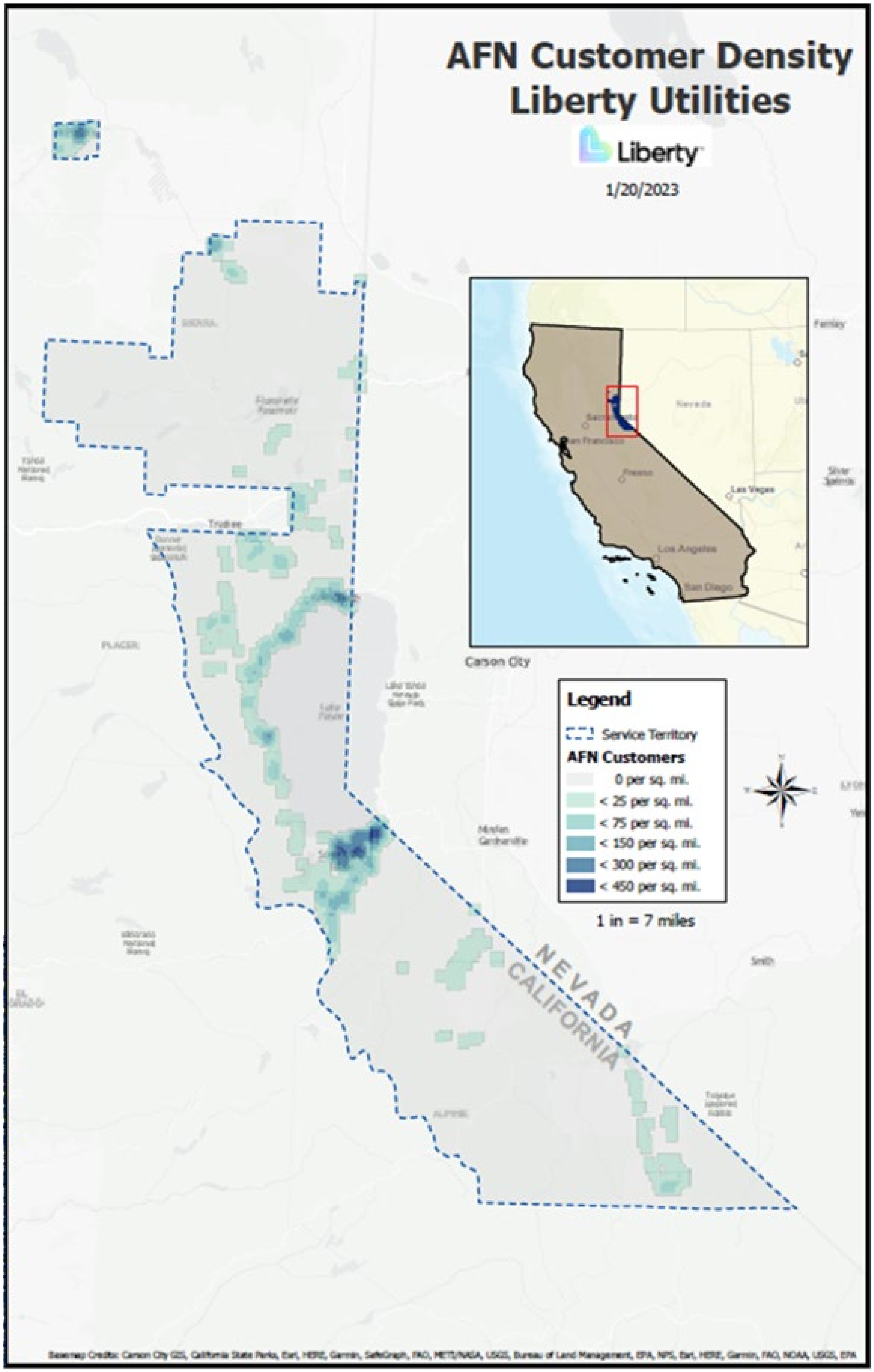
The electrical corporation must provide a brief narrative (one to two paragraphs) describing the total number of people and distribution of people at risk from wildfire across its service territory.

Of Liberty’s 47,954 customers, 44,369 customers reside in an HFTD zone, placing 93% of Liberty’s customers at risk of wildfire.

Liberty’s service territory, specifically the Lake Tahoe area, is a temporary residence or vacation destination for many people. Accordingly, the total number of customers served by Liberty (47,954) is higher than the permanent population of its service territory (approximately 44,000). Liberty’s customer data is a more reliable indicator of individuals at risk from wildfire than census population tract data, which does not align precisely with Liberty’s service territory.

Liberty has 6,103 AFN customers and 185 MBL customer in its service territory as of January 1, 2023. See Figure 5-10 for the density of AFN customers in Liberty’s service territory.

Figure 5-10: Density of AFN Customers in Liberty's Service Territory



5.4.3.2 Social Vulnerability and Exposure to Electrical Corporation Wildfire Risk

The electrical corporation must provide a brief narrative describing the intersection of social vulnerability and community exposure to electrical corporation wildfire risk across its service territory. This intersection is defined as census tracts that 1) exceed the 70th percentile according to the Social Vulnerability Index (SVI) or have a median household income of less than 80 percent of the state median, and 2) exceed the 85th percentile in wildfire consequence risk according to the electrical corporation's risk assessment(s).[18]

For SVI, the electrical corporation must use the most up-to-date version of Centers for Disease Control and Prevention/Agency for Toxic Substances and Disease Registry's Social Vulnerability Index dataset (Year = 2018;[19] Geography = California; Geography Type = Census Tracts).[20]

In addition, the electrical corporation must provide a single geospatial map showing its service territory (polygon) overlaid with the distribution of the SVI and exposure intersection and urban and major roadways. Any additional maps needed to provide clarity and detail should be included in Appendix C.

Liberty has not conducted a wildfire risk assessment using the 85th percentile consequence calculation. Liberty provides a map in Figure 5-11 showing its service territory overlaid with the SVI and its current Reax risk polygons. Liberty provides an additional map in Appendix C showing the SVI distribution, Liberty's updated utility risk analysis in its 2023 WMP and major roads.

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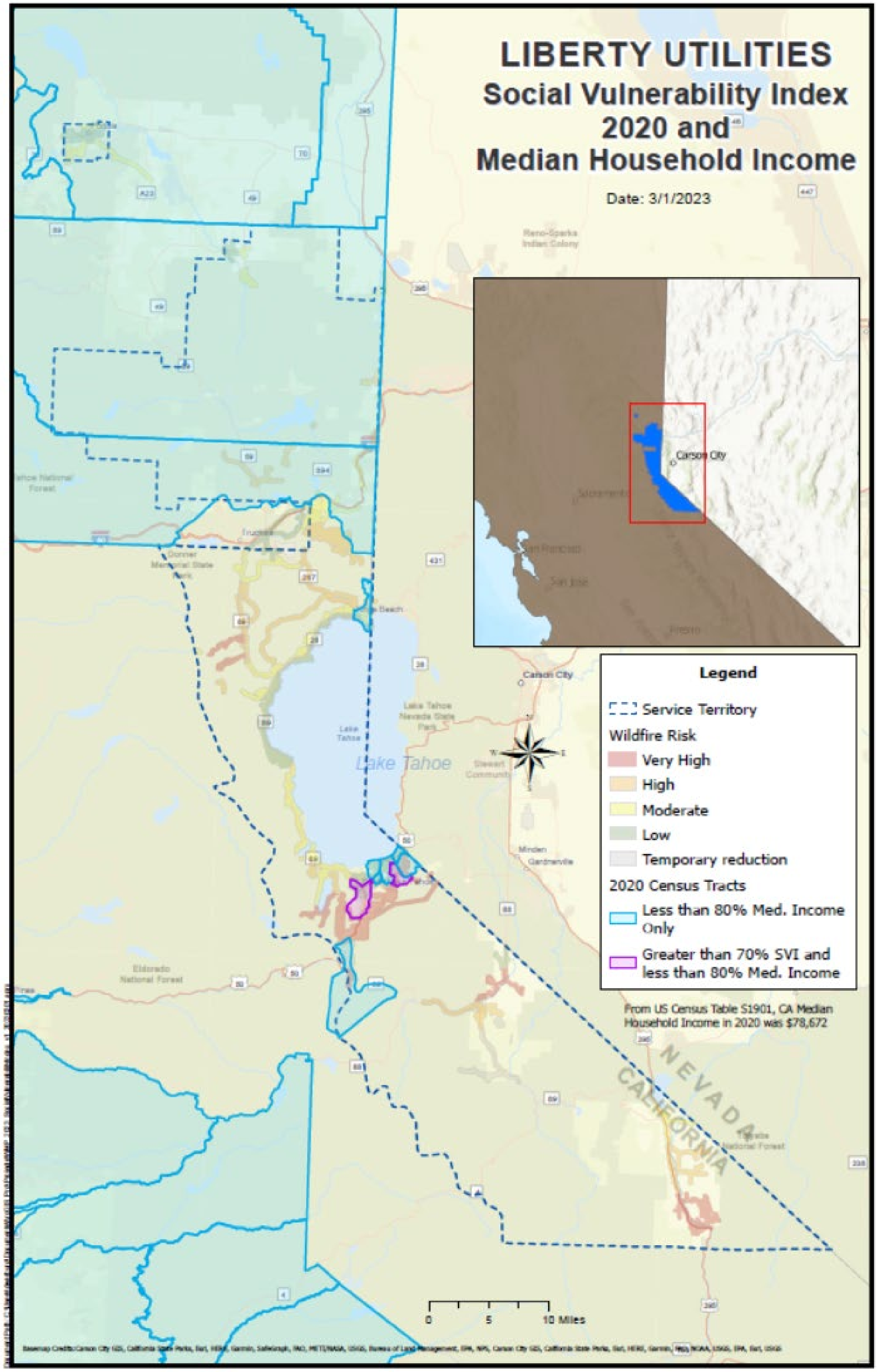
18 These criteria are derived from Cal OES Recovery Division, Hazard Mitigation Assistance Branch's Multiple Hazards and Social Vulnerability Analysis, dated January 18, 2022: https://www.caloes.ca.gov/wp-content/uploads/Recovery/Documents/Socially-Vulnerable-and-High-Hazard-Risk-Community-Criteria.-Methodology.pdf & https://calema.maps.arcgis.com/apps/dashboards/3c78aea361be4ea8a21b22b30e613d6e.

19 As of the publishing of these Guidelines, 2018 was the most recent version of the dataset. Electrical corporations must use the most up-to-date version of the dataset.

20 Centers for Disease Control and Prevention/Agency for Toxic Substances and Disease Registry Social Vulnerability Index Data and Documentation Download (https://www.atsdr.cdc.gov/placeandhealth/svi/data_documentation_download.html, accessed Oct. 11, 2022).

Figure 5-11: Liberty Service Territory Map with SVI and Risk Map



5.4.3.3 Sub-Divisions with Limited Egress or No Secondary Egress

The electrical corporation must provide a brief narrative overview (one to two paragraphs) describing sub-divisions with limited egress or no secondary egress, per CAL FIRE data,[21] across the electrical corporation's service territory.

CAL FIRE surveys sub-divisions—defined as any group of more than thirty dwelling units—across Liberty's service territory for modes of ingress/egress. Sub-divisions within El Dorado and Placer Counties have been identified and surveyed as part of the Board of Forestry and Fire Protection Subdivision Review Program.

Survey reports produced by CAL FIRE identified 10 sub-divisions in South Lake Tahoe with no secondary egress, and one with limited egress. These sub-divisions consist mostly of single-family homes on flat land, surrounded by grass, trees, brush, and timber. In Placer County, CAL FIRE identified 21 subdivisions with no secondary egress, and three with limited egress. These areas include a mix of single-family homes, townhomes, and duplexes surrounded by similar vegetation, but the topography varies from flat land to slopes, ridges, and canyons. All 35 sub-divisions were categorized by CAL FIRE as "Very High" Fire Hazard Severity Zones.

5.4.4 Critical Facilities and Infrastructure at Risk from Wildfire

The electrical corporation must provide a brief narrative describing the distribution of critical facilities and infrastructure located in the HFTD/HFRA across its service territory. Critical facilities and infrastructure are defined in Appendix A.

Approximately 80% of critical facilities and infrastructure in Liberty's service territory is located along the shore of Lake Tahoe or within the City of South Lake Tahoe. The remaining 20% is spread throughout the rest of the service territory. Almost all critical facilities and infrastructure are in HFTD or HFRA areas, with 83% in HFTD Tier 2 zones, 6% in HFTD Tier 3 zones, 10% in HFRA (non-HFTD), and only 1% in neither HFTD nor HFRA.

5.4.5 Environmental Compliance and Permitting

In this section, the electrical corporation must provide a summary of how it ensures its compliance with applicable environmental laws, regulations, and permitting related to the implementation of its WMP. This overview must include:

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21 Board of Forestry and Fire Protection Subdivision Review Program (https://bof.fire.ca.gov/projects-and-programs/subdivision-review-program/, accessed Oct. 11, 2022).

- A description of the procedures/processes to ensure compliance with relevant environmental laws, regulations, and permitting requirements before and during WMP implementation. The process or procedure should include when consultation with permittees occurs (*i.e.*, at what stage of planning and/or implementation of activities described in the WMP)
- Roadblocks the electrical corporation has encountered related to environmental laws, regulations, and permitting related to implementation of its WMP and how the electrical corporation has addressed, is addressing, or plans to address the roadblocks.
- Any notable changes to its environmental compliance and permitting procedures and processes since the last WMP submission and a brief explanation as to why those changes were made. Include any planned improvements or updates to the initiative and the timeline for implementation.

The electrical corporation must also provide a table of potentially relevant state and federal agencies that may be responsible for discretionary approval of activities described in WMPs and the relevant environmental laws, regulations, and permitting requirements. If this table extends past two pages, provide the required information in an appendix.

Liberty conducts environmental compliance reviews for all proposed construction activities. These reviews are facilitated by Liberty's Environmental Review Checklist ("ERC"). The ERC is initiated by identifying the work activities to be conducted and their location and then completing a desktop review of the activity for potential impacts to environmental resources including, but not limited to, the following:

- public lands,
- wetlands and waterways,
- seasonal restrictions,
- ground disturbance,
- vegetation trimming and/or removal, and
- cultural resources

The goal of the desktop review is to capture the existing environmental conditions of the site and its surroundings to confirm that implementation of the activity will not result in any potentially significant impacts that would necessitate a full review by any of the federal, state, or local agencies with jurisdiction over the activity location. If any potential triggers for agency approval or notification are identified, it is noted in the ERC and a detailed permitting review follows. A site visit by Liberty's subject matter experts from environmental, engineering, and/or construction groups may be conducted to confirm the design meets operational requirements while avoiding potential environmental effects to the extent feasible.

If Liberty's detailed permitting review indicates the need for agency approval/notification prior to the start of the activities, Liberty initiates agency consultation once the scope and design have been finalized. In rare occurrences, under emergency conditions, Liberty will conduct activities, such as repairing a downed pole, for public safety and continued operations and notify the appropriate agencies in accordance with the applicable regulations.

Environmental Regulatory Roadblocks: Implementation of Liberty's WMP requires compliance with applicable federal, state, and local environmental laws and regulations. Liberty takes its duty to protect the public and the environment seriously while providing reliable electric service. Due to the sensitive location of Liberty's facility locations, many regulatory roadblocks, including but not limited to the following, can be encountered to conduct routine operations and maintenance ("O&M") activities:

- multi-agency coordination,
- lack of standardized agency requirements,
- notification of absentee landowners, and
- seasonal restrictions.

The Sierra Mountains and Lake Tahoe basin, where Liberty operates its facilities, are a highly managed and regulated landscape due to the natural resources and outdoor recreation opportunities it provides, which makes the location a highly desirable area for vacation homes. With four national forests in two different regions, California state environmental regulations, local ordinances, and the Tahoe Regional Planning Agency ("TRPA"), all but the smallest activities require approval/notification from multiple agencies, resulting in agency coordination extending compliance timelines and often delaying the start of activities. The United States Forest Service ("USFS"), for example, has 10 regional offices nationwide, two of which (Regions 4 and 5) have jurisdiction over portions of Liberty's operational area. The following four national forests are within Regions 4 and 5:

- Plumas National Forest,
- Tahoe National Forest,
- Lake Tahoe Basin Management Unit, and
- Humboldt-Toiyabe National Forest.

Each regional office issues different orders, and each national forest has its own management plan, making compliance challenging and likely to result in delays.

The Sierra Mountains and Lake Tahoe area are a popular vacation destination, containing many own second homes and/or rental properties, resulting in numerous absentee landlords. Absentee landlords make notification requirements and coordination for O&M activities difficult, sometimes resulting in delayed activities or their cancellation entirely.

Further complicating Liberty's efforts is the climate of its operational area and associated agency-mandated seasonal restrictions, resulting in a narrow yearly window to complete construction activities. Many years, snow is prevalent from late fall through early spring, restricting the opportunity to conduct many routine O&M activities during this timeframe. In addition, the TRPA requires that all ground disturbance be completed between May 1 and October 15. Further, the breeding season of sensitive species, such as the California spotted owl (Strix occidentalis occidentalis) and Northern goshawk (Accipiter gentilis), which extends from March 1 to August 31 and February 15 to September 15, respectively, can result in work not being able to be completed in proximity to nesting birds.

Because of the limited construction season, even small schedule adjustments can result in delaying activities to the next season.

To address the challenges associated with multi-agency coordination, absentee landowners, and seasonal restrictions, Liberty has instituted more advanced planning of operational and maintenance activities, planning projects approximately two years in advance. This advanced planning provides Liberty with more time to adequately address landowner notifications and agency coordination prior to initiating construction activities. Liberty has also invested in hiring more permanent environmental staff to conduct its internal reviews of planned work activities, enabling it to identify activities that may need agency notifications and/or approval and scheduling them accordingly.

Environmental Procedures Updates: Liberty is currently working with the TRPA to update an existing memorandum of understanding ("MOU") for O&M activities to allow minor repairs, replacements and vegetation maintenance to be completed without agency review and approval. This update will allow for a greater, but still small, amount of ground disturbance and excavation to be conducted under the MOU and in accordance with the TRPA Regional Plan and Code of Ordinances. Under the current MOU, up to 35 cubic yards of fill is allowed to be excavated or backfilled and up to 5,280 linear feet (one mile) of undergrounding conversion or repairs/replacements is allowed. Potential updates would increase these thresholds before TRPA review and approval are required. Such updates would allow Liberty to conduct minor upgrades, repairs, and replacements in a timely manner, and enable TRPA staff to focus their reviews on larger, more complicated activities being planned. The goal is to execute an updated MOU by May 2023.

Table 5-6 provides the relevant state and federal agencies that are responsible for discretionary approval of activities described in Liberty's WMP and the relevant environmental laws, regulations, and permitting requirements.

Table 5-6: Relevant State and Federal Environmental Laws, Regulations, and Permitting Requirements for Implementing the WMP in Liberty's Service Territory

Environmental Law, Regulation, or Permit	Responsible Permittee/Agency
Federal	
National Environmental Policy Act	Any federal agency with discretionary approval authority; typically, the Tahoe Regional Planning Agency or United States Forest Service
Federal Land Policy and Management Act of 1976	Bureau of Land Management
National Forest Management Act of 1976	United States Forest Service: • Plumas National Forest • Tahoe National Forest • Lake Tahoe Basin Management District • Humboldt-Toiyabe National Forest
Section 10 of the Rivers and Harbors Act of 1899	United States Army Corps of Engineers
Section 404 of the Clean Water Act	
Section 7 of the Endangered Species Act	United States Fish and Wildlife Service
Bi-State Compact and Regional Plan	Tahoe Regional Planning Agency
Tahoe Regional Planning Agency Code of Ordinances	
Federal Aviation Administration Order 1050.1F & 14 Code of Federal Regulations, Part 77	Federal Aviation Administration
25 Code of Federal Regulations, Part 169	Bureau of Indian Affairs

Environmental Law, Regulation, or Permit	**Responsible Permittee/Agency**
Section 106 of the National Historic Preservation Act	Advisory Council on Historic Preservation
Code of Federal Regulations Title 49, Section 1152	Union Pacific
State	
General Order 131-D	CPUC
California Code of Regulations, Title 2, Division 3, Chapter 1, Subchapter 2, Article 2, Section 2002: Right-of-way Lease	California State Lands Commission
California Streets and Highways Code, Section 660: Encroachment Permit	California Department of Transportation
Section 2081 of the California Endangered Species Act	California Department of Fish and Wildlife
Section 1600 of the California Fish and Game Code	
Water Quality Order No. 99-08 – National Pollution Discharge Elimination System ("NPDES") General Permit for Stormwater Discharges associated with Construction	State Water Resources Control Board
Water Quality Order No. 2003-0003 – Statewide General Waste Discharge Requirements for discharges to land with a low threat to water quality	
Section 401 of the Clean Water Act	Regional Water Quality Control Board (Lahontan/Central Valley)
Board Order No. R6T-2007-0008 – Waiver of Waste Discharge Requirements Related to Timber Harvest and Vegetation Management Activities	
Board Order No. R6T-2005-2007 – Waste Discharge Requirements and NPDES General Permit No. CAG616002	
Board Order No. R6T-2008-0023 – Renewed Waste Discharge Requirements and NPDES General Permit for Limited Threat Discharges to Surface Waters	

Environmental Law, Regulation, or Permit	Responsible Permittee/Agency
California Code of Regulations, Title 14, Division 3, Chapter 1, Section 4309 – Special Permits	California Department of Parks and Recreation
California Forest Practice Act of 1973	California Department of Forestry
California Health and Safety Code, Division 20, Chapter 6.5 - Hazardous Waste Control Law	California Department of Toxic Substances Control
Local:	
Northern Sierra Air Quality Management District Rules and Regulations	Northern Sierra Air Quality Management District
Placer County Air Pollution Management District Rules and Regulations	Placer County Air Pollution Control District
El Dorado County Air Pollution Management District Rules and Regulations	El Dorado County Air Pollution Management District
Great Basin Unified Air Pollution Control District Rules and Regulations	Great Basin Unified Air Pollution Control District
Plumas County Code of Ordinances	Plumas County
Sierra County Code of Ordinances	Sierra County
Nevada County Code of Ordinances	Nevada County
Placer County Code of Ordinances	Placer County
El Dorado County Code of Ordinances	El Dorado County
Alpine County Code of Ordinances	Alpine County
Mono County Code of Ordinances	Mono County
City of Portola Municipal Code	City of Portola
City of Loyalton Municipal Code	City of Loyalton
Town of Truckee Municipal Code & Town Charter	Town of Truckee
City of South Lake Tahoe City Code	City of South Lake Tahoe

6. Risk Methodology and Assessment

In this section of the WMP, the electrical corporation must provide an overview of its risk methodology, key input data and assumptions, risk analysis, and risk presentation (*i.e.*, the results of its assessment). This information is intended to provide the reader with a technical understanding of the foundation for the electrical corporation's wildfire mitigation strategy for its Base WMP. Sections 6.1–6.7 below provide detailed instructions.

For the 2023-2025 Base WMP, the electrical corporation does not need to have performed each calculation and analysis indicated in sections 6.2, 6.3, and 6.6. If the electrical corporation is not performing a certain calculation or analysis, it must describe why it does not perform the calculation or analysis, its current alternative to the calculation or analysis (if applicable), and any plans to incorporate those calculations or analyses into its risk methodology and assessment.

Through guidance from OEIS, participation in the joint-utility Risk Modeling Working Group, and collaborations with Direxyon Technologies and Technosylva, Liberty is committed to continuously improving its risk modeling practices. Liberty will continue to conduct the analyses and calculations described in the Technical Guidelines, to the extent possible, with the goal of successfully maintaining a Risk-Based Decision Making ("RBDM") platform that provides actionable, data-driven insights.~~Although the current approach provides significant advancements over earlier efforts, it was neither reasonable nor feasible to conduct all the calculations and analyses provided in the 2023-2025 Wildfire Mitigation Plan Technical Guidelines ("Technical Guidelines") prior to Liberty's 2023 WMP submission. Liberty, however, is committed to continuing to evolve and improve its risk modeling practices and intends to conduct the analyses and calculations described in the Technical Guidelines, to the extent possible, as part of future work.~~

Additionally, Liberty has a risk model working group. This group meets regularly to discuss the company's risk model, including but not limited to the company's modeling techniques, data integration, and overall approach to modeling wildfire, asset failure, and PSPS risk in its service territory.[22] ~~In future WMPs Liberty plans to consolidate the analytics for asset probability of failure and probability of ignition, given weather analytics from Reax that also incorporates tree risk for overall fire risk and consequences.~~

[22] Liberty's wildfire and PSPS risk was analyzed, modeled, and assessed by Reax Engineering and Arup in consultation with Liberty's risk management team.

Beginning in June 2023, Liberty began developing an updated RBDM platform. The RBDM platform analyzes wildfire, asset failure, and PSPS risks through models that guide the company's decision makers.

The RBDM platform is a continuously evolving platform. In 2023, the foundational work needed to create an overall modeling framework was completed. In the last year, Liberty prioritized the continued development and functionality of its wildfire risk and asset failure risk modules. Such activities include, but are not limited to, grid hardening and vegetation management WMP initiatives described in Section 8 of Liberty's 2023-2025 WMP. With respect to this priority, in collaboration with Direxyon Technologies, Liberty produced functioning models of both vegetation and assets. In doing so, Liberty also better aligned the company's technical and business processes.

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During this WMP cycle, Liberty's other objectives include the continued development of the integrated model components and the further integration of asset and vegetation risk. Additionally, Liberty intends to continue to develop a model for PSPS risk analysis.

6.1 Methodology

In this section, the electrical corporation must present an overview of its risk calculation approach. This includes one or more graphics showing the calculation process, a concise narrative explaining key elements of the approach, and definitions of different risks and risk components.

~~Liberty's overall wildfire risk scores consist primarily of an evaluation of environmental factors and expected ignition rates along Liberty's overhead lines.~~

6.1.1 Overview

The electrical corporation must provide a brief narrative describing its methodology for quantifying its overall utility risk of wildfires and PSPS. This methodology will help inform the development of its wildfire mitigation strategy (see Section 7). The electrical corporation must describe the methodology and underlying intent of this risk assessment in no more than five pages, inclusive of all narratives, bullet point lists, and any graphics.

~~Liberty's risk assessment is based on a quantified analytic approach using ISO 31000 Risk Management Framework, industry standards and studies to determine overall utility risk from wildfire and PSPS at the consolidated level. The intent of performing this risk analysis is to:~~

- ~~Quantify overall utility risk (comprised of PSPS risk and fire risk) spatiotemporally across the service territory; and~~
- ~~Use this information to develop wildfire mitigation strategies in Section 7 that achieve the goals and plan objectives identified in Section 4.1 and 4.2.~~

Liberty's risk assessment framework, models, and processes measure several levels of wildfire, reliability of service and PSPS risks. This long-term planning risk model has been developed to aid the decisions and strategies for the future, with the objective of reducing the overall risk profile. Some of the considerations in Liberty's risk platform include topography, vegetation-based fuels, climatology, demographics, historic fire weather days, live and dead fuel moisture samples, and impact to the population. These variables are quantified so that Liberty will be able to identify and monitor areas where the data indicates that a wildfire event is likely to occur.

Liberty's risk assessment objectives include the following:

- Quantify Liberty's risk- spatially and temporally across its service territory with the framework and data inputs described above and Liberty asset data.
- Utilize model outputs to develop wildfire mitigation strategies, outlined in Section 7, that achieve the goals and plan objectives identified in Sections 4.1 and 4.2.
- Express commonality between operational and overall risk between the WMP sections to analyze similar results from our suite of risk tools to supplement decision making. Bring operational and planning models into the same suite of risk tools to supplement comparable decision making.
- Establish an RBDM platform that provides data-driven insights for Liberty's decision makers to use as guidance for mitigation strategy.

Liberty is collaborating with Technosylva Inc. and Direxyon Technologies to provide a suite of risk assessment tools.

Technosylva is an industry recognized provider of wildfire risk solutions with a software package known as Technosylva's Wildfire Analyst ("WFA"). Liberty is utilizing the FireSight application within the WFA to supplement its long-term mitigation planning and the FireRisk application to supplement tactical, short-term planning for operations, situational awareness, and PSPS decision-making.

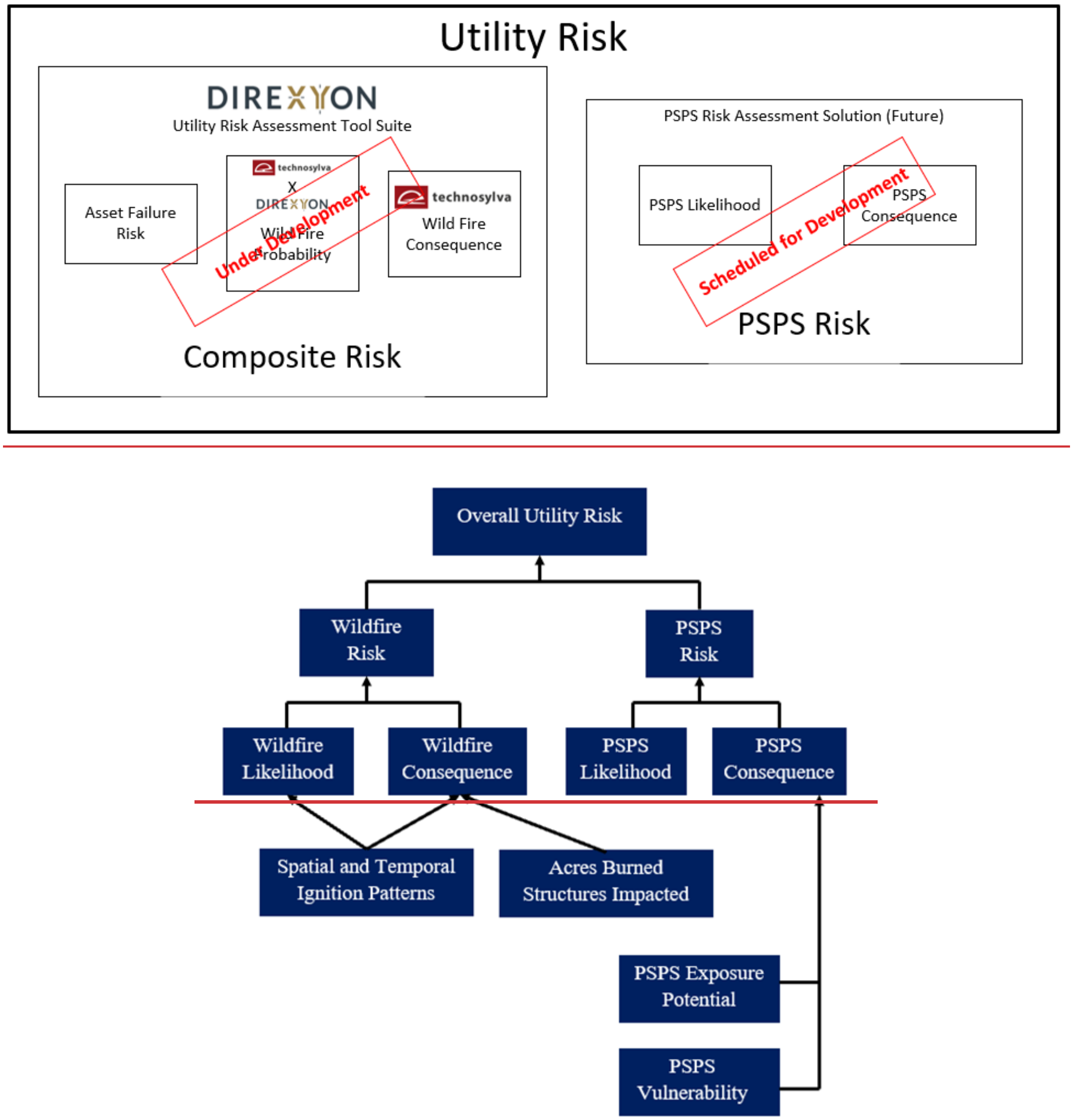
In addition, and in collaboration with Direxyon, Liberty is developing an asset level risk analysis utilizing data inputs from these products, as well as Liberty's internal asset data and subject matter expert knowledge, to quantify risk at the circuit, segment, and individual asset level.

As Liberty's improved RBDM platform is developed, enhancements to wildfire, asset failure, and PSPS risk models will be continually evaluated by collaboration and review from internal and external sources. Through continued development and enhancements, Liberty's aims for its RBDM platform to:

- Quantify wildfire risk at specific locations by measuring the probability and consequence of a fire event occurring;
- Assess the vulnerability of an asset and the risk of a utility caused ignition based on the likelihood and consequence of that asset failing; and
- Analyze PSPS conditions to assess the likelihood and consequence of a PSPS event being initiated.

The RBDM framework ~~risk analysis~~ is shown schematically in Figure 6-1.

Figure 6-1: Composition of Overall Utility Risk



6.1.2 Summary of Risk Models

In this section, the electrical corporation must summarize the calculation approach for each risk and risk component identified in Section 6.2.1. This documentation is intended to provide a quick summary of the models used. The electrical corporation must provide the following information:

- **Identification (ID)**: Unique shorthand identifier for the risk or risk component.
- **Risk component:** Unique full identifier for the risk or risk component.
- **Design scenario(s)**: Reference to design scenarios evaluated with the model to calculate the risk or risk component. These must be defined in Section 6.3.
- **Key inputs**: List of key inputs used to evaluate the risk or risk component. These can be in summary form (*e.g.*, the electrical corporation may list "equipment properties" rather than listing out equipment age, maintenance history, etc.).
- **Sources of inputs**: List of sources for each input parameter. These must include data sources (such as LANDFIRE) and modeling results (such as wind predictions) as relevant to the calculation of the risk or risk component. If the inputs come from multiple sources, each source should be on a new line.
- **Key outputs**: List of outputs calculated for the risk or risk component.
- **Units**: List of the units associated with the key outputs.

~~As shown in Figure 6-1, the two main components of Liberty's overall utility risk are wildfire risk and PSPS risk.~~

~~**Wildfire risk**: Wildfire risk is quantified for each circuit as the product of wildfire Likelihood of Risk Event ("LoRE") and wildfire Consequence of Risk Event ("CoRE"). Wildfire likelihood is determined from an ignition model that estimates ignition rate from gridded hourly weather conditions (wind gust and fuel bed ignition probability). When aggregated at the circuit level and annualized, this provides wildfire LoRE as the expected number of ignitions per year by circuit. Wildfire consequence is quantified in terms of safety (equivalent fatalities or EF, estimated from impacted structures) and financial impacts (related to acres burned) by modeling fire progression from ignition locations and times determined by the ignition model. A multi-attribute value function ("MAVF") is used to combine EF and financial impacts into a single dimensionless CoRE score for each circuit. Table 6-1 summarizes the fire risk model. The design scenarios noted in Table 6-1 are explained in Section 6.3.1.~~

~~**PSPS risk**: Like wildfire risk, PSPS risk is quantified from PSPS LoRE and CoRE. PSPS likelihood is determined by analyzing historical climate and weather conditions for each circuit to determine PSPS LoRE as the annualized likelihood that PSPS thresholds are met by circuit. PSPS consequence is determined by estimating the number of Customer Minutes Interrupted ("CMI") for a PSPS event by circuit. A MAVF is then used to translate CMI into a dimensionless CoRE score for each circuit. Finally, utility risk is calculated by combining wildfire risk (weighted at 80%) and PSPS risk (weighted at 20%) into an overall utility risk score for each circuit.~~Figure 6-2 provides a visual overview of the data inputs to various models and the outputs of DRAT.

Figure 6-2: Direxyon Risk Assessment Tool Data Flow

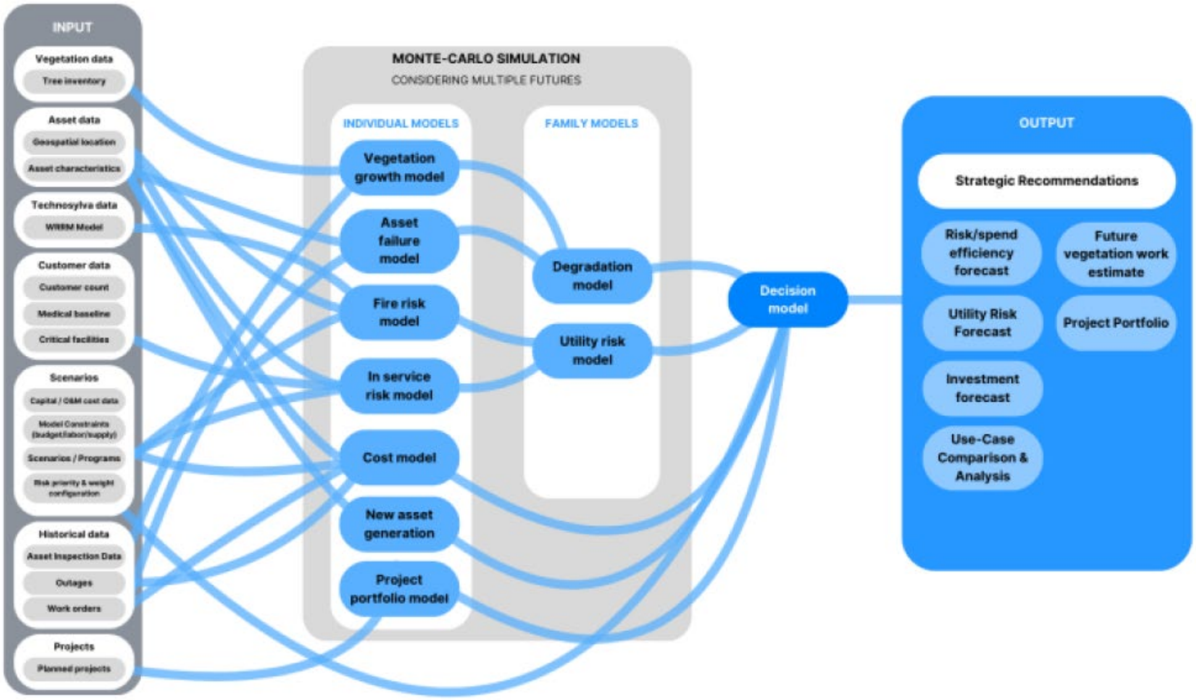


Table 6-1 summarizes the utility risk models. The design scenarios noted in Table 6-1 are explained in Section 6.3.1.

Table 6-1: Summary of Fire Risk Model and PSPS Risk Model

Fire Risk Model

ID	Risk Component	Design Scenario(s)	Key Inputs	Source of Inputs (Data and/or Models)	Key Outputs	Units
UR	Utility Risk		Wildfire Risk Asset Failure Risk PSPS Risk (Future)	Previous modeling steps	Utility Risk	
CR	Composite Risk		Wildfire Risk Asset Failure Risk	Technosylva WFA Asset Failure Risk	Composite Risk	Score 0-9
WR	Wildfire Risk	WC1, WC2, VC1, VC2, VC3, WLC5	Wildfire Likelihood Wildfire Consequence	Previous modeling steps	Fire Risk Score 0-81	1/year
WC	Wildfire Consequence	WC1, WC2, WLC5	Population Impact Impacted structures Acres burned Spatial/Temporal ignition patterns	WFA Conditional Fire Risk WFA Expected Fire Risk	Fire Size Potential, Buildings Threatened/Destroyed, Population Impacts	No unit
WL	Wildfire Likelihood	WC1, WC2, VC1, VC2, VC3, WLC5	Probability of Fire ("POF") Probability of Ignition ("POI")	Previous modeling steps	Asset Failure Risk Score	
AFR	Asset Failure Risk		Probability of Failure Consequence of Failure			
APF	Probability of Failure		Utility Asset Data Outage Data Condition Modifiers	GIS System OMS	Asset Probability of Failure Score	

ID	Risk Component	Design Scenario(s)	Key Inputs	Source of Inputs (Data and/or Models)	Key Outputs	Units
ACF	Consequence of Failure		Fire Consequence Metrics Community Resilience POI	Technosylva WFA	Asset Consequence of Failure Score	

PSPS Risk Model

ID	Risk Component	Design Scenario(s)	Key Inputs	Source of Inputs (Data and/or Models)	Key Outputs	Units
PR	PSPS Risk	WC1	PSPS Consequence PSPS Likelihood	Previous modeling steps	PSPS Risk	1/year
PC	PSPS Consequence	WC1	Outage duration Customer count by circuit	Customer records	PSPS CoRE	No unit
PL	PSPS Likelihood	WC1	PSPS thresholds relative to weather conditions	Gridded hourly weather data	PSPS LoRE	Count/year

~~ID~~	~~Risk Component~~	~~Design Scenario(s)~~	~~Key Inputs~~	~~Source of Inputs (Data and/or Models)~~	~~Key Outputs~~	~~Units~~
~~Fire Risk Model~~						
~~UR~~	~~Utility risk~~	~~WC1/VC1~~ ~~WC1/VC3~~ ~~WC3/VC23~~	~~Wildfire risk~~ ~~PSPS risk~~	~~Previous modeling steps~~	~~Utility risk~~	~~1/year~~
~~WR~~	~~Wildfire risk~~	~~WC1/VC1~~ ~~WC1/VC3~~ ~~WC3/VC23~~	~~Wildfire LoRE~~ ~~Wildfire CoRE~~	~~Previous modeling steps~~	~~Wildfire risk~~	~~1/year~~
~~WC~~	~~Wildfire consequence~~	~~WC1/VC1~~ ~~WC1/VC3~~ ~~WC3/VC23~~	~~Ignition patterns, impacted structures, acres burned~~	~~Ignition model~~ ~~Fire model~~	~~Wildfire CoRE~~	~~No unit~~

~~ID~~	~~Risk Component~~	~~Design Scenario(s)~~	~~Key Inputs~~	~~Source of Inputs (Data and/or Models)~~	~~Key Outputs~~	~~Units~~
~~WL~~	~~Wildfire likelihood~~	~~WC1/VC1~~ ~~WC1/VC3~~ ~~WC3/VC23~~	~~Spatiotemporal ignition patterns~~	~~Historical outages~~ ~~Weather data~~	~~Wildfire LoRE~~	~~Ignitions/year~~
~~PSPS Risk Model~~						
~~PR~~	~~PSPS risk~~	~~WC1~~	~~PSPS LoRE~~ ~~PSPS CoRE~~	~~Previous modeling steps~~	~~PSPS risk~~	~~1/year~~
~~PC~~	~~PSPS consequence~~	~~WC1~~	~~Outage duration &~~ ~~Customer count by circuit~~	~~Customer records~~	~~PSPS CoRE~~	~~No unit~~
~~PL~~	~~PSPS likelihood~~	~~WC1~~	~~PSPS thresholds relative to weather conditions~~	~~Gridded hourly weather data~~	~~PSPS LoRE~~	~~Count/year~~

6.2 Risk Analysis Framework

In this section of the WMP, the electrical corporation must provide a high-level overview of its risk analysis framework. This includes a summary of key modeling assumptions, input data, and modeling tools used.

At a minimum, the electrical corporation must evaluate the impact of the following factors on the quantification of risk:

- **Equipment/Assets** (*e.g.*, type, age, inspection, maintenance procedures, etc.)
- **Topography** (*e.g.*, elevation, slope, aspect, etc.)
- **Weather** (at a minimum this must include statistically extreme conditions based on weather history and seasonal weather)
- **Vegetation** (*e.g.*, type/class/species/fuel model, canopy height/base height/cover, growth rates, moisture content, inspection, clearance procedures, etc.)
- **Climate change** (*e.g.*, long-term changes in seasonal weather; statistical extreme weather; impact of change on vegetation species, growth, moisture, etc.) at a minimum, this must include adaptations of historical weather data to current and forecasting future climate
- **Social vulnerability** (*e.g.*, AFN, socioeconomic factors, etc.)
- **Physical vulnerability** (*e.g.*, people, structures, critical facilities/infrastructure, etc.)
- **Coping capacities** (*e.g.*, limited access/egress, etc.)

~~Liberty's wildfire risk analysis framework is grounded in well-established annualized burn probability modeling techniques[23] and best practices[24] that have been used to quantify fire risk, for example in the Wildfire Risk to Communities[25] project. The primary differences between power line fire risk modeling and conventional burn probability/fire risk modeling are:~~

1. ~~In utility wildfire risk modeling, geospatial ignition patterns are constrained to power lines, whereas in conventional fire risk modeling, past fire occurrence is used to build an ignition density surface that incorporates fires from all causes across the entire landscape.~~

~~[23] Finney, M.A., McHugh, C.W., Grenfell, I.C., Riley, K.L., and Short, K.C., "A simulation of probabilistic wildfire risk components for the continental United States," *Stochastic Environmental Research and Risk Assessment* **25**: 973-1000 (2011).~~

~~[24] Scott, J.H., Short, K.C., and Finney, M.A., "FSim: the large fire simulator Guide to best practices," Pyrologix LLC, March 2018 (available at https://pyrologix.com/wp-content/uploads/2019/11/FSimBestPractices_0.3.1.pdf)~~

~~[25] https://wildfirerisk.org/.~~

1. ~~The desired outcome from utility wildfire risk modeling is the risk associated with ignitions starting at power line-constrained locations, whereas in conventional fire risk modeling the desired outcome is risk from all-cause fires to specific locations on the landscape or specific Highly Valued Resources or Assets ("HVRAs").~~
2. ~~Temporal patterns in power line-caused fires occurrence are strongly influenced by wind speed and secondarily by dryness, whereas intermediate to long term fuel dryness, usually quantified as Energy Release Component ("ERC") percentile, drives temporal fire occurrence in conventional fire risk modeling.~~

~~The following factors are included in the wildfire risk analysis:~~

- ~~Equipment/assets: Location of overhead conductors~~
- ~~Topography: elevation, slope, aspect~~
- ~~Weather: Wind speed and direction, relative humidity and temperature, precipitation, etc.~~
- ~~Vegetation: Surface fuel model, canopy height, canopy base height, canopy bulk density, and canopy cover~~
- ~~Climate change: Potential changes in weather conditions by mid-century (2050)~~
- ~~Assets at risk: Structures and land area~~
- ~~Fire ignition and spread: Spatial and temporal patterns of power line-caused fire ignition and resultant spread, including impacts to assets at risk, under historical and future weather conditions.~~

~~Among the factors identified above, several (location of overhead conductors, topography, vegetation, and weather under current & climate adjusted conditions) impact the quantification of risk as GIS inputs to the fire consequence model described in Sections 6.2.1 and 6.2.2. The following factors are not currently included in the wildfire risk analysis although Liberty intends to incorporate these in the future as its risk modeling process continues to mature and develop:~~

- ~~Social vulnerability~~
- ~~Physical vulnerability~~
- ~~Coping capabilities~~

~~The following factors are included in the PSPS risk analysis:~~

- ~~PSPS thresholds~~
- ~~Historical weather and climate conditions~~
- ~~Medical baseline customers~~

- ~~Critical infrastructure customers~~

~~PSPS exposure potential and the vulnerability of a community to PSPS are considered by calculating the consequence of a PSPS on a circuit based on the corresponding total number of customers, total number of medical baseline customers, and total number of critical infrastructure customers. Circuits can therefore be assigned expected PSPS consequence scores based on safety, reliability and financial metrics calculated from a weighted sum of the expected customer minutes interrupted.~~

6.2.1 Risk and Risk Component Identification

In this section, the electrical corporation must provide a brief narrative and one or more simple graphics describing the framework that defines its overall utility risk. At a minimum, the electrical corporation must define its overall utility risk as the comprehensive risk due to both wildfire and PSPS events across its service territory.

Within its RBDM framework, Liberty's Composite risk score consists of modules for fire risk and asset failure risk. At a high level, the fire risk module is comprised of models for fire probability and fire consequence, while the asset failure risk module is comprised of models that inform on asset failure probability and consequence.

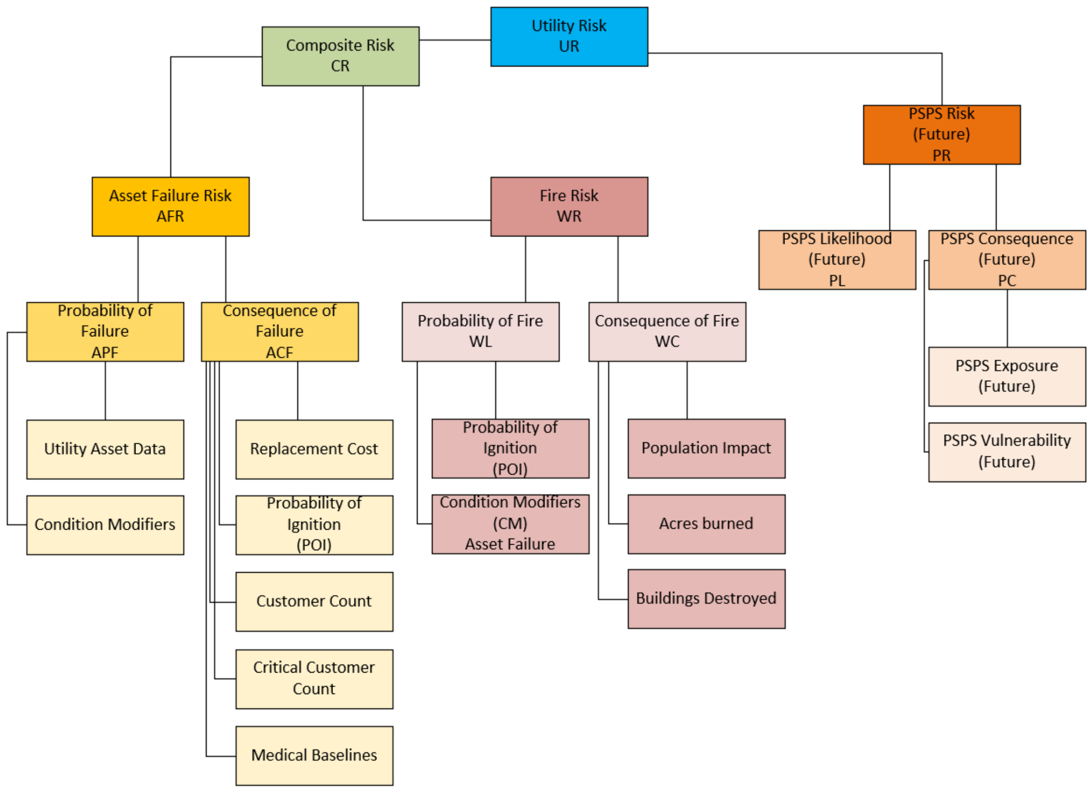
Topography, weather, and vegetation modeling are all factored into the fire risk module. The Asset Failure module includes internal asset data from Liberty's GIS database~~,~~ and is being developed in collaboration with Direxyon to identify the programs and maintenance activities that would reduce risk at specific locations in the system, such as covered conductor installation, pole replacements, or additional inspections. The creation of a Composite risk score using these models will aid Liberty in mitigating fire risk at locations in its service territory where the likelihood and potential consequence for a utility ignited fire is highest.

Currently, Liberty is utilizing its previous PSPS risk assessment methodology that was developed as part of its 2023-2025 WMP. In the future, Liberty will be implementing PSPS modeling into the Direxyon Risk Assessment Suite to align PSPS risk assessment with asset and fire risk assessments.

Liberty's PSPS risk model will consist of models for PSPS likelihood and PSPS consequence to the system, environment, and stakeholders if an event were to occur. Liberty plans to evaluate the development of an incumbent PSPS risk module after fire risk and asset failure risk modules are implemented in 2024. Upon completion, the PSPS risk module will be combined with Liberty's Composite risk score to produce an overall Utility Risk score.

Liberty's RBDM model framework is shown in Figure 6-3 below. ID numbers correspond to ID numbers in Table 6-1.

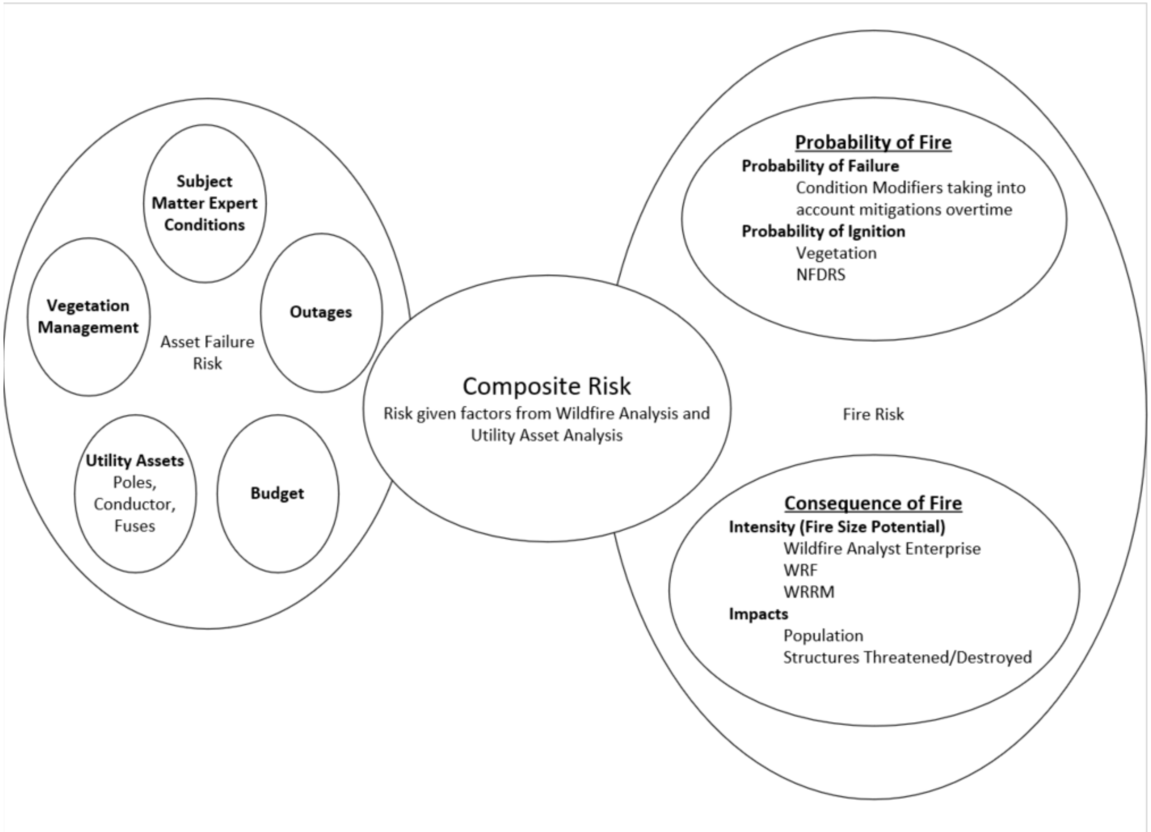
Figure 6-3: RBDM Framework



Utility Risk ("UR"): Throughout development, Liberty has prioritized implementation of its Composite risk score with the intention of shifting efforts to its PSPS risk module once the Composite score is implemented and tested for functionality. Until the PSPS risk module ~~can be~~ is completed, Liberty will utilize its Composite risk score to quantify overall Utility risk.

Composite Risk ("CR"): As described in Figure 6-3, Composite risk is comprised of the Asset Failure risk and Fire Risk modules. Liberty has utilized the modeling capabilities of Technosylva's WFA and the outputs of Technosylva's FireSight application, specifically the "conditional risk" and "expected risk" attributes, to build these models. Figure 6-4 below illustrates the components of the Composite risk score.

Figure 6-4: Composite Risk Score Framework



Fire Risk ("WR"): Direxyon calculates Fire Risk at the individual asset level, and the cumulative risk at each level, contributing to the overall fire risk. Fire Risk is calculated based on two components: Probability of Fire – WL and Consequence of Fire – WC.

*Probability of Fire * Consequence of Fire = Fire Risk*

Probability of Fire – WL: Refer to Section 6.2.2.1

Consequence of Fire – WC: Refer to Section 6.2.2.2

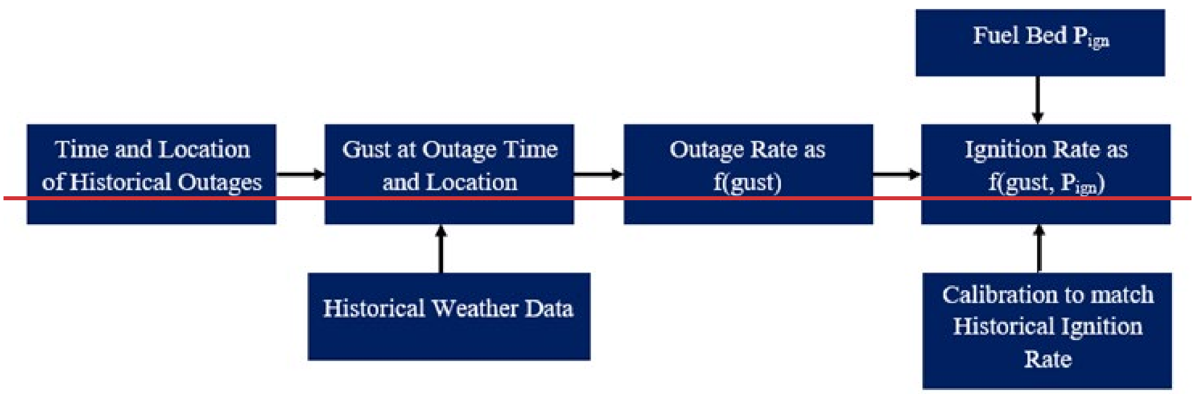
Asset Failure Risk – AFR: Refer to Section 6.2.2.3

~~Liberty's overall utility risk (see Figure 6-2) is the comprehensive risk associated with utility-caused wildfire and PSPS events across its service territory. As described previously, the four main components of overall utility risk include:~~

1. ~~**Wildfire likelihood**: Using historical outage and ignition data, a spatiotemporal wildfire occurrence model (hereafter, "ignition model") is used to provide expected ignition rates (ignitions per line mile per unit time) as a function of environmental factors (wind gust speed and fuel bed ignition probability, P_{ign}). A schematic of this ignition model is~~

~~provided in Figure 6-2. Combined with a long-duration hourly gridded weather stream, the ignition model makes it possible to estimate annualized ignition rates (ignitions per line mile per year) by circuit. In practice, this analysis is conducted simultaneously with wildfire consequence modeling and then converted to wildfire LoRE by multiplying each circuit's annualized ignition rate by its length to arrive at expected ignitions per year by circuit. Liberty's ignition model does not separate fire occurrence into discrete sequential processes (ignition followed by transition to a wildfire as in the Technical Guidelines) because it provides ignition rates for fires that have the potential to become propagating wildfires. Liberty does not possess sufficient fire ignition statistical data to incorporate drivers such as equipment, vegetation contact, and object contact in an ignition model as suggested by the Technical Guidelines. Finally, Liberty also does not consider burn probability from fires caused by sources other than utilities as in the Technical Guidelines. Liberty may revisit these modeling approaches in the future to more closely align with the Technical Guidelines, as appropriate.~~

~~Figure 6-2: Schematic of ignition model that is used for wildfire likelihood and consequence modeling~~



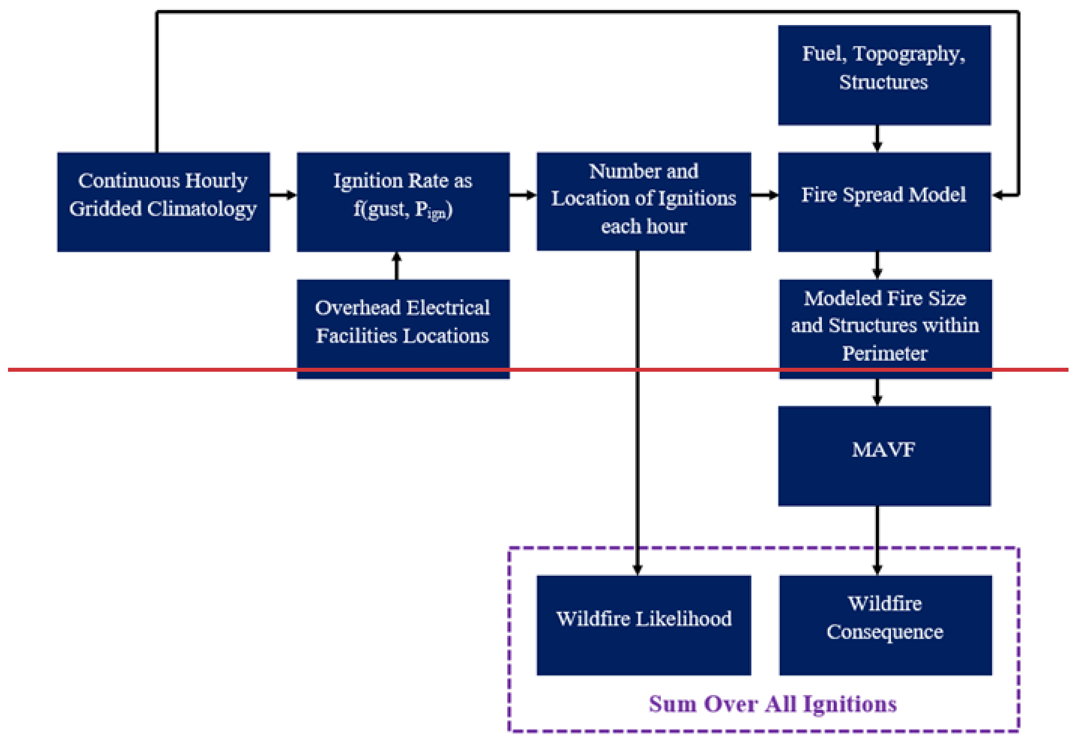
2. ~~**Wildfire consequence**: The ignition model described above is used to model spatiotemporal distribution of ignitions across the service territory, hour by hour, under a continuous gridded hourly weather stream. A fire spread model is then used to quantify the consequence of each of these ignitions. Because the consequences of wildfires – particularly catastrophic utility-caused wildfires, which are ignited under high winds – are strongly dependent on fire weather conditions at and immediately after ignition, Liberty's wildfire consequence modeling is directly coupled to its wildfire likelihood modeling. At each hour in the driving climatology and for each ignition location as determined by the ignition model, the Eulerian Level set Model of FIRE~~

~~spread ("ELMFIRE") operational fire spread model~~[26][27] ~~is used to calculate fire consequence in terms of total acres burned and number of structures within the modeled fire perimeter. This is repeated for millions of ignitions. A MAVF that considers both safety (EF) and financial impacts is used to combine the number of structures within the fire perimeter and acres burned into an overall CoRE score for each circuit. A schematic of the coupled wildfire likelihood and consequence modeling is shown in Figure 6-3. No attempt is made to quantify whether a structure within a modeled fire perimeter is damaged or destroyed because this is beyond the capabilities of fire protection engineering and fire science. Put differently, generalized structural fragility curves that link hazard from fire models (such as flame length or ember flux) to a structure's probability of being damaged or destroyed do not yet exist, although this remains an active research area. For these reasons, wildfire hazard intensity, wildfire exposure potential, and wildfire vulnerability as defined in the Technical Guidelines, are not direct considerations in Liberty's fire consequence modeling. Liberty may incorporate these factors in the future if ongoing research matures to the point that generalized fragility curves have been developed, disseminated, and validated.~~

[26] ~~Lautenberger, C., "Wildland Fire Modeling with an Eulerian Level Set Method and Automated Calibration," Fire Safety Journal 62: 289-298 (2013).~~

[27] ~~Lautenberger, C., "Mapping Areas at Elevated Risk of Large-Scale Structure Loss Using Monte Carlo Simulation and Wildland Fire Modeling," Fire Safety Journal 91: 768-775 (2017).~~

~~*Figure 6-3: Schematic of coupled wildfire likelihood and consequence model*~~



The two main components of utility PSPS risk are:

1. **PSPS Likelihood**: The purpose of the PSPS likelihood model is to estimate annualized proactive de-energization rates by circuit (PSPS LoRE). This is accomplished by analyzing historical gridded weather data and climate conditions to determine the annualized likelihood that PSPS thresholds (in terms of ERC percentile, wind gust, and Fosberg Fire Weather Index) are exceeded for each circuit.
2. **PSPS Consequence**: The purpose of the PSPS consequence model is to measure the anticipated adverse effects from a PSPS for the community at risk. The average PSPS duration is assumed to be a constant value for every circuit and weather condition, so that the PSPS consequence is only a function of the demographics of the circuit's customers. Therefore, for each circuit, given the average PSPS duration, the average CMI can be calculated based on the number of total customers expected to be impacted. A MAVF that considers safety equivalent facilities ("EF"), financial impacts, and reliability is used to calculate an overall dimensionless CoRE score for each circuit. The calculation of safety employs a weighted count of impacted customers that includes extra weight for the number of medical baseline and critical infrastructure customers expected to be impacted by the de-energized circuit.

6.2.2 Risk and Risk Components Calculation

The electrical corporation must calculate each risk and risk component defined in Section 6.2.1. Appendix B, "Calculation of Risk and Risk Components," provides additional requirements on these calculations. These are the minimum requirements and are intended to establish the baseline evaluation and reporting of all electrical corporations. If the electrical corporation identifies other key factors as important, it must report them in the WMP in a similar format.

The electrical corporation must provide schematics illustrating the calculation of each risk and risk component as necessary to demonstrate the logical flow from input data to outputs, including separate items for any intermediate calculations.

The electrical corporation must summarize any differences between its calculation of these risk components and the requirements of these Guidelines. These differences may include any of the following:

- **Additional input parameters** beyond the minimum requirements for a specific risk component
- **Calculations of additional outputs** beyond the minimum requirements for a specific risk component
- **Calculations of additional risk components** defined by the electrical corporation in Section 6.2.1

The process used to combine risk components must be summarized for each relevant risk component. This process must align with applicable CPUC decisions regarding the inclusion of Risk Assessment and Mitigation Phase ("RAMP") filings. If scaling factors (such as multi-attribute value functions ["MAVFs"] or representative cost) are used in this combination, the electrical corporation must present a table with all relevant information needed to understand this procedure. The electrical corporation must organize this discussion into the following two subsections focusing on likelihood and consequence.

6.2.2.1 Likelihood

The electrical corporation must discuss how it calculates the likelihood that its equipment (through normal operations or failure) will result in a catastrophic wildfire and the resulting likelihood of issuing a PSPS. The risk components discussed in this section must include at least the following:

- Ignition likelihood
  - Equipment failure likelihood of ignition

- Contact from vegetation likelihood of ignition
- Contact from object likelihood of ignition

- Burn probability
- PSPS likelihood

Liberty's Fire Risk module accounts for Probability of Fire using models for the Probability of Asset Failure ("APF"), and Probability of Ignition ("POI"). Refer to Figure 6-3 above for a visualization of this framework.

Probability of Asset Failure ("APF") – Ignition Likelihood: Liberty utilizes Direxyon's Asset Failure Risk model to identify the probability of failure given specific asset conditions. Adjustments to POF are based on characteristics of assets or mitigations within Liberty's WMP initiatives, such as conductor type and vegetation interventions. These characteristics act as condition modifiers that are calculated by Direxyon and reflect criteria not accounted for by Technosylva. Condition modifiers are necessary to account for the change of conditions over time due to repairs and mitigation work performed since the point in time when POF was calculated. Put simply, these condition modifiers allow Liberty to forecast risk while accounting for planned mitigation and repair work for up to a 30-year timeline. Poles are the only asset type with an age-based degradation factor and are therefore considered the primary driver of the asset failure probability component. Details on specific condition modifiers can be found in Appendix B. To calculate APF with condition modifiers Direxyon utilizes a Weibull distribution with age, material, and other condition modifiers identified by SMEs to quantify a probability score ranging from 1 to 9. As part of planned additions and enhancements, Liberty will include additional asset types to increase the coverage that APF has over its initiatives, rounding out the capability of its AFR module. Refer to Section 6.5 for a road map of planned enhancements to Liberty's RBDM framework. APF is derived from the formula below given the list of condition modifiers that can be input to the Weibull distribution.

Min((Weibull(Age: Material)):1) = APF

Condition Modifiers = $CMF_{[1\text{-}8]}$:

1. Pole Failure
2. Fuse Failure
3. Conductor Type
4. Conductor Cover
5. Count of Equipment on Pole
6. Tree Density

7. Fall In
8. Grow In

Probability of Ignition (POI) – WL: Burn Probability: Liberty utilizes the outputs of Technosylva's FireSight modeling tool to estimate the probability of a fire, or POI, starting from an ignition source given fuel, fuel dryness, and wind conditions. FireSight uses the National Fire Danger Rating System to perform this estimate. POI determines the probability that a burning material will create a wildfire that requires suppression. POI ranges on a scale from 0 to 1, and is calculated at various ignition points along Liberty's distribution and transmission circuits.

Probability of Fire – WC: The probability of fire is quantified as the inner product of POI and condition modifiers Direxyon has developed using the calculation below.

To achieve a unitless risk, the Probability of Fire is scaled from 1 to 9 as shown below.

$$Probability\ fire_{scaled} = min\ (\exp\left(Probability\ of\ Fire * \frac{\ln(10)}{Probabity\ of\ fire_{80th\ percentil}}\right), 9)$$

Condition Modifiers illustrate the impact of asset characteristics and specific interventions on the calculated POI from Technosylva. For example, POI from Technosylva is a static metric from a point in time, where applying the condition modifiers represents the difference between the modified assets since the initial state of the simulation. Condition modifiers are computed by the weighted sum using the calculation below.

$$CM = W_1 * CM_1 + \ldots + W_n * CM_n$$

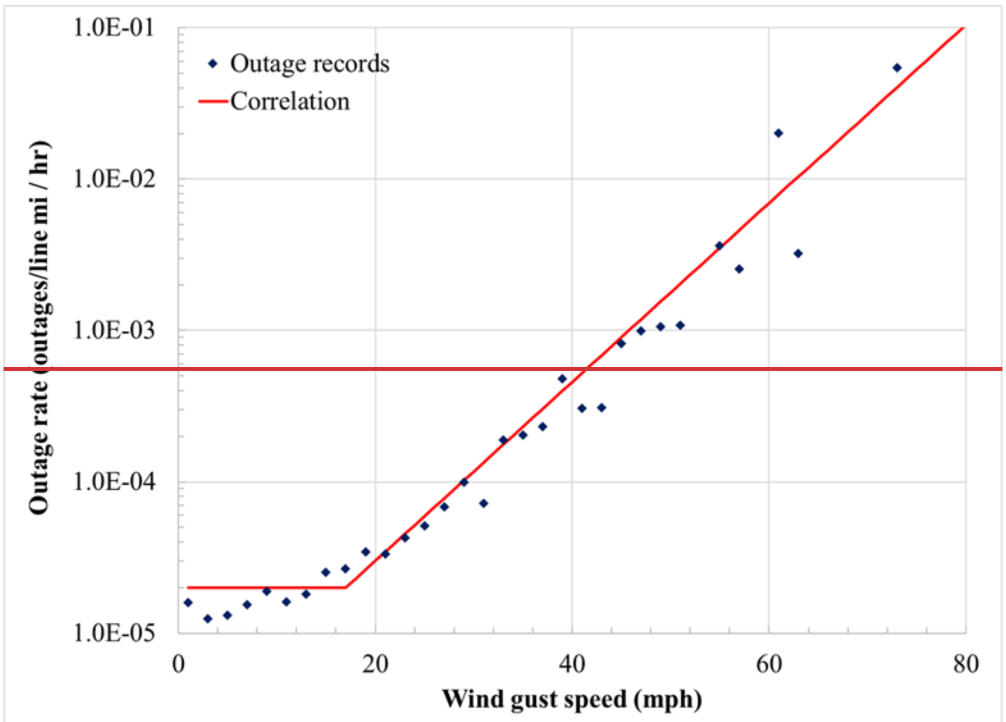
Full details of the condition modifiers related to each asset type are described in Appendix B.

~~Wildfire likelihood: Liberty's wildfire ignition model is based on correlation of its forced outage data with wind gust speed (Figure 6-4). Because this correlation (red line) provides outage rate ("OR," outages per line mile per hour) as a function of wind gust, two approximations are made to estimate ignition rate ("IR," ignitions per line mile per hour) as a function of environmental factors (*i.e.*, wind gust, fuel bed moisture content, and fuel bed temperature):~~

1. ~~Given a receptive fuel bed with zero fine dead fuel moisture content, ignition rate is proportional to forced outage rate, and~~

2. ~~Given a forced outage, the probability that the outage causes an ignition is proportional to National Fire Danger Rating System ("NFDRS") ignition probability, P_{ign}[28], which provides an estimate of fuel bed ignitability as a function of moisture content and temperature.~~

~~*Figure 6-4: Correlation of Outage Rate with Wind Gust Speed*~~



~~Under these approximations, ignition rate (IR, ignitions/line mi/hr) can be estimated from Equation 3 as:~~

$$\mathrm{IR} = F \times P_{ign} \times \mathrm{OR} \qquad (1)$$

~~In Equation 1, F is a calibration constant that is used ensure that the overall modeled wildfire likelihood matches Liberty's historical fire ignition data. This ignition submodel captures the salient feature of power line fire occurrence, namely that fire ignitions are exponentially more likely to occur under high winds that drive catastrophic fire losses than under low wind conditions. For example, using this fire occurrence submodel, ignition rate is approximately 10,000 times greater for wind gusts of approximately 80 mph wind gust than for wind gusts below approximately 16 mph.~~

[28] ~~Bradshaw, L.S., Deeming, J.E., Burgan, R.E., and Cohen, J.D., "The 1978 National Fire-Danger Rating System: Technical Documentation," United States Department of Agriculture Forest Service, Intermountain Forest and Range Experiment Station, General Technical Report INT-169, 1983.~~

~~Modeling proceeds as a Monte Carlo simulation that stochastically models spatiotemporal patterns of power line fire occurrence over approximately 100,000 years of fire occurrence. A continuous gridded hourly climatology is used and fires are permitted to ignite every hour in the driving climatology. The actual number of fires that occur each hour is determined from instantaneous environmental conditions (wind gust, fuel moisture, and fuel temperature) using the ignition submodel described above. For each hour:~~

1. ~~Ignition rate is calculated from wind gust, fine dead fuel moisture, and temperature (Equation 1) at all 30 m grid cells within a buffer surrounding overhead electrical facilities.~~
1. ~~Random sampling is used to distribute ignition locations proportional to this modeled ignition rate across the service territory.~~
2. ~~For each ignition location, fire spread is modeled and consequences are tallied (see Section 6.2.2.2).~~

~~With this approach to ignition modeling, fire occurrence is highly variable in both space and time. Due to the exponential dependency of power line fire ignition rate on wind gust, fire occurrence may be dominated by a small number of low probability/high consequence wind events, to the extent that they are reflected in the driving climatology.~~

~~After progressing sequentially through each hour of the climatological data, the total number of ignitions is summed for each circuit. Ignition rate (ignitions/line mi/year) is then calculated at the circuit level as the total number of modeled ignitions divided by the circuit length (line miles) divided by the total equivalent number of years simulated (approximately 100,000). Wildfire annualized Likelihood of Risk Event (“LoRE”) is then calculated for each circuit by multiplying its ignition rate by its length.~~

PSPS likelihood: Until Liberty can develop, implement, and test a PSPS Risk model under its improved RBDM framework, it will continue to utilize the PSPS likelihood methodology described in its 2023-2025 WMP~~PSPS LoRE is modeled as follows~~:

1. Climate data are used to estimate the probability, by month, that ERC percentile is above the ERC percentile threshold for PSPS on a given day.
2. Gridded historical weather data are analyzed to determine the probability, by month, that wind gust speed and Fosberg Fire Weather Index exceed circuit-specific de-energization thresholds.
3. For each month, ERC percentile exceedance probability is multiplied by wind gust/Fosberg exceedance probability, and all months are summed to arrive at annualized PSPS LoRE.

4. For conservatism, PSPS LoRE is set to the maximum of 2% and the PSPS LoRE as calculated above.

6.2.2.2 Consequence

The electrical corporation must discuss how it calculates the consequences of a fire originating from its equipment and the consequence of implementing a PSPS event. The risk components discussed in this section must include at least the following:

- Wildfire consequence
- Wildfire hazard intensity
- Wildfire exposure potential
- Wildfire vulnerability
- PSPS consequence
- PSPS exposure potential
- PSPS vulnerability

Liberty's Fire Risk module accounts for Consequence of Fire using consequence metrics calculated by FireSight. Refer to Figure 6-3 above for a visualization of this framework.

Consequence of Fire or Wildfire Consequence ("WC"): Technosylva's FireSight application conducts fire simulations with an 8-hour duration, based on a typical first burning period. FireSight produces a set of consequence metrics that quantify various fire impacts. These metrics include potential acres burned, population impacted, number of buildings threatened, and estimated number of buildings destroyed. FireSight is used to conduct the modeling, deliver these metrics as outputs, and monitor and visualize model results.

Utilizing tools developed by Direxyon, Liberty derives fire consequence utilizing FireSight consequence metrics for Acres Burned, Population Impact, and Number of Buildings Destroyed:[29]

- Population Impact: Total population impacted by the simulation footprint.
- Fire Size Potential (Acres Burned): Total simulation size in acres. The Fire Size Potential represents the actual simulated acreage of a fire based on the local fuels, weather, and terrain starting from an ignition at a specific location and time.

[29] https://help.wildfireanalyst.com/wfae-web/data-outputs

- Estimated Number of Buildings Destroyed: Estimated number of buildings destroyed for each simulation, derived using Building Loss Factor (“BLF”) data assigned to each building.

The consequence model outputs do not change based on the assets’ conditions and are considered static. Therefore, condition modifiers are not considered for consequence metrics. Each consequence model output has summarized output metrics that are calculated to include:

- Standard ~~D~~deviation values for all simulations.
- Average values for all simulations.
- Percentiles values for all simulations (0, 20, 40, 50, 60, 80, 90, 95, 98, 100).

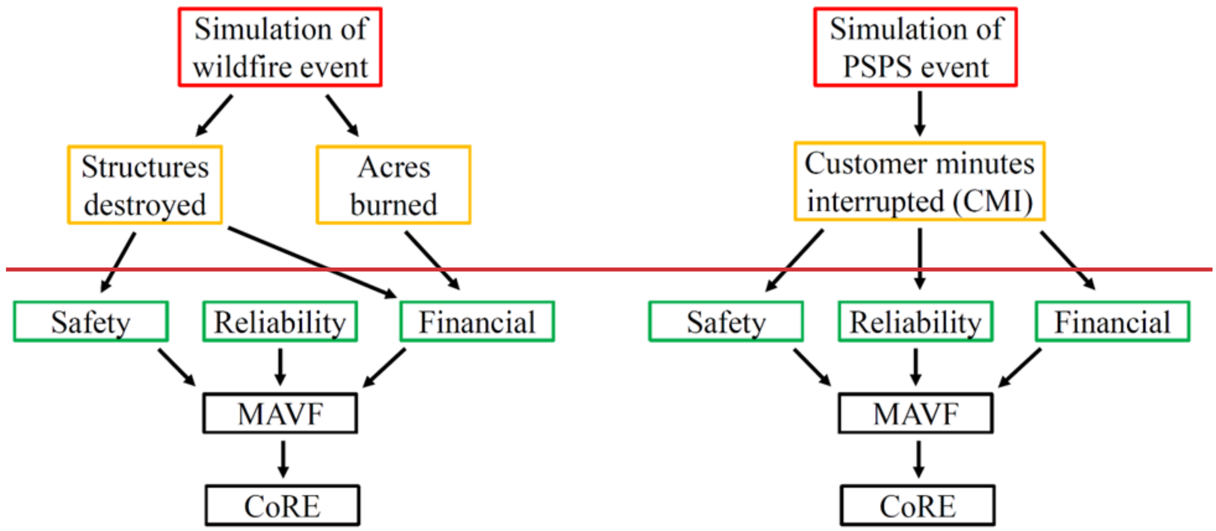
Wildfire Hazard Intensity: Intensity of a wildfire is defined as the potential intensity of a wildfire at a specific location within the service territory factoring the probabilistic characteristics of weather profiles, vegetation, and topography at a given point in time. Hazard Intensity is calculated using Technosylva’s WFA modeling to quantify wildfire risk given outputs from surface fire, crown fire, wind, spotting, encroachment, spark modeling, weather, and impact and consequence as detailed in Section 2.4.3, “Equations and Implementation,” of Appendix B-1.

Wildfire Exposure Potential: Exposure potential of a wildfire is defined as the potential impact to people, property, critical infrastructure, livelihoods, health, environmental services, economies, cultural/historical resources, and other high value assets factoring in indirect, short-term, and long-term impacts. Exposure ~~P~~potential is calculated using values at risk (“VAR”) as underlying inputs to Technosylva’s models that calculate locational risk factors with respect to wildfire hazard. Liberty’s Wildfire Consequence Model quantifies exposure potential as an overall risk score of VAR where “risk” associated with resources and assets, with risk representing the possibility of loss or harm occurring due to wildfire. A detailed description of VAR and its use in Technosylva’s WFA is provided in Section 2.5.5, “Values at Risk,” of Appendix B-1.

Wildfire Vulnerability: Vulnerability is defined as the resources available to anticipate, cope with, resist, and recover from the adverse effects of a wildfire. Vulnerability is calculated using VAR as underlying inputs to Technosylva’s models that calculate locational risk factors. Wildfire vulnerability is a part of Liberty’s Wildfire Consequence model ~~which~~ that quantifies the factors of VAR, such as population count (location), building footprints, and critical facilities. A detailed description of VAR and its use in Technosylva’s WFA is provided in Section 2.5.5, “Values at Risk,” of Appendix B-1.

~~Liberty’s approach to consequence modeling is summarized in *Figure 6-5*.~~

~~*Figure 6-5: Overall Consequence Modeling Approach*~~



~~The MAVF used for both wildfire consequence and PSPS consequence can be summarized by the table below. All scaling is linear.~~

~~*Table 6-2: Summary of MAVF for Wildfire and PSPS*~~

~~**Attributes**~~	~~**Unit**~~	~~**Range**~~	~~**Weight**~~
~~Safety~~	~~Equivalent Fatalities (EF)~~	~~0 – 20~~	~~60%~~
~~Reliability~~	~~Customer Minutes Interrupted (CMI)~~	~~0 – 1 billion~~	~~20%~~
~~Financial~~	~~Dollars~~	~~0 – 1 billion~~	~~20%~~

~~The MAVF summarized above was developed in accordance with the 2018 Safety Model Assessment Proceeding (“S-MAP”).~~

~~Wildfire consequence~~~~**: Wildfire consequence modeling is conducted simultaneously with wildfire likelihood modeling because they are linked through the fire occurrence submodel described above. For each ignition, the following data is recorded:**~~

- ~~**Fire area (acres)**~~
- ~~**Structures within modeled perimeter**~~

~~**Liberty’s risk modeling does not currently include an explicit step that quantifies the likelihood that its equipment could cause a catastrophic wildfire because the current ignition model provides ignition rates for fires that have the potential to become propagating wildfires. However, because fire size and number of impacted structures are outputs from**~~

~~each modeled fire, these quantities could be compared with the Technical Guidelines' definition of "catastrophic wildfire", i.e. fires that damage over 500 structures or burn over 5,000 acres.~~

~~As explained previously in Section 6.2.1, wildfire hazard intensity, wildfire exposure potential, and wildfire vulnerability are not currently considered in Liberty's wildfire consequence modeling due to limitations of fire protection engineering and fire science. However, these factors may be included in Liberty's future modeling efforts work as ongoing research matures. Similarly, PSPS exposure potential and PSPS vulnerability are not presently included in Liberty's current PSPS modeling, but will be included as Liberty's risk model continues to mature and develop.~~

~~An overall wildfire CoRE score is calculated for each circuit using a MAVF. Safety and financial impacts are the two inputs to the MAVF used to calculate wildfire CoRE by circuit:~~

1. ~~*Safety*: Safety is quantified in terms of equivalent fatalities ("EF"), which is estimated from the number of structures within each modeled fire perimeter. Recent data from California suggesting a ratio of one fatality for every 260 structures destroyed[30] are used here. The EF range is 0 – 20.~~
2. ~~*Financial impacts*: Financial impacts are estimated from acres burned and the number of structures within each modeled fire perimeter, assuming a value of $1,000,000 per structure and $2,000 per acre burned.[31] The financial impacts range is 0 - $1 billion.~~

PSPS consequence: PSPS consequence modeling is decoupled from PSPS likelihood modeling and can therefore be done independently. The expected CMI for each circuit is calculated by multiplying the total number of customers dependent on the circuit by an average de-energization time of 24 hours, which accounts for the expected duration of the weather event, ~~as well as~~including the time to de-energize and re-energize before and after the event. For each circuit, the following summary data is recorded:

- Safety: Safety is quantified in terms of EF, which is estimated by multiplying the expected number of fatalities per CMI (1.5×10^{-9} EF/CMI[32]) by the Weighted Customers. The number of Weighted Customers is calculated based on the equation below:

~~[30] https://www.fire.ca.gov/stats-events/.~~

~~[31] https://www.fire.ca.gov/stats-events/ and https://www.fire.ca.gov/media/px5lnaaw/suppressioncostsonepage1.pdf.~~

[32] This is estimated as based on a review of the 2003 Northeast Blackout, in which about 100 fatalities occurred as a result of power outages to about 50 million people lasting, on average, 2 days (48 hours). It is then estimated that there are 2.1 people per electricity customer based on national 2021 EEI data.

$$\text{Weighted Customers} = \text{Safety Multiplier} \times \text{Total Customers} \tag{2}$$

The Safety Multiplier is calculated based on the equation below:

$$\text{Safety Multiplier} = \frac{30\times(\text{Medical Customers})+30\times(\text{Critical Infrastructure Customers})+(\text{Other Customers})}{\text{Total Customers}} \tag{3}$$

1. Reliability: Reliability is measured by using CMI directly.
2. Financial impacts: Financial impacts are estimated from CMI using an estimated value of $250 per customer per 24-hour period of de-energization (or $0.17 per CMI).

PSPS exposure potential and PSPS vulnerability are not presently included in Liberty's current PSPS modeling but will be included in future work. Liberty's PSPS Risk Assessment will consist of models for PSPS likelihood and PSPS consequence to the system, environment, and stakeholders if an event were to occur. Liberty plans to evaluate the development of an incumbent PSPS Risk Assessment after Fire Risk and Asset Failure Risk models have been put into production in 2024.

6.2.2.3 Risk

The electrical corporation must discuss how it calculates each risk and the resulting overall utility risk defined in Section 6.2.1. The discussion in this section must include at least the following:

- Ignition risk
- PSPS risk
- Overall utility risk

Composite Risk (Ignition Risk): The components of Liberty's Ignition Risk score, named Composite Risk, and its role in the overall RBDM framework, are described in Section 6.2.1. The Composite Risk score encapsulates the average Fire Risk ("WR") at the individual asset level and the calculated Asset Failure Risk ("AFR") at the circuit level. Through collaboration between Liberty's subject matter experts ("SMEs") and Direxyon, it was determined that an initial allocation of 50% weight to each component was appropriate. Weight allocations are configurable, and can be easily adjusted during the simulation process. The formula for quantifying Composite Risk is outlined below.

W_n = Weight given where the sum of weightings = 1.

$$\textit{Overall Probability of Failure} = (W_{APF} * APF) + (W_{WL} * WL)$$

*Overall Consequence of Failure = (W_{ACF} * ACF) + (W_{WC} * WC)*

*Composite risk = Overall Probability of Failure * Overall Consequence of Failure*

As shown in Figure 6-3, Composite Risk (Ignition Risk) is comprised of the following modules for WR and AFR:

Fire Risk ("WR"): Direxyon computes WR at the individual asset level, and the cumulative risk at each level contributes to the overall fire risk assessment of the utility network. Each individual asset type's fire risk is comprised of WL and WC, as shown in the formula below.

*WL * WC = WR*

Asset Failure Risk ("AFR"): AFR is derived from the risk scores for Probability of Failure ("APF") and Consequence of Failure ("ACF"), which are quantified by Direxyon's modeling tools. AFR allows Liberty to identify those mitigations and programs that will reduce the risk of an asset failing and potentially causing an ignition, as measured in the Probability of Fire ("WL") model of the Fire Risk ("WR") module. Liberty's proprietary asset data is utilized as an input to AFR modeling~~,~~ and is used to calculate current and forecasted risk scores for specific asset or mitigation types, as well as Risk Spend Efficiency ("RSE") metrics. For example, AFR utilizes historical data from vegetation inspections in various zones adjacent to Liberty's assets in order to forecast vegetation fall-in and grow-in potential. In doing so, it identifies segments of the service territory that may require a higher inspection frequency based on an increased level of fall-in or grow-in risk. The AFR module can then produce an RSE that will inform the budget forecast for work that will reduce a specified amount of risk to those segments. By comparing analysis for different segments, Liberty can identify locations in its service territory where it makes the most sense to reduce risk given the probability and consequence of a vegetation-related event occurring. AFR is comprised of risk scores for Probability of Failure ("APF") and Consequence of Failure ("ACF"), as shown in the formula below:

*ACF * APF = AFR*

PSPS Risk: Liberty's PSPS risk module will consist of models for PSPS likelihood and PSPS consequence to the system, environment, and stakeholders if an event were to occur. Liberty plans to evaluate the development of an incumbent PSPS risk module after fire risk and asset failure risk modules have been put into production in 2024.

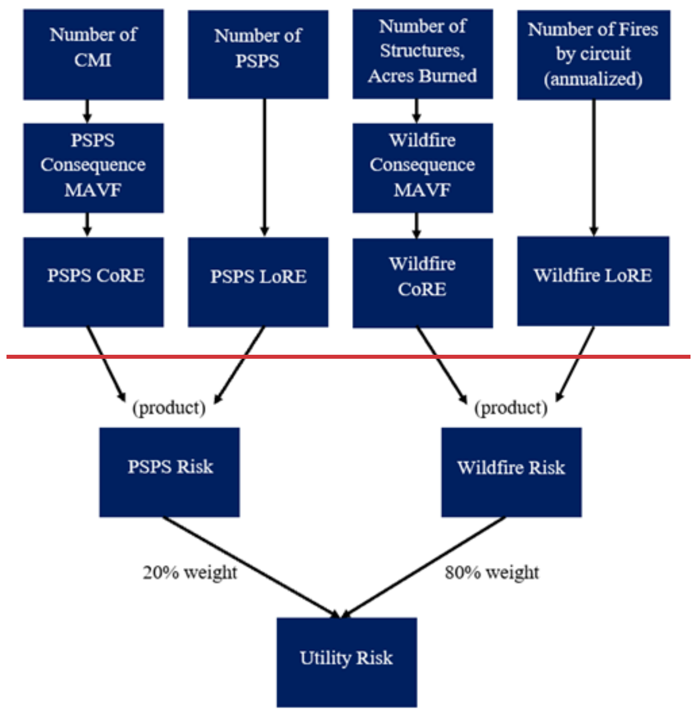
Utility Risk: As discussed in Section 6.2.1 above, a calculation for overall Utility risk will not be available until after a module for PSPS risk ("PR") can be developed. In the interim, Composite Risk ("CR") is being utilized in its place

~~The three main risk components are:~~

1. ~~Wildfire risk is calculated for each circuit by multiplying wildfire LoRE by wildfire CoRE.~~
2. ~~PSPS risk is calculated for each circuit by multiplying PSPS LoRE by PSPS CoRE.~~
3. ~~Overall utility risk is calculated by circuit from wildfire risk and PSPS risk, with an 80% weight to wildfire risk and 20% to PSPS risk.~~

~~This is summarized schematically in Figure 6-6.~~

~~*Figure 6-6: Utility Risk Calculation Schematic*~~



6.2.3 Key Assumptions and Limitations

Because the individual elements of risk assessment are interdependent, the interfaces between the various risk models and mitigation initiatives must be internally consistent. In this section of the WMP, the electrical corporation must discuss key assumptions, limitations, and data standards for the individual elements of its risk assessment.

The primary risk modeling assumptions and limitations are provided in Table 6-2~~of the modeling approach described above are broken down by wildfire/PSPS likelihood and consequence:~~

~~Wildfire likelihood:~~

1. ~~Presence or absence of canopy has a real-world effect on ignition probability but is not included in the wildfire likelihood model.~~
2. ~~Although subtransmission/transmission lines are more resilient than distribution lines, circuit voltage is not considered in the wildfire likelihood submodel~~
3. ~~Asset health and system configuration, presence of covered conductor, etc. do not factor into the wildfire likelihood submodel.~~

~~Wildfire consequence: All operational wildfire spread models, including the model used here to quantify wildfire consequence, have several well-known limitations including:~~

1. ~~Suppression is not taken into consideration and fires are modeled as unsuppressed.~~
2. ~~Fire spread in high-density urban areas where surface fuels are classified as urban is not modeled.~~
3. ~~Fire and atmosphere interactions are not modeled, leading to under-prediction of spread for plume-dominated fires.~~
4. ~~The contribution of large diameter fuels (coarse woody debris > 3" diameter) is not included in the underlying surface fire spread model.~~

~~PSPS likelihood:~~

1. ~~The PSPS likelihood analysis is based on historical weather analysis data whereas the decision to implement a PSPS is based on weather forecast data.~~
2. ~~Due to the use of historical weather analysis data, climate change and "black swan" events may not be captured in the PSPS likelihood analysis~~

~~PSPS consequence:~~

1. ~~The actual consequences of de-energization to customers may be non-linear in nature (*e.g.*, 1 outage for 100 minutes may be more consequential than 100 outages for 1 minute) but this model assumes the consequences are linear.~~
2. ~~Customers not designated as medical baseline customers or critical infrastructure customers are all assigned equal weight in terms of PSPS consequences.~~

~~3.~~1. ~~The availability of backup power for customers who may have it is not incorporated explicitly~~.

Table 6-2: ~~3~~Primary Risk Modeling Assumptions and Limitations

Assumption	Justification	Limitation	Applicable Models
The physical framework development is based on an idealized situation in steady state spread, which may not fit some extreme behavior of fires.~~Ignition rate is quantified in terms of wind gust and fuel bed ignitability.~~	The model is semi-empirical and as a result does not capture all possible wildfire scenarios.~~Internal analysis shows CPUC-reportable ignitions strongly correlated with wind gust and fuel-bed ignitability.~~	The model may not represent unique weather cases.~~Asset health and presence or absence of canopy is not considered.~~	Wildfire Spread Model~~Ignition model/Wildfire likelihood~~
Fuels are assumed to be continuous and uniform for the scale of the input (typically between 10-to-30-meter (m) resolution)~~Wildfire consequence quantified from MAVF that estimates EF from structures within perimeter and financial impact from acres burned.~~	This is the highest resolution data available across the service territory, and the standard for fuels mapping for fire agencies and IOUs in the US.~~A simple method is needed to combine safety (EF) and financial impacts (acres burned).~~	Real fuels are more granular and thus not captured by the fire spread modeling.~~Modeling structure losses and fatalities is beyond the current capabilities of fire science. Land value varies. Suppression costs not considered.~~	Wildfire Spread Model~~Wildfire consequence~~

Assumption	Justification	Limitation	Applicable Models
Fire characteristics at a point only depends on the conditions at that point (point-functional model). This means that there are certain non-local phenomena like: • Increase of ROS due to a concave front. • Fire interaction between different parts of the same fire or a different one.	Point functional models are much faster to solve than non-local ones.	Several non-local effects like radiation concentration from different parts of the front are not considered.	Wildfire Spread Model
Fire spread is assumed to be elliptical although there are several variations such as double ellipse, oval, egg-shape, etc.	Fire perimeters obtained in constant wind and slope conditions are known to have a pseudo elliptical shape. The difference between existing fire shape models is small and it is not clear which one is the correct one.	This approach would does not capture the real spread mechanism of fire nor the small difference in fire shape, and only captures a macroscopic shape of the perimeter.	Wildfire Spread Model
Weather is given hourly and is assumed to remain constant during that time. There is no interpolation in time to compute evolution of weather between hours.	Computing sub hourly wind speeds is expensive and not the standard among fire agencies or IOUs. Sub hourly data is not readily available.	Winds change more rapidly than at the hour level and thus are not captured by the fire spread model.	Wildfire Spread Model

Assumption	Justification	Limitation	Applicable Models
Reliability of weather inputs in the mid-range forecast (2 to 5 days)	Weather forecasts become less accurate the further out in time you model, however WRF models are proven to be very accurate in reflecting past weather scenarios and predicting future short-term weather scenarios.	Fire spread models are impacted due to imperfect weather.	Wildfire Spread Model
Fire is not coupled with the atmosphere in any way. This may seem like a major limitation in the model as wind is a main contribution to fire spread and at present many models (especially physical ones) try to couple wind and fire.	It is not technically feasible to run millions of simulations considering the coupling effect given current science and technology. Empirical and semiempirical models have been developed using an average wind speed as an input, so it is not clear that considering more granular wind at the front is advisable or performs less.	Fire atmosphere interactions are not captured.	Wildfire Spread Model
Fire is always assumed to be fully developed. Fire acceleration, flashover, or decay is not considered.	Fire acceleration only affects the initial time of the fire expansion and its effect on an 8-hour simulation may not be too significant.	Models are not valid for short duration fires.	Wildfire Spread Model
Atmospheric instability which may have a deep impact on ROS (beer 1991) is not considered in the model.	Capturing atmospheric instability is not easy with the present forecast available.	There is a significant range of fire behavior that may not be considered in the model.	Wildfire Spread Model

Assumption	Justification	Limitation	Applicable Models
Gusts are not considered in the model.	Gust duration is highly unpredictable and that could affect the fire very differently.	Fire behavior at a lower scale is not expected to follow a simple symmetrical behavior with respect to wind and slope.	Wildfire Spread Model
No interaction between slope and wind other than creating an effective or equivalent wind. This means that fire is assumed to have an elliptical shape no matter the alignment of wind and slope.	The slope-wind effect is known to be significantly symmetrical in fires under control conditions. There are not many nonphysical models that describe the wind-slope effect in a non-symmetrical way.	Fire behavior at a lower scale is not expected to follow a simple symmetrical behavior with respect to wind and slope.	Wildfire Spread Model
Fuel array description of the vegetation may not perfectly describe fuel characteristics.	There are no perfect fuel datasets available at the territory scale. However, additional custom fuel models have been developed and used to reflect more accurate spread in WUI, agricultural and timber areas.	Fuel characteristics are not captured perfectly by the fire spread model.	Wildfire Spread Model
Spotting is only considered in surface fires.	Calculating crown spotting would require having an accurate tree inventory (height, species, width, etc.). However, the models are still thoroughly validated on non-surface fires.	Wildfire spread for crown fires is impacted.	Wildfire Spread Model

Assumption	Justification	Limitation	Applicable Models
Asset Risk Condition Modifier weights are projected based on manufacturer, historical, and scientific data.	To project the condition of an asset in the future, the condition must be modified to account for work performed on the system to calculate risk.	Condition Modifiers may not accurately portray the projected risk.	Probability of Failure (APF) Condition Modifiers influence POI or POF Weibull for Asset Failure
POI should be scaled on the same scale as the other models.	To make the risk easily interpretable, the POI is scaled from 1 to 9.	There’s no logical threshold between 1 and 2 and 3.	Consequence of Failure (ACF) Probability of Fire (POF)
Conductor risk factors are equivalent.	There is not sufficient knowledge to accurately weight the conductor risk factors.	It is considered that the material is equivalent in risk to length of span, even if it’s not.	Probability of Failure (APF)
Conductor does not have a degradation factor.	Lack of information on present number of splices on the network, age of conductor, and failure model.	The conductor will not degrade over time in the model.	Probability of Failure (APF)
Projected Vegetation work orders are based on past work orders.	There’s no other way to estimate work volume to do and it seems to give accurate results.	The model will tend to mimic what was done in the past, which may not be accurate.	Probability of Failure (APF)
Degradation of vegetation uses data outside of Liberty’s available data.	Let the model simulate growth of vegetation.	Vegetation Degradation is based on scientific research and not historical data.	Probability of Failure (APF)
The decision trees may suggest interventions that would not be typically done in the field.	Uses overtime will allow for Liberty and Direxyon to fine tune the decision trees.	Until the model is validated the decision tree output are subject to SME review.	Probability of Failure (APF)

Assumption	Justification	Limitation	Applicable Models
Deterministic methods can pinpoint the exact time of asset failure.	Direxyon uses Monte Carlo Simulation Methodology.	Asset failures are inherently unpredictable in real-world situations.	Asset Failure Risk (AFR)
Deterministic methods can estimate cost.	Direxyon uses Monte Carlo Simulation Methodology.	Costs are inherently unpredictable in real-world situations.	Asset Failure Risk (AFR)

6.3 Risk Scenarios

In this section of the WMP, the electrical corporation must provide a high-level overview of the scenarios to be used in its risk analysis in Section 6.2. These must include at least the following:

- **Design basis scenarios** that will inform the electrical corporation's long-term wildfire mitigation initiatives and planning
- **Extreme-event scenarios** that may inform the electrical corporation's decisions to provide added safety margin and robustness

The risk scenarios described in Sections 6.3.1 and 6.3.2 below are the minimum scenarios the electrical corporation must assess in its wildfire and PSPS risk analysis. The electrical corporation must also describe and justify any additional scenarios it evaluates.

Each scenario must consider:

- **Local relevance:** Heterogeneous conditions (*e.g.*, assets, equipment, topography, vegetation, weather) that vary over the landscape of the electrical corporation's service territory at a level sufficiently granular to permit understanding of the risk at a specific location or for a specific circuit segment. For example, statistical wind loads must be calculated based on wind gusts considering the impact of nearby topographic and environmental features, such as hills, canyons, and valleys
- **Statistical relevance:** Percentiles used in risk scenario selection must consider the statistical history of occurrence and must be designed to describe a reasonable return interval/probability of occurrence. For example, designing to a wind load with a 10,000-year return interval may not be desirable as most conductors in the service territory would be expected to fail (*i.e.*, the scenario does not help discern which areas are at elevated risk)

6.3.1 Design Basis Scenarios

Fundamental to any risk assessment is the selection of one or more relevant design basis scenarios (design scenarios). These scenarios will inform long-term mitigation initiatives and planning. In this section, the electrical corporation must identify the design scenarios it has prioritized from a comprehensive set of possible scenarios. The scenarios identified must be based on the unique wildfire and PSPS risk characteristics of the electrical corporation's service territory and achieve the primary goal and stated plan objectives of its WMP.

Weather is already considered in Technosylva's model as well as fire risk/consequence and population risk/consequence. Additionally, Liberty considers asset, budget, and labor scenarios as a part of the Direxyon Risk Assessment Tool ("DRAT").

Table 6-3 summarizes the design basis scenarios utilized in Technosylva's WFA suite. Refer to Appendix B for more detail regarding Technosylva design scenarios.

Table 6-3: Liberty Summary of Design Basis Scenarios

Scenario ID	**Design Scenario**	**Purpose**
WLC1	Wind Load	Baseline wind load used in design, construction, and maintenance.
WLC2	Wind Load	95th percentile wind gusts based on maximum daily values over a 30-year history.
WLC3	Wind Load	Wind gusts with a probability of exceedance of five percent over the three-year WMP cycle (i.e. 60-year return interval)
WLC4	Wind Load	Wind gusts with a probability of exceedance of one percent over the three-year WMP cycle (i.e. 300-year return interval).
WLC5	Wind Load	WFA models wind speeds to identify at what point a specific transmission or distribution circuit may fail in windy conditions. The results are based on three-hour aggregated probabilities based on the maximum wind gust during that three-hour period.
WC1	Weather Condition	Anticipated weather conditions over the next three years. This is based on historical weather days that best represents the days when weather and fuel conditions can lead to increased risk of ignition.

Scenario ID	Design Scenario	Purpose
WC2	Weather Condition	Long-~~-~~term conditions. Technosylva has calculated the historical weather days that best represent the days when weather and fuel conditions can lead to increased risk of ignition based on their Weather Research and Forecast (WRF) Model. WRF is calculated annually to capture new days that should be incorporated into the historical weather days to account for changing conditions in locations.
VC1	Vegetation Condition	Modeling of current vegetation conditions to identify where current vegetation fuels risk.
VC2	Vegetation Condition	Modeling of projected 2025 vegetation conditions to identify potential mid-range vegetation fuels risk.
VC3	Vegetation Condition	Modeling of projected 2030 vegetation conditions to identify potential long-range vegetation fuels risk.

~~Wind loading on electrical equipment: Liberty adheres to G.O. 95 heavy loading pole calculations when designing new pole additions or for rebuilding existing overhead lines, that includes design of covered conductor projects.~~

~~Class A heavy loading calculations are the highest strength requirement for G.O. 95 design and construction standards. Any consideration above a Class A design would be in exceedance of G.O. 95 safety standards that were recently reviewed and adopted in CPUC Decision ("D") 20-01-010.[33] D.20-01-010 adopted several revisions to G.O. 95. However, only one change revised Pole Loading Calculation for Added Facilities in Rule Change 44.2.~~

~~In addition, heavy loading considers the resultant stress due to wind, ice, and dead weight under the following conditions:~~

1. ~~Wind: A horizontal wind pressure of six pounds per square foot of projected area on cylindrical surfaces, and 10 pounds per square foot on flat surfaces shall be assumed. Where latticed structures are used, the actual exposed area of one lateral face shall be increased by 50% to allow for pressure on the opposite face, provided this computation~~

~~[33] In May 2020, the California Public Utilities Commission (CPUC) finalized significant changes updating rules were adopted as part of Rulemaking 17-10-010, Rulemaking to Consider Amendments to General Order 95—that commenced in 2017 with a petition filed by the CPUC's Safety & Enforcement Division (SED). The G.O. 95 rule changes became effective in May 2020.~~

~~does not indicate a greater pressure than would occur on a solid structure of the same outside dimensions, under which conditions the latter shall be taken.~~

2. ~~Ice: A radial thickness of one–half inch of ice, weighing 57 pounds per cubic foot, on all conductors shall be assumed in computing vertical and wind loadings.~~
3. ~~Temperature: Conductor temperature shall be assumed to be 0°F at the time of maximum loading. A conductor temperature of at least 130°F shall also be assumed for computing sag and its effect on structural loads due to weight span.~~

~~Wind Load Condition 1: Baseline~~

~~Liberty uses wind loading factors of six pounds per square foot of horizontal wind pressure of the projected area on cylindrical surfaces, and 10 pounds per square foot on flat surfaces. Liberty's engineering and design team factors in the following assumptions to account for local conditions when designing the structural integrity needs of a new pole or to redesign an overhead line segment.~~

- ~~Local known windy locations, such as the Topaz overhead lines. Design scenarios could include different sag requirements to lessen the likelihood for line galloping or installing covered conductor lines with breakaway ties.~~
- ~~Loading considerations for significant snow event scenarios (ex. Echo Summit line project).~~

~~Additional information on wind load conditions is provided in Table 6-4 below.~~

~~Table 6-4. Wind Load Condition Summary~~

~~Wind Load Condition~~	**~~Compliance Requirement~~**	**~~Wind Gust Scenarios~~**	**~~Liberty - G.O. 95 Heavy Loading Requirement~~**
~~Condition 1 – Baseline~~	~~G.O. 95 Section 31.1: Apply to all Overhead Lines, not Liberty specific~~	~~Locally relevant 3-second wind gusts over a 30-year wind speed history during fire season in its service territory~~	~~A horizontal wind pressure of six pounds per square foot of projected area on cylindrical surfaces, and 10 pounds per square foot on flat surfaces shall be assumed. Where latticed structures are used, the actual exposed area of one lateral face shall be increased by 50% to allow for pressure on the opposite face, provided this computation does not indicate a greater pressure than would occur on a~~

~~Wind Load Condition~~	~~Compliance Requirement~~	~~Wind Gust Scenarios~~	~~Liberty - G.O. 95 Heavy Loading Requirement~~
			~~solid structure of the same outside dimensions, under which conditions the latter shall be taken.~~
~~Condition 2 - Very High~~	~~G.O. 95 Section 31.1: Apply to all Overhead Lines, not Liberty specific~~	~~95th percentile wind gusts based on 30-year history~~	~~A horizontal wind pressure of six pounds per square foot of projected area on cylindrical surfaces, and 10 pounds per square foot on flat surfaces shall be assumed. Where latticed structures are used, the actual exposed area of one lateral face shall be increased by 50% to allow for pressure on the opposite face, provided this computation does not indicate a greater pressure than would occur on a solid structure of the same outside dimensions, under which conditions the latter shall be taken.~~
~~Condition 3 - Extreme~~	~~G.O. 95 Section 31.1: Apply to all Overhead Lines, not Liberty specific~~	~~Wind gusts with prob of exceeding 5 percent (*i.e.*, 60-year return interval)~~	~~A horizontal wind pressure of six pounds per square foot of projected area on cylindrical surfaces, and 10 pounds per square foot on flat surfaces shall be assumed. Where latticed structures are used, the actual exposed area of one lateral face shall be increased by 50% to allow for pressure on the opposite face, provided this computation does not indicate a greater pressure than would occur on a solid structure of the same outside~~

~~**Wind Load Condition**~~	~~**Compliance Requirement**~~	~~**Wind Gust Scenarios**~~	~~**Liberty - G.O. 95 Heavy Loading Requirement**~~
			~~dimensions, under which conditions the latter shall be taken.~~
~~Condition 4 – Credible Worst Case~~	~~G.O. 95 Section 31.1: Apply to all Overhead Lines, not Liberty specific~~	~~Wind gusts with prob of exceeding 1 percent (*i.e.*, 300-year return interval)~~	~~A horizontal wind pressure of six pounds per square foot of projected area on cylindrical surfaces, and 10 pounds per square foot on flat surfaces shall be assumed. Where latticed structures are used, the actual exposed area of one lateral face shall be increased by 50% to allow for pressure on the opposite face, provided this computation does not indicate a greater pressure than would occur on a solid structure of the same outside dimensions, under which conditions the latter shall be taken.~~

~~Weather conditions used in calculating fire behavior: Fire weather refers to the use of quantities such as wind speed, relative humidity (or vapor pressure deficit), and temperature to quantify how favorable conditions are for fire development. Fire behavior calculations are dependent on fire weather inputs, and the Technical Guidelines prescribe two weather conditions for use in fire behavior calculations:~~

1. ~~Weather Condition 1 (Anticipated conditions): Weather conditions representative of the next three years of the WMP cycle.~~
2. ~~Weather Condition 2 (Long-term conditions): Weather conditions that are representative of the last 30 years.~~

~~Weather Condition 1 (Anticipated conditions) was developed from a 12-year RTMA[34]-based climatology with a period of record from 2011 – 2022.~~

~~To address Weather Condition 2, Liberty applied Monte Carlo simulation of synthetic fire seasons in accordance with approaches presented by the United States Forest Service[35, 36] using 44 years (1979 – 2022) of data from gridMET.[37] A sample synthetic season time series is presented in Figure 6-7. Monthly statistics were compared with analogous statistics developed from 12 years (2011-2022) of RTMA data, and it was determined that within Liberty's service territory the last 12 years of weather are more severe from a fire weather standpoint than the last 44 years due to the non-stationary nature of climate. For that reason, weather condition 2 (long term conditions over the last 30 years) was not analyzed because it is less conservative than Weather Condition 1. For future work, Liberty may commission a 30-year gridded hourly climatology to better align its modeling approach with the Technical Guidelines and explicitly address Weather Condition 2.~~

~~Wildfire likelihood and consequence modeling was constrained to a May 15 – December 1 "fire season" because fire activity in Liberty's service territory has historically been insignificant outside of this window.~~

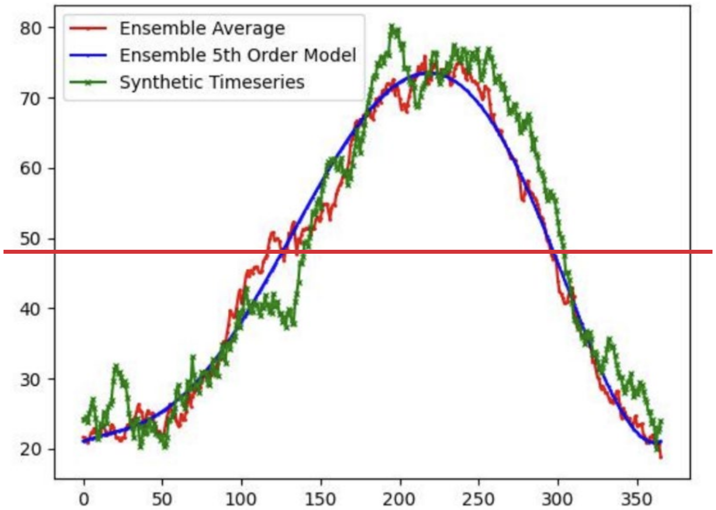
~~34 https://www.nco.ncep.noaa.gov/pmb/products/rtma/.~~

~~35 M. A. Finney, I. C. Grenfell, C. W. McHugh, R. C. Seli, D. Trethewey, R. D. Stratton, and S. Brittain, 2011, "A Method for Ensemble Wildland Fire Simulation," *Environmental Modeling & Assessment* 16, no. 2: 153–167.~~

~~36 M. A. Finney, C. W. McHugh, I. C. Grenfell, K. L. Riley, and K. C. Short, 2011, "A Simulation of Probabilistic Wildfire Risk Components for the Continental United States," *Stochastic Environmental Research and Risk Assessment* 25: 973–1000.~~

~~37 https://www.climatologylab.org/gridmet.html.~~

~~*Figure 6-7*: Synthetic ERC Timeseries (x-axis is Julian day)~~



~~Vegetation conditions: The Energy Safety Technical Guidelines prescribe three vegetation conditions for use in fire behavior calculations:~~

1. ~~Vegetation Condition 1: Existing fuel load~~
2. ~~Vegetation Condition 2: Short-term forecasted fuel load~~
3. ~~Vegetation Condition 3: Long-term extreme fuel load~~

~~For fire behavior modeling purpose, Vegetation Condition 1 was developed from 2022-capable fuel inputs. Vegetation Condition 3 was developed by regrowing previously burned areas and is representative of fuel conditions on a time horizon of approximately 10 years. Since Vegetation Condition 2 represents intermediate fuel loads, using Vegetation Condition 1 and Vegetation Condition 3 effectively bounds vegetation conditions.~~

~~Design basis scenarios: For the purposes of wildfire likelihood and consequence modeling, a design basis scenario is a unique combination of weather conditions and vegetation conditions. The design basis scenarios that were analyzed are summarized in Table 6-5.~~

~~*Table 6-5. Liberty Summary of Design Basis Scenarios*~~

~~**Scenario ID**~~	~~**Design Scenario**~~	~~**Purpose**~~
~~WC1/VC1~~	~~Weather Condition 1~~ ~~Vegetation Condition1~~	~~Wildfire likelihood and consequence modeling~~

~~Scenario ID~~	~~Design Scenario~~	~~Purpose~~
~~WC1/VC3~~	~~Weather Condition 1~~ ~~Vegetation Condition 3~~	~~Wildfire likelihood and consequence modeling~~

6.3.2 Extreme-Event/High Uncertainty Scenarios

In this section, the electrical corporation must identify extreme-event/high-uncertainty scenarios that it considers in its risk analysis.

Liberty's RBDM platform quantifies fire risk and asset failure risk using the design basis scenarios described in Section 6.3.1 above. Liberty is assessing the ability of FireSight to account for extreme or high uncertainty scenarios. Refer to Table 6-4.

~~To address the role of climate change on fire behavior, Liberty developed Weather Condition 3 to represent mid-century (2050) climatology/weather. This was accomplished using dynamically downscaled Weather Research and Forecasting ("WRF") data initialized with global climate models from the 6th Coupled Model Intercomparison Project ("CMIP6").[38] This data provides hourly gridded fields of temperature, relative humidity, wind speed, and wind direction at 3 kilometer resolution. A 10-year temporal block from years 2046 – 2055 was selected for analysis. Table 6-6 summarizes this scenario.~~

~~[38] https://registry.opendata.aws/wrf-cmip6/~~

Table 6-4: ~~6.~~Liberty Summary of Extreme-Event Scenarios

Scenario ID	Extreme-Event Scenario	Purpose
ES1~~WC3/VC3~~	Climate Change 1 Weather Condition 2~~3~~ Vegetation Condition 3	Impact of climate change on long-term weather and vegetation conditions that impact fire behavior. ~~Wildfire likelihood and consequence modeling~~

6.4 Risk Analysis Results and Presentation

In this section of the WMP, the electrical corporation must present a high-level overview of the risks calculated using the approaches discussed in Section 6.2 for the scenarios discussed in Section 6.3.

The risk presentation must include the following:

- Summary of electrical corporation-identified high fire risk areas in the service territory
- Geospatial map of the top risk areas within the High Fire Risk Area (HFRA) (*i.e.*, areas that the electrical corporation has deemed at high risk from wildfire independent of HFTD designation)
- Narrative discussion of proposed updates to the HFTD
- Tabular summary of top risk-contributing circuits across the service territory
- Tabular summary of key metrics across the service territory

The following subsections expand on the requirements for each of these.

6.4.1 Top Risk Areas within the HFRA

In this section, the electrical corporation must identify top risk areas within its self-identified HFRA, compare these areas to the CPUC's current HFTD, and discuss how it plans to submit its proposed changes to the CPUC for review.

6.4.1.1 Geospatial Maps of Top-Risk Areas within the HFRA

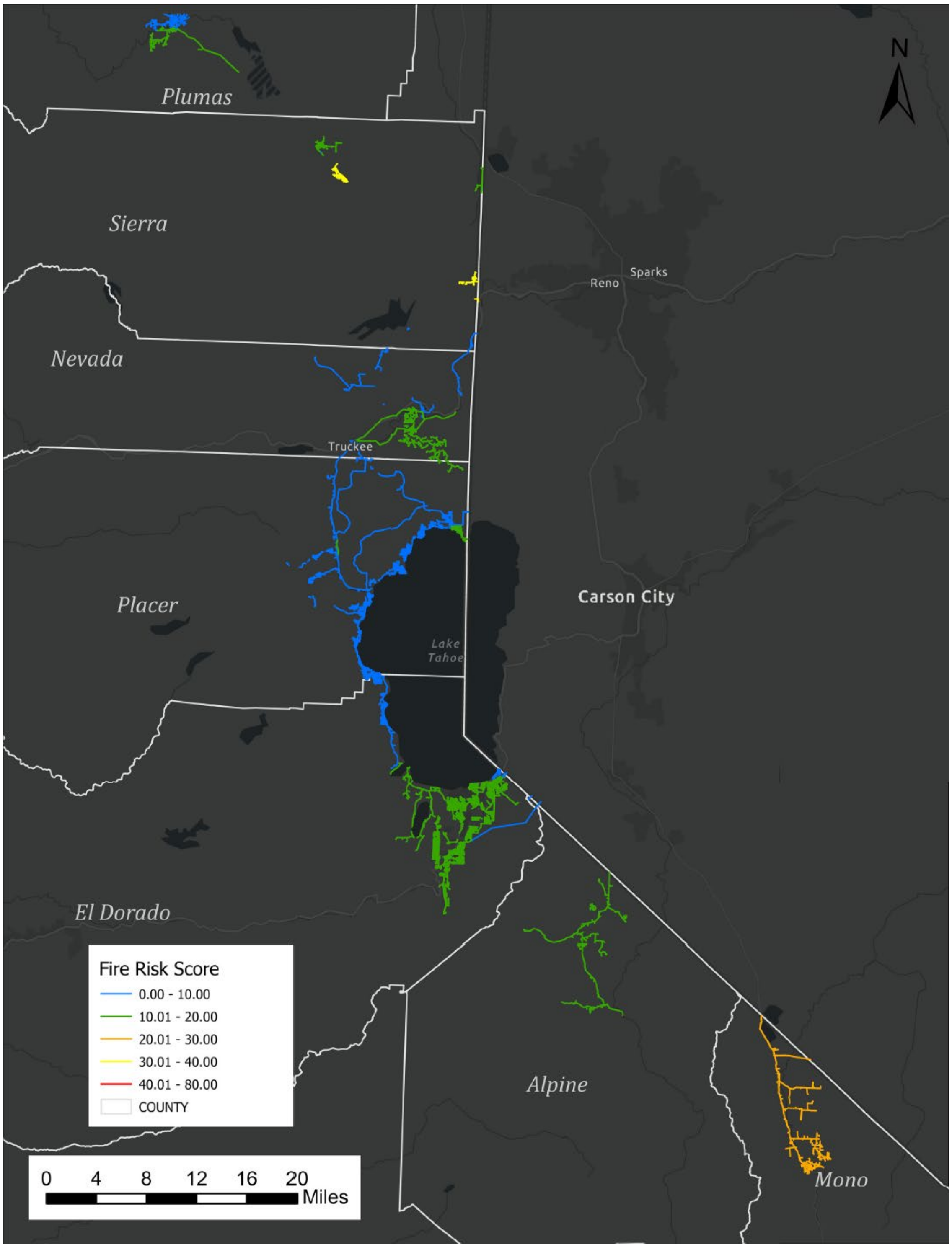
The electrical corporation must evaluate the outputs from its risk modeling to identify top risk areas within its HFRA (independent of where they fall with respect to the HFTD). The electrical corporation must provide geospatial maps of these areas.

The maps must fulfill the following requirements:

- **Risk levels:** Levels must be selected to show at least three distinct levels, with the values based on the following:
    - Top 5 percent of overall utility risk values in the HFRA
    - Top 5 to 20 percent of overall utility risk values in the HFRA
    - Bottom 80 percent of overall utility risk values in the HFRA
- **Colormap:** The colormap of the risk levels must meet accessibility requirements (recommended colormap is Viridis)
- **County lines:** The map must include county lines as a geospatial reference
- **HFTD tiers:** The map must show a comparison with existing HFTD Tiers 2 and 3 regions.

~~Figure 68~~Figure 6-5 is a map of utility fire risk in California counties, and Figure 6-6 ~~Figure 69~~ is an analogous map with Tier 2 and Tier 3 high fire threat district polygons. These maps represent preliminary outputs produced by Direxyon. Liberty's Fire Risk model is expected to be in production in Quarter 3 of 2024.

Figure 6-5 ~~8~~: Liberty Fire Risk Map with County Borders



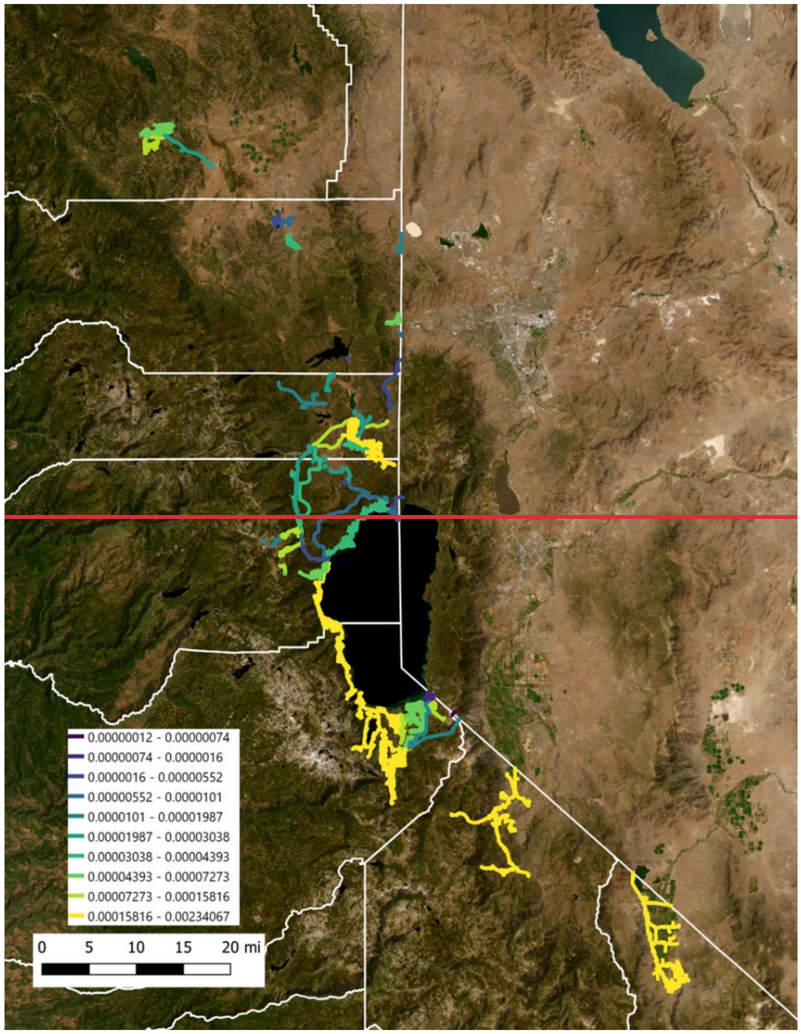
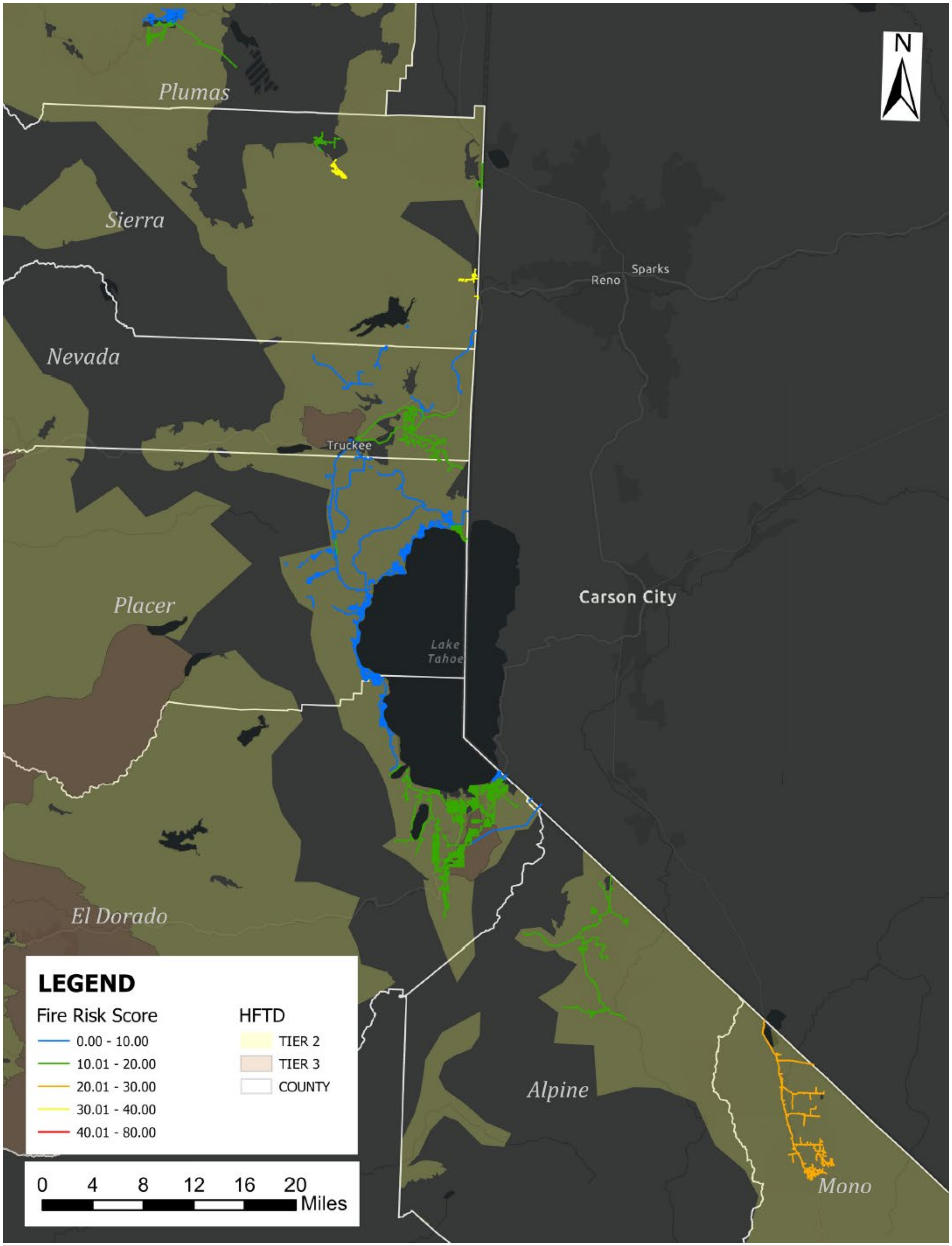
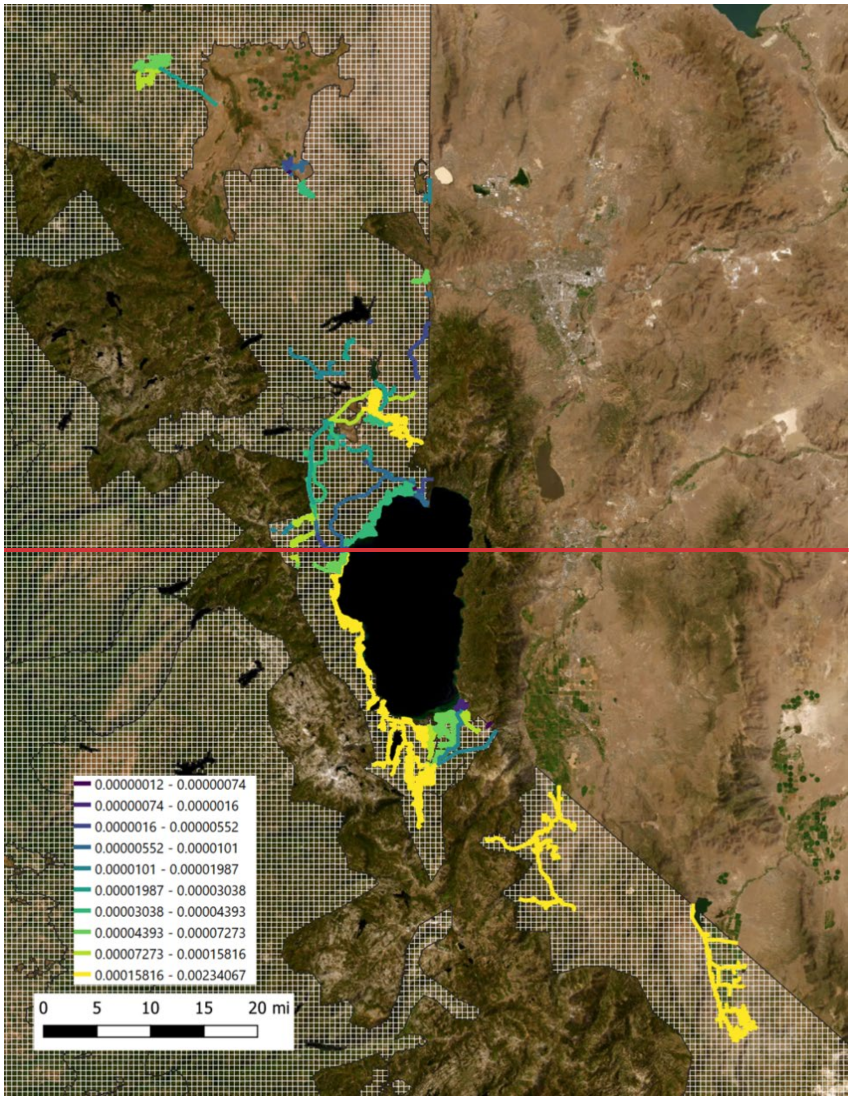

0.00000012 - 0.00000074
0.00000074 - 0.0000016
0.0000016 - 0.00000552
0.00000552 - 0.0000101
0.0000101 - 0.00001987
0.00001987 - 0.00003038
0.00003038 - 0.00004393
0.00004393 - 0.00007273
0.00007273 - 0.00015816
0.00015816 - 0.00234067
0 5 10 15 20 mi

Figure 6-6: Liberty Fire Risk Map with HFTD Polygons





6.4.1.2 Proposed Updates to the HFTD

In this section, the electrical corporation must discuss the differences between the electrical corporation-identified top-risk areas within the HFRA and the existing CPUC-approved HFTD. The electrical corporation must identify areas that its risk analysis indicates are at a higher risk than indicated in the current HFTD. The electrical corporation must also describe its process for submitting proposed changes to the HFTD to the CPUC, if such changes are desired; the electrical corporation need not conclude that the HFTD should be modified. Any proposed changes to the HFTD must be mapped in accordance with the requirements in the previous sub-section.

Currently, Liberty does not have any proposed updates to the CPUC-defined HFTD areas. In the CPUC-approved HFTD risk maps, most of Liberty's service territory is designated as Tier 2, with a single Tier 3 designation in the Meyers circuits ~~of~~ in the South Lake Tahoe area. As shown in Section 6.4.2, Liberty's current risk modeling identifies some circuits as having higher risk than this Tier 3 area when the consequence of fires (structures impacted, acres burned) are quantitively calculated and assessed.

Although Liberty does not currently propose updates to the CPUC-approved HFTD areas, Liberty intends to actively participate in future rulemakings addressing HFTD mapping and will provide input at that time. In accordance with CPUC requirements, if Liberty identifies areas in ~~our~~ its service territory that should be added to or removed from the HFTD, Liberty ~~would~~ will submit those proposed modifications to the CPUC via a petition for modification to D.17-12-024. This petition for modification would, at a minimum, provide a unique identifier for each area proposed for modification, define the area's geographic boundaries, and present rationale for why Liberty believes the modification is warranted.

6.4.2 Top Risk-Contributing Circuits/Segments/Spans

The electrical corporation must provide a summary table showing the highest-risk circuits, segments, or spans[39] within its service territory. The table should include the following information about each circuit:

- **Circuit, Segment, or Span ID:** Unique identifier for the circuit, segment, or span
- **Overall utility risk scores:** Numerical value for each risk
- **Top risk contributors:** The risk components that lead to the high risk on the circuit

The electrical corporation must rank its circuits, segments, or spans by circuit-mile-weighted overall utility risk score and identify each circuit, segment, or span that significantly contributes to risk. A circuit/segment/span significantly contributes to risk if it:

1. Individually contributes more than 1 percent of the total overall utility risk; or
2. Is in the top 5 percent of highest risk circuits/segments/spans when all circuits/segments/spans are ranked individually from highest to lowest risk.

~~Table 6-7~~Table 6-5 provides risk scores for Liberty's top 20 risk-contributing circuits.

Table 6-5: ~~7:~~ Liberty Top-Risk Circuits

[39] For the section, the electrical corporation may use either circuits, segments, or spans, whichever is more appropriate considering the granularity of its risk model(s).

Risk Ranking	Circuit	Composite Risk Score	Fire Risk Score	Asset Failure Risk Score
1	STL3101	27.9439408	17.4916161	28.1626272
2	TPZ1261	24.33849979	23.3308025	17.64815582
3	MEY3200	23.89626556	12.24412266	31.75587828
4	CAL204	23.87746171	31.46516196	11.68490153
5	MEY3300	23.33960489	16.46418173	28.62590154
6	CEM41	23.1484375	15.90151952	19.2890625
7	MEY3400	23.13973442	10.82709268	29.59332652
8	T640	23.07749077	16.5128694	15.89114391
9	MEY3100	22.86836935	12.20107026	28.95343811
10	MEY3500	22.62896871	19.33121787	26.45724218
11	STL3501	22.54609929	12.02970858	27.28014184
12	POR32	22.38978307	9.522927366	27.42491253
13	POR31	22.2193865	10.98820784	25.97447853
14	SRB51	21.22222222	30.22581151	10.74213836
15	TRK7203	20.64498141	9.780865584	22.04460967
16	WSH201	20.1671159	9.699994921	24.09703504
17	KBH4202	19.28797127	11.43895671	18.02692998
18	CEM42	19.17560976	11.06651664	18.75609756
19	MULLER1296	18.68535524	14.04229006	16.15659739
20	SLK257	17.96491228	17.99090088	10.1754386

Risk Ranking	Circuit	Utility Risk	Wildfire Risk	PSPS Risk
1	TPZ1261	2.34E-03	2.28E-03	6.51E-05
2	MULLER1296	3.74E-04	3.29E-04	4.57E-05
3	MEY3400	3.30E-04	1.15E-04	2.15E-04
4	TAH7300	2.71E-04	6.74E-05	2.04E-04
5	GLS7400	2.00E-04	1.76E-04	2.42E-05
6	MEY3300	1.86E-04	8.17E-05	1.04E-04
7	STL3101	1.55E-04	1.28E-05	1.42E-04
8	POR31	1.45E-04	1.45E-04	0.00E+00
9	SQV8200	8.56E-05	8.39E-05	1.63E-06
~~10~~	~~SQV7201~~	~~8.12E-05~~	~~5.95E-05~~	~~2.16E-05~~
11	608	7.87E-05	7.87E-05	1.30E-09
12	MEY3200	7.35E-05	1.69E-05	5.66E-05
13	MEY3100	7.25E-05	1.63E-05	5.62E-05
14	STL3501	6.36E-05	3.02E-06	6.06E-05
15	TAH7100	6.26E-05	1.45E-05	4.81E-05
16	MEY3500	5.45E-05	2.66E-05	2.79E-05
17	CAL204	5.33E-05	5.33E-05	0.00E+00
18	POR32	5.10E-05	5.10E-05	0.00E+00
19	TRK7204	4.09E-05	4.09E-05	0.00E+00
20	SRB51	3.42E-05	3.42E-05	0.00E+00

6.4.3 Other Key Metrics

The electrical corporation must calculate, track, and present on several other key metrics of risk across its service territory. These include, but are not limited to the frequency of:

- **High Fire Potential Index (FPI):** The electrical corporation must specify whether it calculates its own FPI or uses an external source, such as the United States Geological Survey.[40]
- **Red Flag Warning (RFW)**
- **High Wind Warning (HWW)**

For each metric, the frequency of its occurrence within each HFTD tier and the HFRA must be reported in the table below. The metric must be reported in number of overhead circuit mile (OCM) days of occurrence normalized by circuit miles within that area type. For example,

40 United States Geological Survey Fire Danger Map and Data Products Web Page (accessed Oct. 27, 2022): https://firedanger.cr.usgs.gov/viewer/index.html.

consider an electrical corporation with 1,000 OCM in HFTD Tier 3. If 100 of these OCM are under a RFW for one day, and 10 of those OCM are under a RFW for an additional day, then the average RFW-OCM per OCM would be:

$$\frac{RFW\_OCM}{OCM} = \frac{(100 \times 1 + 10 \times 1)}{1000} = 0.1$$

This metric represents the average RFW-OCM experienced by an OCM within the electrical corporation's service territory within HFTD Tier 3. If the metric is continuous (such as FPI), the report should include a note stating the threshold used to select high values.

Other key metrics Liberty uses to track risk across its service territory include:

- High Fire Potential Index ("FPI"): ~~Liberty uses a~~ The proprietary FPI ~~to~~ informs on PSPS and related activities within designated FPI zones.
- Red Flag Warning ("RFW"): RFWs issued by the National Weather Service are used to calculate overhead line miles subject to RFW per quarter.
- High Wind Warning ("HWW"): HWWs issued by the National Weather Service are used to calculate overhead line miles subject to HWW~~RFW~~ per quarter.

For each metric, the frequency of its occurrence within each HFTD tier is reported in Table 6-8. The values shown in ~~Table 6-8~~Table 6-6 have been normalized by circuit miles within each HFTD across the entire service territory

Table 6-6 ~~8~~:~~.~~ Liberty Summary of Key Metrics by Statistical Frequency in 2023

Metric	Non-HFTD (circuit mile days)	HFTD Tier 2 (circuit mile days)	HFTD Tier 3 (circuit mile days)
FPI-OCM/ OCM	~~50.043~~11.999	~~48.585~~248.778	~~40.004~~235.203
RFW-OCM/ OCM	~~0.045~~0.0	~~0.002~~0.0	~~0.000~~0.0
HWW-OCM/ OCM	~~0.343~~0.0	~~0.689~~5.500	~~0.809~~0.180

6.5 Enterprise System for Risk Assessment

In this section, the electrical corporation must provide an overview of inputs to, operation of, and support for a centralized wildfire and PSPS risk assessment enterprise system. This overview must include discussion of:

- The electrical corporation's database(s) used for storage of risk assessment data.
- The electrical corporation's internal documentation of its database(s).
- Integration with systems in other lines of business.
- The internal procedures for updating the enterprise system including database(s).
- Any changes to the initiative since the last WMP submission and a brief explanation as to why those changes were made. Include any planned improvements or updates to the initiative and the timeline for implementation.

Liberty's current databases for risk assessment data: Liberty's risk assessment data is available in multiple databases, field data applications, and disparate analyses files and reports. Maintenance, tracking, and analysis of ~~the~~ risk data is generally sectioned off by the area of responsibility (*i.e.*, vegetation management group) and is reviewed holistically in preparation for the company's annual WMP filing.

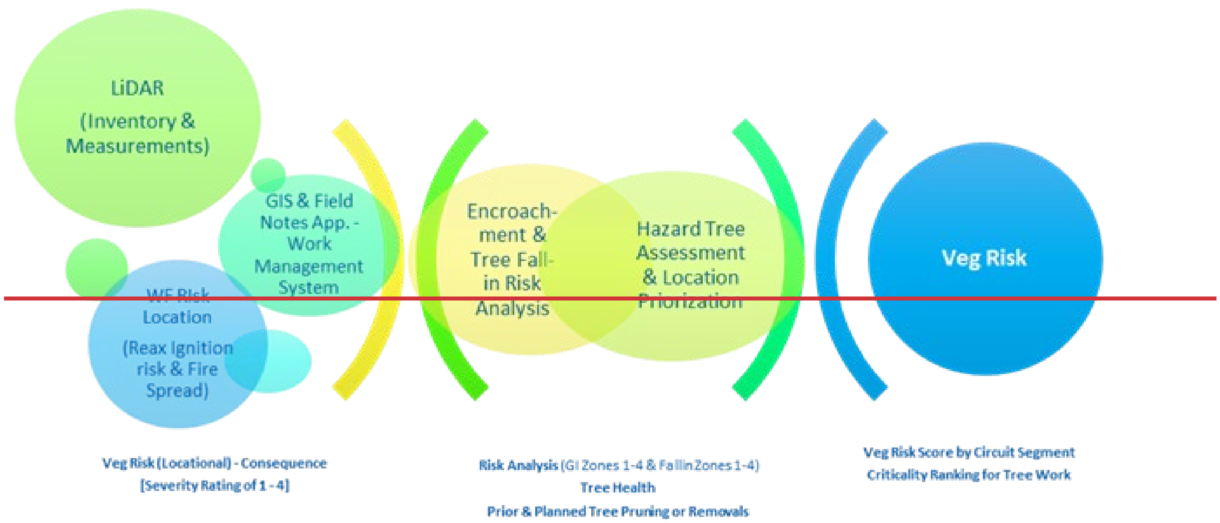
The following are Liberty's risk assessment data sources ~~are listed below~~:

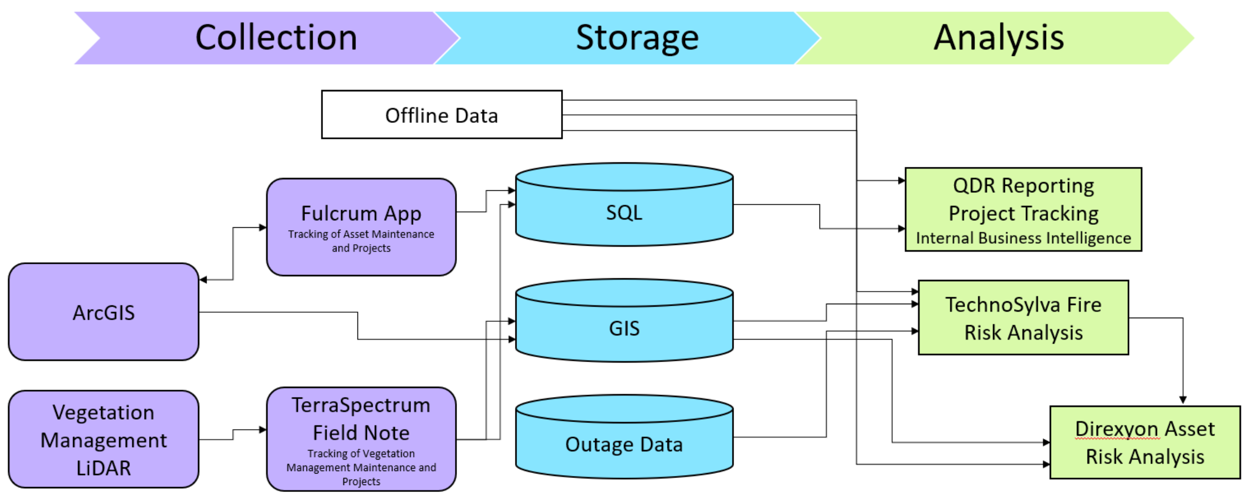
- LiDAR – – Tree inventory database
- Fulcrum – Asset inspection data application
- GIS – Geospatial asset inventory
- ~~Responder~~ Outage Management System/Database
- Vegetation Management Application – TerraSpectrum Field Note~~s Application~~

Liberty's internal documentation of its database(s): Liberty has various general system documentation, procedures, and internal job aids across its data collection, storage, and analysis tools. For those tools that are not yet operationalized, documentation will continue to be developed (i.e. Direxyon Asset Risk Analysis).

~~Figure 6-10~~Figure 6-7 is a diagram of the data sources, other lines of business that the systems feed, and current data flow for risk assessment:

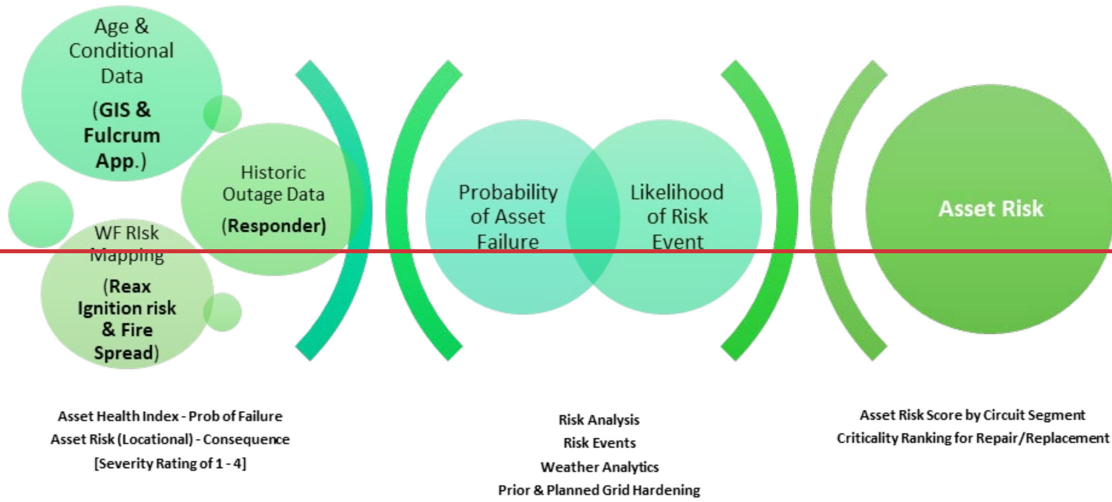
Figure 6-7 ~~10~~: Data Sources and Data Flow for Liberty Risk Assessment





Liberty's internal procedures for updating the enterprise system including updates from collection applications to data storage locations, include:

- ArcGIS & GIS Data Storage (As-Builts, electrical system source of truth);

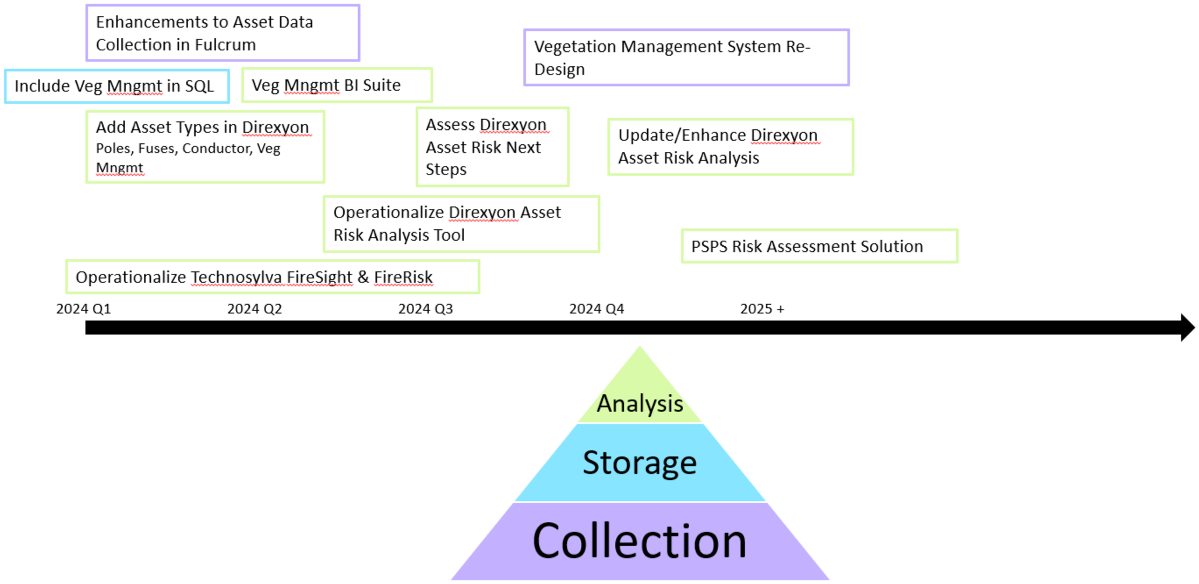


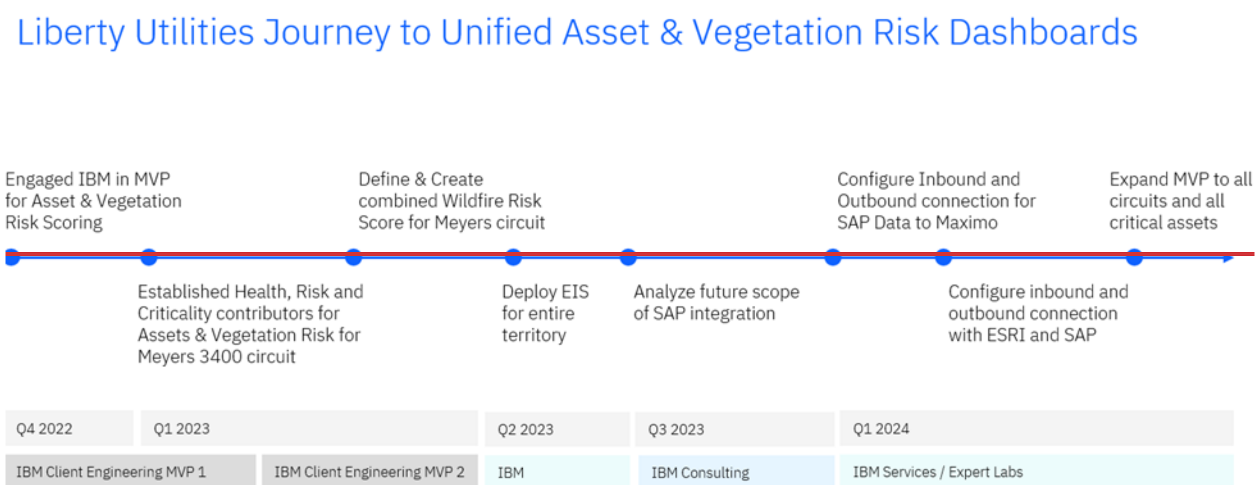
- Fulcrum App – field data collection applications (inspections, repairs, projects, assets, safety);
- Flows to SQL via Scheduled Data Syncs to support Business Intelligence and Quarterly Data Reports;
- Vegetation Management LiDAR updated annually; and
- TerraSpectrum Field Note (inspections, work orders, etc.).

Changes to the initiative since last WMP submission: Liberty has implemented several updates to the Enterprise System Roadmap with respect to the IBM proposal and the next steps in its risk analysis. Following the last WMP submission, Liberty ended its discussions with IBM for a Vegetation and Asset Management System with IBM's technology. Instead, Liberty is focusing on enhancing and implementing Business Intelligence solutions by using its existing systems and enriching data collection processes and optimizing data storage solutions internally. Additionally, Liberty has further engaged with Technosylva and Direxyon to formulate an RBDM platform to facilitate WMP guidelines and requirements and to elevate Liberty's informed decision-making abilities. Technosylva provides the base data by calculating weather, environment, and historical measures, and Direxyon takes Technosylva's outputs to a more granular level, as discussed in the previous sections. Refer to Figure 6-8 for a timeline of Liberty's Enterprise System updates. ~~Liberty has discussed with vendors potential data solutions to consolidate the data collection to improve data analytics and risk analysis at the company level. Liberty has a co-create project solution under development with IBM's vegetation analytics team and Maximo spatial project engineers. The Liberty and IBM project team has~~

~~discussed the current data flow challenges with consolidating the asset and vegetation risk factors into a consolidated weighted risk scoring at the circuit level. The months of data discovery, project design, and solution customization for Liberty's specific risk management data integration will result in a Minimum Viable Product ("MVP"). The IBM team's proposal will enable Liberty's risk data sources to be consolidated in Maximo's work management solution for asset risk scoring and similarly IBM's vegetation spatial can integrate LiDAR tree data into an applicable risk analytical tool that could integrate risk scores at the circuit segment level. Maximo is also a work management solution with predictive capabilities that may be utilized in the future~~

Figure 6-8~~11~~: ~~Liberty Timeline to Unified Asset and Vegetation Risk Dashboards~~Liberty Enterprise System Updates Timelines





Enhancements to Asset Data Collection in Fulcrum – Fulcrum is being revamped to efficiently serve more facets of the business, organize data collection, and prioritize business intelligence opportunities with the collected data.

Include Vegetation Management in SQL – Implementing the Vegetation Management Data into SQL will allow for automated reporting and access to additional business intelligence tools.

Vegetation Management BI Suite – After Vegetation Management data is available in SQL, Business Intelligence analytics will be more easily accessible to serve multiple use cases.

Add Asset Types in Direxyon – Additional asset types added to the Direxyon Risk Analysis tool will allow for use cases such as Risk Spend Efficiency, Asset Degradation, Scenario Conceptualization, and others to be fully available for planning mitigations and projects.

Operationalize Technosylva FireRisk – As Liberty moves away from Reax's operational analysis, the new tool needs to be set up and begin to be used. With Technosylva's FireRisk tool, the same statistical basis for planning will be used in tactical operational decision-making such as PSPS awareness and triggers for fire threat operating procedures. This system is intended to be used for the 2024 fire season.

Operationalize Direxyon Asset Risk Analysis Tool – With asset types loaded into the Asset Risk Analysis tool, risk-informed decision-making at the asset level can start. To operationalize the tool user training, procedures for using the tool, and formulating model results will need to be input to existing users and processes.

Assess Direxyon Asset Risk Next Steps – As Liberty develops its risk tools, pausing and assessing the work completed and looking ahead to what is next is important to guide enhancements and additional development. With the risk platform continuing to evolve, a further timeline and plans for implementation will be analyzed with each phase. These enhancements can come in the form of additional scenarios for maintenance and mitigations, additional asset types to add to the tool, and other unforeseen items.

Vegetation Management System Re-Design – After the enhancements to the Asset Data system, Liberty will assess the need to include similar enhancements to the Vegetation Management System.

Update/Enhance Direxyon Asset Risk Analysis – Liberty plans on making- continual updates and enhancements to this platform through continued analysis.

PSPS Risk Assessment – As discussed above, PSPS Risk Assessment will be analyzed after Wildfire Risk/Composite Risk is in production. PSPS Risk Assessment will serve the operational decision-making associated with performing a PSPS event during fire seasons, determining the consequence of such an event occurring, and identifying the likelihood of a PSPS event occurring. Liberty has not had a PSPS event in the past, which indicates, historically, that PSPS risk is comparatively lower than Fire Risk.

6.6 Quality Assurance and Control

The electrical corporation must document the procedures it uses to confirm that the data collected and processed for its risk assessment are accurate and comprehensive. This includes but is not limited to model, sensor, inspection, and risk event data used as part of the electrical corporation's WMP program. In this section of the WMP, the electrical corporation must describe the following:

- **Independent review:** Role of independent third-party review in the data and model quality assurance
- **Model controls, design, and review:** Overview of the quality controls in place on electrical corporation risk models and sub-models

~~Liberty is in the process of consolidating risk event data, LiDAR tree data analytics, inspection data, and asset management work flows that is expected to be completed by mid-2024. Developing a quality assurance and control review is not currently relevant.~~

6.6.1 Independent Review

The electrical corporation must report on its procedures for independent review of data collected (*e.g.*, through sensors or inspections) and generated (*e.g.*, through risk models and software) to support decision-making. In this section of the WMP, the electrical corporation must provide the following:

- **Independent reviews:** The electrical corporation's procedures for conducting independent reviews of data collection and risk models.
- **Additional review triggers:** The electrical corporation's internal procedures to identify when a third-party review is required beyond the routinely scheduled reviews.
- **Results, recommendations, and disposition:** The results and recommendations from the electrical corporation's most recent independent review of its data collection and risk models. This includes the electrical corporation's disposition of each comment.
- **Routine review schedule:** The electrical corporation's routine review schedule.

The electrical corporation must enter each accepted recommendation from independent review into its action tracking system for resolution (assignment of responsibility, development of technical plan, schedule for development and deployment, etc.) in accordance with the requirements discussed in Section 11.

Liberty performs internal reviews of the data ~~that is~~ used in risk modeling and ~~that is~~ provides the data to vendors as risk model inputs. Additionally, Liberty ~~internally~~ reviews all WMP data provided as part of its quarterly data reporting to Energy Safety. Below is a list of data used in risk modeling and a description of the independent review process:

- **Liberty outage data**: Liberty currently uses Responder as its outage management system ("OMS") to collect outage data. Liberty engineers review and validate outage data based on cause codes, dispatch remarks, outage times, restoration times and restoration steps provided from OMS to ~~ensure~~ present accurate outage data ~~is~~

~~presented~~. Liberty uses the data collected to document where outages occur, the outage cause, and the impact to customers. Liberty uses outage data to gain an understanding of how Liberty's system is performing, to collect SAIDI/SAIFI metrics, and to perform risk analysis. Liberty subject matter experts and managers review data ~~internally~~ and refine~~s~~ it to improve its effectiveness for these uses. For example, Liberty attempts to minimize outage data that has an unknown cause ~~through~~ by training ~~of~~ field staff who collect data in the field and through post-processing ~~of~~ freeform text fields. In addition, Liberty is in the process of implementing a new and improved OMS to replace its Responder system with a fully supported Schneider OMS that will help Liberty ~~more effectively~~ collect outage data more effectively. With respect to wildfire risk analysis, subject matter experts and managers review outage data before providing it to expert consultants, such as Technosylva, to compute probability of ignition throughout the system.

- **Liberty ignition data**: Liberty tracks and records ignitions through its Fulcrum system. ~~Liberty's Fire Specialist is NWCG FI-110-certified and maintains and reviews t~~The information in Liberty's ignition database~~,~~ includes~~ing~~ ignition causes and investigation results per observations in the field in correlation with local fire municipalities. Dependent on specific factors related to the ignition, Liberty may supply the information from Liberty's ignition database to CAL FIRE or other fire municipalities upon request for additional review.
- **Operations data**: Liberty's asset inspection results are independently reviewed through its Asset Inspection QA/QC Program detailed in Section 8.1.6. Additionally, Liberty subject matter experts and data analysts review inspection data, work order data, and repair data prior to each quarterly data submission to Energy Safety and as necessary to support operations. This review includes data pipeline quality checks.
- **Vegetation data**: Liberty's vegetation data is independently reviewed as detailed in Section 8.2.5.
- **Technosylva wildfire risk modeling outputs**: In addition to historical reviews, Technosylva improves the accuracy and performance of the published fire models to better adjust results to observed fire behavior. This includes a better definition of the fuel types, improved forecast of live fuel moisture content, modifications to the crown fire modelling initialization scheme, and automatic fire adjustment based on data assimilation techniques using rate of spread ("ROS") adjustment factor. In addition, Technosylva has implemented more than 20 additional fuel models into the WFA~~-E~~ platform to enhance accuracy and address know limitations of published fire models. These improvements include crown fire analysis, ember and spotting, urban / non-

burnable area encroachment, and consequence and impact quantification. It is important to note that improvement of the fire modeling platform of choice necessitates not only improvements in mathematical algorithms but substantial improvements in the accuracy and resolution of input data sources. These work in concert to enhance the modeling and outputs to match observed and expected fire behavior. A robust operationalization of fire models requires constant and on-going research, testing, validation and implementation of both models and data sources.

- **Reax risk modeling outputs:** Inputs to Liberty's risk modeling work with Reax are obtained from industry-standard data sources, many of which are developed by the Federal government. Such inputs are widely used by myriad organizations for wildfire spread and risk modeling. Examples of industry standard data sources that are used as inputs include Real Time Mesoscale Analysis ("RTMA") data, LANDFIRE fuel data, and the Microsoft US Building footprints dataset.[41] These datasets are developed and validated by other experts upstream of Liberty's risk modeling process. The underlying wildfire spread model used in Liberty's risk modeling work (ELMFIRE) with Reax has been published in the peer reviewed archival journal Fire Safety Journal.[42] Being an open-source model hosted from a publicly accessible GitHub repository,[43] the model itself is transparent and available for inspection by others. ELMFIRE is documented at https://elmfire.io where a user's guide, technical reference, tutorials, and verification plus validation test cases are available. ELMFIRE has been used to forecast the spread of most large fires in the Continental US in real time for the last 5 fire seasons.[44] Along with Near Term Fire Behavior ("NTFB") and Fire Spread Probability ("FSPro"), ~~it~~ ELMFIRE is one of the three operational fire spread models used by the Federal Government to inform fire resource allocation decisions and is funded to do so through 2027. As such, its predictive capabilities and limitations are known, including a retrospective assessment from the 2022 fire season.[45]
- **Annual WMP Independent Evaluation**: As part of the OEIS WMP process, Liberty selects an Independent Evaluator ("IE") to review and assess its level of compliance with its WMP. This independent evaluation process requires Liberty to provide all requested data related to its prior year's WMP initiatives for independent review and verification.

41 https://www.nco.ncep.noaa.gov/pmb/products/rtma/; https://landfire.gov; https://github.com/microsoft/USBuildingFootprints.
42 https://doi.org/10.1016/j.firesaf.2013.08.014.
43 https://github.com/lautenberger/elmfire.
44 https://pyrecast.org.
45 https://elmfire.io/validation.html.

~~As~~ Liberty's risk modeling is in the early stages of development. As such, currently, Liberty ~~currently~~ does not have further formal independent review procedures or additional review triggers established for reviewing its risk modeling datasets, risk model inputs, or risk model outputs. Liberty does not have results or recommendations from independent review of its risk modeling data at this time.

As Liberty's risk modeling process continues to mature and develop, Liberty will consider establishing additional robust internal and external review procedures over its risk modeling data collected and generated. Considerations will include processes for initiating independent third-party reviews, additional review triggers such as large updates to data inputs and alterations to the model framework, assessing and incorporating results from said reviews as needed and developing routine review schedules (*i.e.*, annual review). Once the initial wildfire risk model implementation is complete, procedures Liberty expects to apply for the following model validation activities include the following:

- **Technosylva independent review**: Ongoing fire model validations are performed both internally and during operational scenarios in California in collaboration with CAL FIRE. Technosylva assessed the performance of fire spread models for initial attack incidents (either surface or crown) currently used in operational environments in California through the analysis of the rate of spread (ROS) of 1,853 wildfires. The work has been published in the International Journal of Wildland Fire.[46] The paper states that the fire spread model's performance for California is in line with previous studies developed in other regions and the models are accurate enough to be used in real-time operations to assess initial attack fires. Technosylva identified how some environmental variables may bias the ROS predictions, especially in timber areas where the Scott and Burgan (2005) fuel models underestimated ROS. New improvements in the fuel families and crown fire spread models have further improved the accuracy and performance of the fire models to better adjust the results to observed fire behavior.
- **Direxyon independent review**: The proposed vendor solution uses data from different sources such as GIS and Technosylva model outputs. While these data inputs are not validated by Direxyon, the required fallback logics for missing value imputation and the other required data transformation by Direxyon are confirmed with Liberty in advance. Direxyon Results and Dashboard module generates a large quantity of raw and aggregated data through Monte-Carlo simulation. The Results interface (also known as the Audit screen) offers a full set of features to search through the raw data generated

46 https://www.publish.csiro.au/WF/WF22128.

via simulation. This interface is at the center of Direxyon's "Glass-Box" approach as users can find the complete details of any asset characteristic during any simulation or simulation period. This interface is primarily used to validate the models' mechanics or share with third-party auditors. The user can validate why a specific value is calculated for the asset.

- **Additional Liberty internal review**: In 2023, Liberty initiated an internal Risk Focus Group to review wildfire risk data and model outputs and to work with its wildfire risk modeling consultants to validate results throughout the construction of the model and framework.

Liberty's wildfire risk model will continue to evolve with plans to utilize an updated version of its wildfire risk model for limited facets of its business starting in Quarter 3 2024. Liberty will initially focus on implementing and utilizing the wildfire risk modeling outputs for grid hardening initiatives (*i.e.*, covered conductor, pole replacements, and fuse replacements), vegetation management initiatives, and operations. Internal and vendor reviews will begin with the completion of this initial risk model transition in Quarter 3 2024. Liberty will also assess the need for additional third-party independent reviews at the time of its initial risk model transition in Quarter 3 2024.

6.6.2 Model Controls, Design, and Review

An electrical corporation's risk modeling approaches are complex, with several layers of interaction between models and sub-models. If these models are designed as a single unit, it can be difficult to evaluate the propagation of small changes in assumptions or inputs through the models. The requirements in this section are designed to facilitate the review of models by the stakeholders and Energy Safety, and to allow for more comprehensive retrospective analysis of failures in the system.

The electrical corporations must report on its risk modeling software's model controls, design, and review in the following areas:

- **Modularization:** The electrical corporation must report on the degree to which its software architecture is sufficiently modular to track and control changes and enhancements over time. At a minimum, the electrical corporation must report if it has separate modules to evaluate each of the following:
  - Weather analysis
  - Fire behavior analysis
  - Seasonal vegetation analysis

- Equipment failure
- Exposure and vulnerability analysis

- **Reanalysis:** The electrical corporation must describe its capability to provide the results of its risk model based on the operational version of the software (including code and data) on a specific historic day.
- **Version control:** The electrical corporation must report on how it conforms to industry standard practices in version controlling its risk model and sub-models. At a minimum, the electrical corporation is expected to report on:
  - Models and software version controls aligned with industry standard programs, procedures, and protocols
  - Version control of model input data, including geospatial data layers
  - Procedures for updating technical, verification, and validation documentation.

By having modules for weather, fire, assets, and other risk factors, Liberty has developed the ability to examine risk at a granular level for each of the aforementioned categories. Technosylva, Direxyon, and Liberty SMEs develop risk modeling efforts to meet industry standards.

~~Liberty's current risk modeling approach is modular, and analytics are outsourced. The model controls and review protocols conform to industry standards. Below is a summary of the current risk inputs and outputs that are outsourced.~~

Weather Analysis: Weather analysis and forecasting are outsourced and managed by Reax Engineering. Reax monitors national weather forecasting models for temperature and wind speeds specific to Liberty's service territory and informs Liberty's wildfire and operations personnel of changing conditions and possible exceedance of PSPS thresholds by PSPS zone. Moving forward, as Liberty develops its PSPS Risk Assessment, weather analysis and forecasting will be produced by Technosylva's WFA and WRF modeling for Liberty's service territory. The outputs of these models supplement Liberty's wildfire and operational decision--making preceding and during events with changing conditions and possible exceedance of PSPS thresholds be PSPS zone. The weather analytics module produces metrics, where certain thresholds are met or exceeded, can trigger the decision to initiate a PSPS event for given weather conditions.

Fire Behavior Analysis: Technosylva's WFA model composes Liberty's Fire Behavior Analysis where WRF (as explained above) and key fire metrics are output based on the characteristics of the service territory. WFA calculates fire size potential, fire behavior index, rate of spread and flame length to encompass Liberty's Fire Behavior Analysis model. From the outputs of this model, Liberty quantifies the risk across its service territory to enable decision-making for maintenance and mitigation programs to perform that will quantify to a lower risk of asset failure and utility-caused ignitions.~~Fire behavior analysis is an annual study that Reax Engineering performs for Liberty for its WMP. The fire behavior analysis calculates ignition rate per circuit mile based on fuels, temperature, wind speeds, and humidity along Liberty's overhead lines and simulates fire spread of historic outage events to determine a probabilistic fire model and consequences. Simulated events are tabulated by circuit for acres burned, structures impacted, and timbers lost based on current asset lines at the time of the study. Grid hardening, operational control settings, vegetation risk, and asset risk of failure is currently not modeled nor integrated in performance tracking.~~

Seasonal Vegetation Analysis: Direxyon's asset failure modeling incorporates vegetation as a separate asset type to construct Liberty's Seasonal Vegetation Analysis. Liberty does not account for mitigation of vegetation on a seasonal basis specifically for fire season because its service territory experiences harsh winters. However, risk analysis specifically accounts for ignition risk as a part of the quantified risk score for vegetation. With the ability to individually look at vegetation risk, Liberty quantifies its risk score to identify maintenance and mitigation programs that will lower the risk of system failure, or a utility-caused outage due to vegetation-caused reasons. Having a model that quantifies risk with respect to the consequence of an ignition separately from an outage is important to output a risk score that is helpful for Liberty's SAIFI/SAIDI metrics throughout a given year and not just in fire season. As such, Liberty's vegetation risk model is not geared toward wildfires because of the amount of high wind events occurring outside of fire season.

Equipment Failure: Direxyon's asset failure modeling incorporates multiple asset types pertaining to the electrical system encompassing Liberty's Equipment Failure module of its RBDM platform. From the Composite Risk score described in Section 6.2.2.3, the asset failure risk and fire risk can be individually analyzed so that maintenance and mitigation programs can be assessed given the separate scores of an electrical outage or a utility-caused ignition to account for SAIDI/SAIFI metrics throughout a given year and not just in fire season.~~Liberty's current fire risk modeling, performed by Reax, does not incorporate the probability of assets failing in service and instead focuses on the likelihood of a fire igniting along Liberty's lines based on historic weather at the time of historic outages. See Liberty's Risk Improvement Plan for how Liberty will incorporate proactive asset interventions based on quantitative risk-informed performance measurements in its decision-making.~~

Exposure and Vulnerability Analysis: Analysis of Exposure and Vulnerability is established by Technosylva's WFA modeling and is affiliated with Liberty's consequence metrics, as explained in Section 6.2.2.2. By utilizing Direxyon, Liberty has the ability to quantify risk for asset failure consequence and fire risk.~~Future analysis and assessments would be performed by Liberty based on readily available data sources. Currently, customer vulnerability data gathering is in its infancy stage at Liberty.~~

Reanalysis: Inside the Direxyon tool, simulations that have been run are saved and remain available in the platform with the ability to be viewed or updated given input data updates or historical use cases that need to be revisited. In cases when modeling updates have been made, Liberty can use new or old data to obtain outputs from the updated models. Direxyon has made many of the model variables available so that scenarios with given weightings can be run in comparison.

Version Controls: Version controls for the Direxyon Risk Assessment Tool include:

- Model simulations are not deleted, and each simulation contains the output dataset.
- Model versions can be retrieved for given points in time.
- Input data is manually organized by time of upload and is accessible in the model for outputs given a point in time.
- Direxyon adheres to ISO 27001 and SOC2 Type2, with additional influences from NIST.
    - Yearly audits for compliance are maintained since 2020.
- Direxyon is certified under ISO 9001 given quality management practices.
- Direxyon utilizes Git as a version control utility.
- As a part of Direxyon's version deployments, feature notes are published to identify updates as part of each build.

6.7 Risk Assessment Improvement Plan

A key objective of the WMP review process is to drive year-over-year continuous improvement. In this section, the electrical corporation must provide a high-level overview of its plan to improve both programmatic and technical aspects of its risk assessment in at least four key areas:

- **Risk assessment methodology:** Wildfire and PSPS risk assessment methodology and its documentation, including both quantitative and qualitative approaches
- **Design basis:** Justification of design basis scenarios used to evaluate the risk and its documentation

- **Risk presentation:** Presentation of risk to stakeholders, including dashboards and statistical assessments
- **Risk event tracking:** Tracking and reconstruction of risk events and integration of lessons learned

The overview must consist of the following information, in tabulated format:

- **Key area:** One of the four key areas identified above
- **Title of proposed improvement:** Brief heading or subject of the improvement
- **Type of improvement:** Technical or programmatic
- **Anticipated benefit:** Summary of anticipated benefit and any other impacts of the proposed improvement
- **Timeframe and key milestones:** Total timeframe for undertaking the proposed improvement and any key milestones

Table 6-9 provides an example of the minimum acceptable level of information.

In addition, the electrical corporation must provide a concise narrative of its proposed improvement plan (maximum of five pages per improvement) summarizing:

- **Problem statement:** Description of the current state of the problem to be addressed
- **Planned improvement:** Discussion of the planned improvement, including any new/novel strategies to be developed and the timeline for their completion
- **Anticipated benefit:** Detailed description of the anticipated benefit and any other impacts of the proposed improvement
- **Region prioritization (where relevant):** Reference to risk-informed analysis (*e.g.*, local validation of weather forecasts in the HFTD) demonstrating that high-risk areas are being prioritized for continued improvement
- **Supporting documentation (as necessary)**

Problem Statement #1: Liberty has not established a formal risk-based decision-making framework for its wildfire risk assessment or mitigation planning.

Planned Improvement for Problem Statement #1: In late January 2023, Liberty signed a formal agreement with Direxyon to pilot its asset risk decision-making solution to be incorporated, in part, in this WMP. Liberty and Direxyon have since launched workshop discussions to scope out the parameters and metrics for the various model offerings, including risk, decision, cost, and degradation models. If the pilot is successful for the pole asset type and produces effective decision-making tools for Liberty 's management team, Liberty will continue building out the risk-informed decision-making tools for multiple assets to better plan future investments and repairs and maintenance plans given budget and resource constraints.

Benefits #1: Decision trees, flow charts, dashboards, and other visualization tools will enable Liberty's operations and engineering teams to plan for risk-based interventions throughout the year.

2024 Update: Since January 2023, Liberty has further engaged with Direxyon to develop its formal RBDM framework for risk assessment and mitigation planning. As explained in Section 6, Liberty has worked with Direxyon, to develop its composite risk score that quantifies risk at system, circuit, segment, and asset levels of granularity. Beginning this process with specific asset types that are prevalent to mitigations outlined in this WMP, Liberty plans to operationalize the Direxyon tool to support mitigation, planning, and risk reduction efforts in Quarter 3 of 2024, as detailed in the timelines in Section 6.5.

Problem Statement #2: Liberty's risk data sources are not consolidated in a centralized database to be easily processed and analyzed for modeling purposes. This also makes gathering risk data for WMP performance tracking the top work priority with frequent regulatory reporting requirements and minimal time to analyze trends in risk drivers. There is also no way to effectively measure risk or risk reductions at the location level

Planned Improvement for Problem Statement #2: In fall 2022, Liberty engaged with IBM to co-create a risk-based work management solution that consolidates and scores for asset risk based on health (age and condition) and other criticality factors the teams scoped. The conceptual product IBM is developing for Liberty can link Liberty's risk data sources, including vegetation LiDAR analytics and eventually integrate with Liberty's SAP implementation later this year. IBM's Maximo asset health and predict solution can integrate tree risk analytics at the circuit and/or circuit segment level to better plan work that is influenced by asset risk of failure and tree risk of failure. This consolidated asset/vegetation risk view will help operations plan work effectively throughout the year or adjust planned work for elevated fire risk days.

Benefits #2: Liberty's risk management team can effectively plan for mitigations based on the consolidated asset/vegetation risk scores and measure risk reductions throughout the year.

2024 Update: Liberty ended its engagement with IBM because IBM was unable to align the timeliness of its performance with Liberty's urgency to operationalize a RBDM framework. As such, Liberty enlisted Direxyon to build out the framework. By continuing its efforts with Direxyon, Liberty was able to consolidate its data sources, outlined in Section 6.5, to make Direxyon the source of record for quantifiable risk scores at the system, circuit, segment, and asset level of granularity. Additionally, Liberty has consolidated its own data sources into a SQL database comprised of Asset and Vegetation data to improve data quality and data availability. By doing this, Liberty gathers risk data for WMP performance tracking and reporting more efficiently for regulatory data requests and requirements.

Problem Statement #3: Wildfire risk assessments are only performed once a year for the WMP filing.

Planned Improvement for Problem Statement #3: In late January 2023, Liberty executed an agreement with Technosylva to provide wildfire risk analytics utilizing its Wildfire Risk Reduction Model ("WRRM"). Liberty received its first analytics package with the results from WRRM in late February 2023. With the help of Direxyon, the Technosylva data results will be processed, analyzed, and modeled for various scenarios and risk reduction interventions that is both temporal and spatial.

Benefits #3: Data rich analytics can be evaluated throughout the year to better plan for wildfire risk mitigations and help with investment planning over the life of assets.

2024 Update: Liberty recognizes the need to assess wildfire risk on a frequent basis when evaluating programs, mitigations, and maintenance activities resulting in reduction of risk. Therefore, with further interaction between Technosylva and Direxyon, Liberty is taking steps to update asset and vegetation data coupled with model refreshes twice a year rather than once a year. This increase in frequency will allow Liberty to assess its risk given the programs, mitigations, and maintenance activities performed throughout a given year. Liberty plans to perform these updates at intervals of every six months to have more accuracy at specific times of year (such as fire season) as well as providing updates to its WMP.

See Table 6-7 ~~Table 6-9~~ for Liberty's Risk Assessment Improvement Plan.

Table 6-7~~9.~~: Liberty Utility Risk Assessment Improvement Plan

Key Risk Assessment Area	Proposed Improvement	Type of Improvement	Expected Value Add	Timeframe and Key Milestones
RA-1, risk decision-making framework	RA-1. Establish models to analyze appropriate risk factors at the circuit level for mitigation and investment optimization planning.	Integrated ~~decision~~analytical-making tools for assessing asset risk and vegetation risk.	Improved risk-based decision-making for management stakeholders. Utilize for long-term capital planning – replace vs increase in inspections or maintenance interventions.	2023 – Evaluate Direxyon's decision models, risk models, degradation models, and cost models.
RA-2, risk data integration and performance tracking	RA-2. Integrate LiDAR vegetation data and asset detailed inspection results in ~~IBM's Maximo spatial and ESRI veg solutions~~DRAT for performance tracking of risk reduction.	Data integration and consolidation of asset and veg. risk factors and weighted analytics at the circuit or circuit segment level.	Improved quantitative risk analytics and risk reduction metrics that incorporates annual work efforts.	Conduct initial development, early 2023 Expand minimal viable product following 2024 in-production. ~~2023 and integrate with Liberty's SAP enterprise asset management solution.~~
RA-3, wildfire and PSPS risk analysis	RA-3. Analyze and process Technosylva's Wildfire Analysis ("WFA") ~~Risk Reduction Model ("WRRM")~~ statistical outputs.	Detailed expected overhead asset risk can be analyzed to show impacts of acres burned, structures destroyed, populations at various percentiles of 80th 85th, 95th, 98th, and 100th ranges by outcome and circuit area.	Improve quantitative analytics and risk reduction metrics overall and with new socio-economic impact analysis to use in the risk modeling evaluation.	2023 – Evaluate Technosylva's WFA results for calculating risk scores. 2024 –DRAT in production. 2025 – Integrate PSPS Risk and Enhance DRAT with additional Asset types.~~2023-2025 – Evaluate Technosylva's WRRM and RAVE results for calculating risk scores.~~
RA-4, risk presentation	RA-4. Develop Business Intelligence Solutions to analyze and quantify risk.~~decision-making flow charts and visualization tools to~~	Better plan work activities throughout the year prioritized by risk.	~~Enable~~ Familiarize Liberty's management to utilize decision making tools to drive risk reduction cohesive to the WMP initiatives at a granular level.~~make risk-informed decisions.~~	2023-2025 – Develop integrated dashboard for management to make informed decisions based on risk. Implement Direxyon's analytics dashboard utilizing Technosylva's outputs. ~~Combination of IBM's (Maximo and ESRI Veg) solution and Direxyon's analytics dashboard.~~

7. Wildfire Mitigation Strategy Development

In this section of the WMP, the electrical corporation must provide a high-level overview of its risk evaluation and process for deciding on a portfolio of mitigation initiatives to achieve maximum feasible[47] risk reduction and that meet the goal(s) and plan objectives stated in Sections 4.1–4.2, and wildfire mitigation strategy for 2023-2025. Sections 7.1 and 7.2 below provide detailed instructions.

~~Liberty's strategy development for this WMP did not utilize wildfire risk scores developed by Reax.[48] Instead, Liberty assessed grid hardening efforts, such as covered conductor projects, asset repairs, and replacements completed in recent years along with enhanced vegetation management work to review holistically what is working effectively system-wide to reduce wildfire risk. Liberty has collected risk-related data over the years that once consolidated in a risk-based decision-making framework, will enable Liberty to use data analytics to assess baseline risk at the circuit level. This assessment will provide asset risk scores and tree risk scores at the location level for management to plan the best portfolio of mitigations - grid ops, asset inspections, situational awareness, vegetation management - to reduce consequences of a fire or a PSPS event. To the extent possible, Liberty's risk mitigation planning utilized updated risk metrics and analyses available in conjunction with subject matter expertise from operations, vegetation management, wildfire prevention, and engineering. This collaborative approach and information sharing amongst the various work groups is a vast improvement to Liberty's previous WMP submissions. Continued implementation of risk analytics and data consolidation, as discussed in Section 6, will improve Liberty's overall wildfire mitigation planning in the future.~~

7.1 Risk Evaluation

7.1.1 Approach

In this section of the WMP, the electrical corporation must provide a brief narrative of its risk evaluation approach, based on the risk analysis outcomes presented in Section 6, to help inform the development of a wildfire mitigation strategy that meets the goal(s) and plan objectives stated in Sections 4.1– 4.2.

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47 "Maximum feasible" means, in accordance with Public Utilities Code section 326(a)(2), capable of being accomplished in a successful manner within a reasonable period of time, taking into account economic, environmental, legal, social, and technological factors.

~~48 The updated Reax analyses performed early 2023 to incorporate the new WMP Technical Guidelines was provided to Liberty's risk management team late February for incorporation in Liberty's 2023 WMP.~~

The electrical corporation must describe the risk evaluation approach in a maximum of two pages, inclusive of all narratives, bullet point lists, and any graphics.

The following is an example of this description:

The risk evaluation approach in this WMP is designed to meet a range of industry-recognized standards (e.g., ISO 31000), best practices, and research[49] to determine a wildfire and PSPS risk mitigation strategy. The intent is to use this approach to help inform [electrical corporation]'s development of a portfolio of wildfire mitigation initiatives and activities that meet the goals and objectives stated in Sections 4.1– 4.2. Therefore, the general risk evaluation approach consists of the following:

- *Identify key stakeholder groups, decision-making roles and responsibilities, and engagement process.*
- *Identify risk evaluation criteria based on the balance of various performance goals. Apply these criteria to monitor the effectiveness of the electrical corporation's WMP in achieving its identified goals and objectives.*
- *Evaluate wildfire and PSPS risks and risk components described in Section 4 against the risk evaluation criteria, considering both potential positive and potential negative outcomes. Apply the results from the evaluation of wildfire and PSPS risks within [electrical corporation]'s service territory within a risk-informed decision-making process to develop prioritized areas where mitigation initiatives are necessary.*
- *Identify a portfolio of wildfire mitigation initiatives and activities, prioritized by risk. Identify and characterize potential mitigation approaches for each.*
- *Perform an integrated evaluation of the identified potential risk mitigation initiatives. The outcome is the specification of a portfolio of mitigation initiatives that will be implemented over the WMP cycle.*
- *Provide a summary of the approved risk mitigation strategies for inclusion in the WMP submission. This summary must include schedules for implementation of the strategies, procedures for management oversight of implementation of the mitigations, and methods of evaluation of their effectiveness once deployed.*
- *Discuss the expected improvements in maturity and describe monitoring activities to assess the degree of improvement in maturity.*

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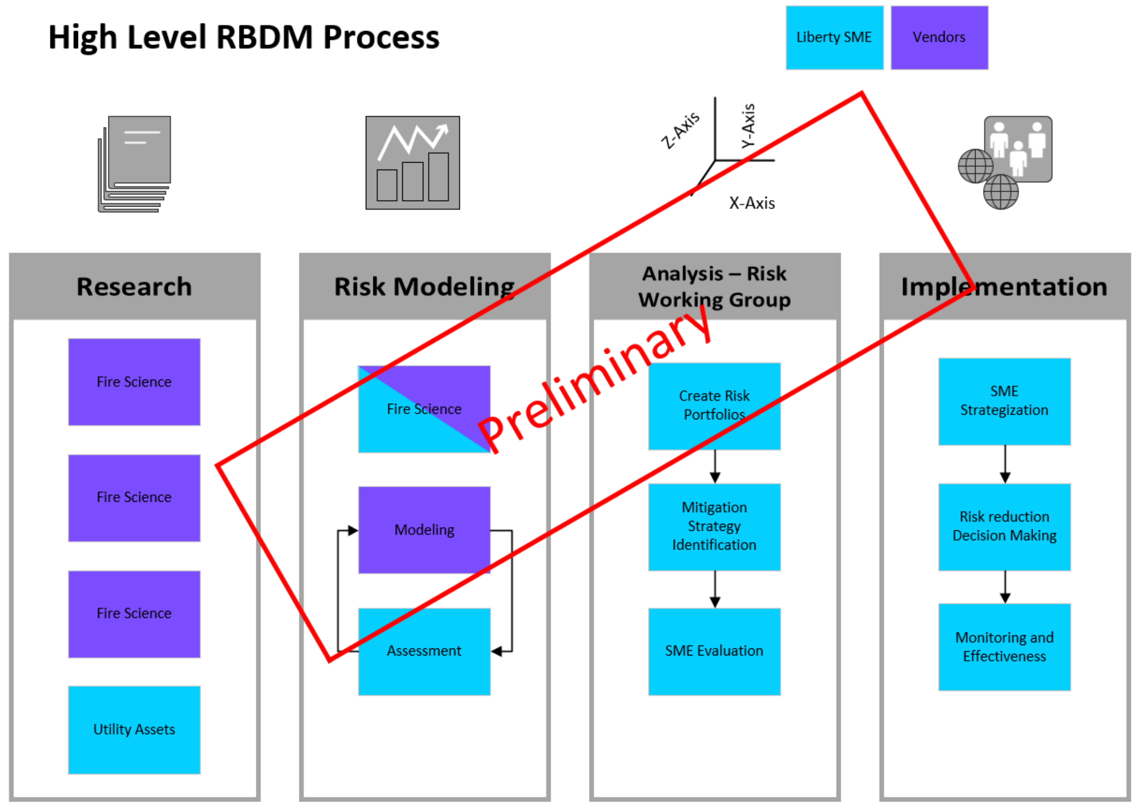
[49] T. Aven, 2012, *Foundations of Risk Analysis*, 2nd ed. John Wiley and Sons, West Sussex, United Kingdom.

Using Direxyon, Liberty has established quantified risk scores as baselines to begin comparing mitigations with the current data that is available. Once the year-over-year data comparisons are available, Liberty will be able to develop a quantifiable risk reduction plan. With the Direxyon tool, Liberty will be able to assess each circuit at the segment level to target riskier areas of its system effectively. By utilizing risk output metrics like Risk Spend Efficiency, Asset Failure Risk, and Composite Risk, Liberty will be able to identify asset types where specific risk reduction mitigation can be performed to reduce overall risk. Preliminary metrics are available in section 6.4 where these results are Liberty's preliminary baseline outputs from Direxyon.

Using the outputs from CloudFire, Liberty has identified circuits ordered by the most risk and targeted the circuits with the highest risks. Also taking into account Liberty's inspection results from previous years, Liberty has prioritized circuits found to have the most pole replacements to perform traditional hardening risk mitigations. In addition, covered conductor, expulsion fuse replacement, and Sensitive Relay Protocol ("SRP") projects have been conducted to mitigate levels of risk.

Through the development and implementation of the Direxyon platform, Liberty will be able to quantify risk below the circuit level to analyze asset types and locations that contribute the most risk. Full implementation of the Direxyon Platform is planned to take effect by the end of Quarter 3 of 2024, as explained in Section 6.5. As preliminary discussions have taken place regarding a process for Risk Based Decision Making, Liberty strives to put a process into place similar to Figure 7-1 by the end of Quarter 3 of 2024.

Figure 7-1: Risk Identification and Analysis Process Flow



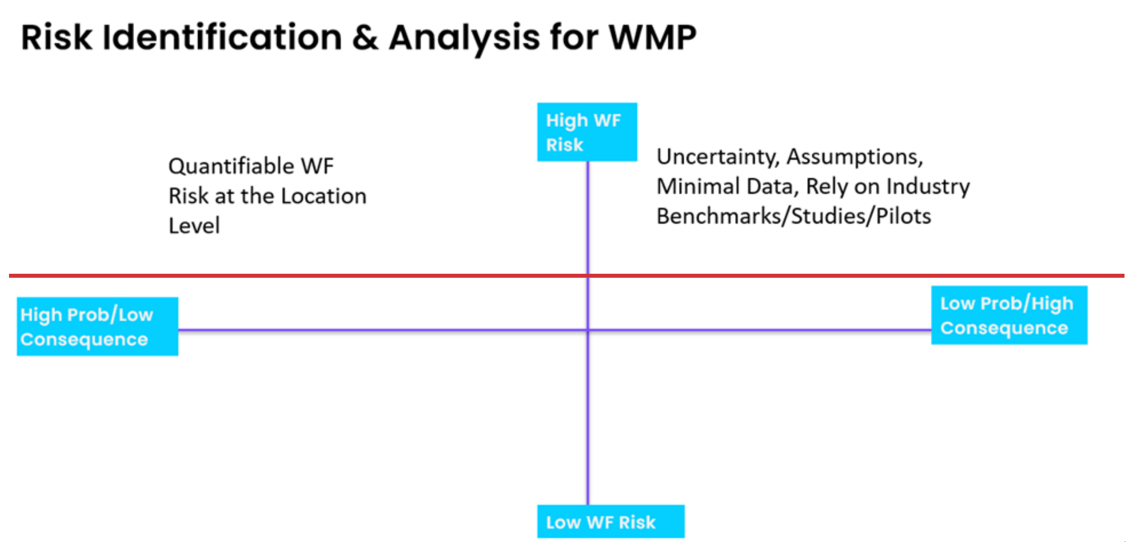
~~Most of Liberty's service territory resides in elevated high fire threat areas absent any mitigation. Liberty's approach to wildfire mitigation includes collaboration with key decision-makers in operations, engineering, and regulatory on best practices to assess risk for mitigation planning in this WMP and for future refinements to its analyses based on the new stringent OEIS guidelines and risk modeling framework. With the shortened timeframe between OEIS finalizing the new technical WMP requirements in late 2022, Liberty had to establish parallel work streams, often with the same key stakeholders, to divide all the new analyses, assessments, and requirements in the matter of two months. What this entailed was a quick evaluation of how to utilize existing risk data and analyses, such as Reax's wildfire risk assessment mapping from Liberty's 2022 WMP Update to help plan and prioritize mitigations for this WMP.[50] In parallel, Liberty sought to separately strategize future risk model~~

~~[50] Liberty's engineering and operations teams also utilized Liberty's original RBDM developed in early 2021 as the best quantitative analyses available to plan mitigations for the Sensitive Relay Protection ("SRP") program piloting this year and other grid hardening mitigations.~~

~~refinements and approaches by onboarding new vendors to help develop a formal risk model decision framework for Liberty. Liberty's risk management team led these parallel work efforts throughout the vendor selection process and product evaluations through coordination and project management expertise to effectively present a cohesive approach to mitigation planning in a matter of weeks leading up to submitting this WMP. Refer to Section 7.2.2.1 for additional information on Liberty's work with vendors to develop and advance its risk model decision framework.~~

~~Evaluation of wildfire and PSPS risks and risk components: Liberty's risk evaluation process started with the identification of all risk events, likelihood of wildfire risk drivers, impacts of significant weather (snow and wind) on asset degradation and health, scenario analyses discussion, and how seasonality affects the planning of overhead system design and operations. These discussion points were then plotted on the graph shown on Figure 7-1 below to plot high/low probability events and wildfire high/low consequences to whether the risk event data could be quantified and measured over time and location. Because Liberty has similar environmental risk factors and topography, overhead lines and trees can be analyzed in conjunction with SMEs knowledge to qualitatively plan for appropriate mitigations over the WMP cycle.~~

~~Figure 7-1: Risk Identification and Analysis for WMP~~

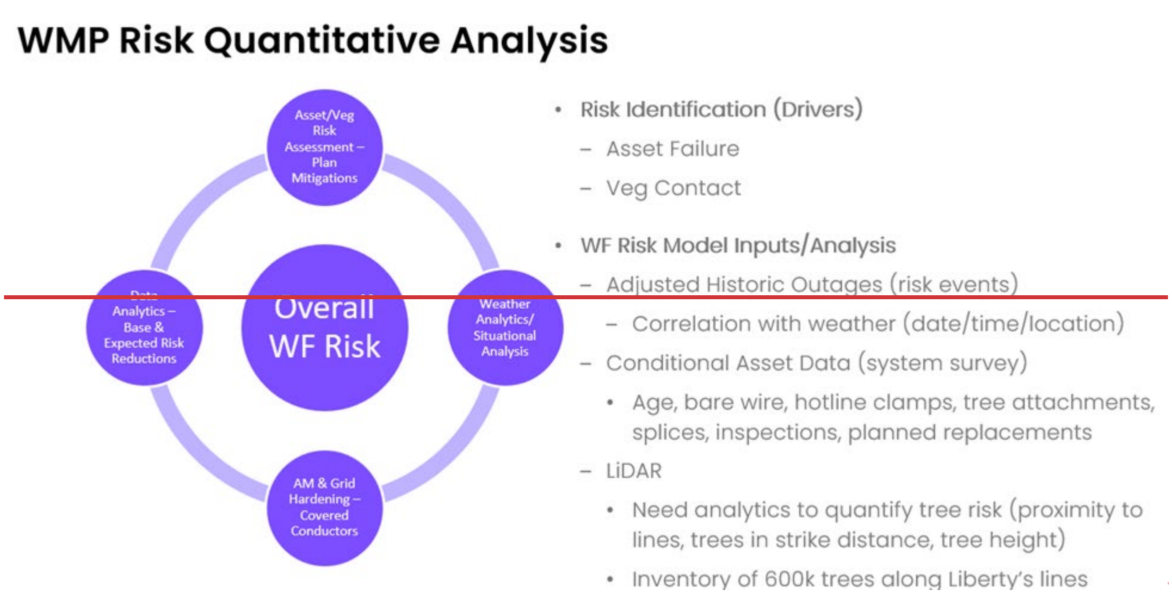


~~Liberty assessed asset risk of failure and vegetation risk of contact as primary risk driver sub-models to its overall wildfire risk by location. Liberty will work with its vendors to incorporate these major risk drivers and analytics in future WMP updates. Liberty focused on the high wildfire risk scenarios and likelihoods for its risk assessment although all quadrants were discussed for completeness.~~

~~See Liberty's overall risk-informed decision-making framework in Figure 7-2 and its quantitative risk assessment in Figure 7-3.~~

~~Figure 7-2: Asset Risk by Circuit~~

~~Figure 7-3: WMP Risk Quantitative Analysis~~



7.1.2 Key Stakeholders for Decision-Making

In this section, the electrical corporation must identify all key stakeholder groups that are part of the decision-making process for developing and prioritizing mitigation initiatives. Table 7-1. Liberty Stakeholder Roles and Responsibilities in the Decision-Making Process provides an example of the required information. At a minimum, the electrical corporation must do the following:

- Identify each key stakeholder group (*e.g.*, electrical corporation executive leadership, the public, state/county public safety partners)
- Identify the decision-making role of each stakeholder group (*e.g.*, decision-maker, consulted, informed)
- Identify method of engagement (*e.g.*, meeting, workshop, written comments)

The electrical corporation must also describe how it communicates decisions to the identified key stakeholders.

As part of Liberty's internal Risk Working Group, engagements are made weekly for low-level actions, analysis, and decision-making. For higher level communications, quarterly sessions are held to discuss budgets, decision-making, and progress of WMP initiatives and risk indicators. Liberty engages with its Public Safety Partners to strengthen relationships and coordinate emergency action plans. To communicate with Liberty's customers, an ad campaign through various news and social outlets runs monthly May through October.

Liberty provides its key stakeholder groups that are part of the WMP decision-making process in Table 7-1.

Table 7-1: Liberty Stakeholder Roles and Responsibilities in the Decision-Making Process

Stakeholder	Stakeholder Point of Contact	Electrical Corporation Point of Contact	Stakeholder Role	Engagement Methods
Liberty's executive leadership (Regional	Greg Sorensen~~Ed ward Jackson~~	West Region President~~, President, Liberty California~~	Informed; decision-maker~~Informed; consulted~~	• Quarterly update meetings • WMP budgeting process • Emergency Events~~Quarterly update meetings~~

Stakeholder	Stakeholder Point of Contact	Electrical Corporation Point of Contact	Stakeholder Role	Engagement Methods
and Corporate)				• ~~WMP budgeting process~~ • ~~Key contract review, approval and execution~~
Liberty's executive leadership (California)~~Liberty's executive leadership (California)~~	Edward Jackson ~~Lindsay Maruncic; Rick Dalton~~	Utility President – California Electric~~Senior Director of Operations, Senior Director of Engineering, Director of Operations~~	Informed; consulted; decision-maker~~Informed; consulted; decision-maker~~	• Update meetings • Working sessions on planning and prioritizing mitigations • WMP budgeting process • Emergency Events~~Update meetings~~ • ~~Working sessions on planning and prioritizing mitigations~~
Liberty's senior management	Peter Stoltman~~Eliot Jones~~	Senior Manager of Wildfire Prevention~~Senior Manager of Wildfire Prevention~~	Decision-maker; consulted~~Decision-maker; consulted~~	• WF vendor selections • WMP strategy and analysis • Planning and prioritizing all WF mitigations • Emergency Events~~WF vendor selections, WMP strategy and analyses required, planning, and prioritizing all WF mitigations~~
Liberty's senior management	Stephen Moore	Senior Operations Manager	Decision-maker; consulted	• Planning and prioritizing all WF mitigations • Emergency Events

Stakeholder	Stakeholder Point of Contact	Electrical Corporation Point of Contact	Stakeholder Role	Engagement Methods
Liberty's senior management	Andrew Lykens	Senior Engineering Manager	Decision-maker; consulted	• Planning and prioritizing all WF mitigations • WMP strategy and analysis
Public Safety Partners	Varies	Lee Kiolbasa; Emergency Manager~~Senior Manager of Wildfire Prevention; Emergency Preparedness Manager, Fire Protection Specialist~~	Decision-maker; consulted; informed~~Decision-maker; consulted; informed~~	• Advisory board meetings • Trainings and exercises • Project-specific meetings (field, phone, in-person)~~Advisory board meetings~~ • ~~Trainings and exercises~~ • ~~Project-specific meetings (field, phone, in-person)~~ • ~~Incident Command Post during emergencies~~
Public	Varies	Varies	Informed	• PSPS outreach • Townhalls, public workshops, social media, email, bill inserts, newsletters, door hangers • Interaction while conducting work in public

7.1.3 Risk-Informed Prioritization

In making decisions risk mitigation, the electrical corporation must identify and evaluate where it can make investments and take actions to reduce its overall utility risk. The electrical corporation must develop a prioritization list based on overall utility risk.

In this section, the electrical corporation must:

- Describe how it selects areas of its service territory at risk from wildfire for potential mitigation initiatives, including, at a minimum, the following:
    - Geographic scale used in prioritization (*i.e.*, regional, circuit, circuit segment, span, asset)
    - Statistical approach used to select prioritized areas (*e.g.*, areas in top 20 percent for risk, areas in top 20 percent for consequences)
    - Feasibility constraints (*e.g.*, limitations on data resolution, jurisdictional considerations, accessibility)
- Present a list that identifies, describes, and prioritizes areas of its service territory at risk from wildfire for potential mitigation initiatives based solely on overall utility risk, including the associated risk drivers.

Selecting Areas: In its 2023 WMP, Liberty primarily used the CloudFire~~Reax~~ wildfire risk and qualitative consequence mapping to select areas to prioritize mitigations and compliance work activities. Many of Liberty's work efforts are compliance based, including vegetation and asset inspections and remediation work. Any wildfire specific and/or standalone mitigations are planned for by engineering, operations, and vegetation management throughout the year to address targeted risk reductions. This can include reducing asset risk of failure by making repairs from failed detailed inspections or reducing vegetation contact risk by pruning or removing vegetation that was identified using LiDAR analysis. See Table 7-2 below which shows this correlation and how wildfire mitigation work is layered on routine compliance efforts and prioritized.

Following Quarter 3 of 2024, when Liberty plans to implement the Direxyon Risk Assessment Tool ("DRAT"), the ability to analyze risk mitigations at more granular levels will become available at the circuit, segment, and asset levels. Liberty has not yet finalized how it will select areas to prioritize, but Liberty will be able to identify risk factors including Probability of Asset Failure, Consequence of Asset Failure, Probability of Ignition, and Consequence of Fire. By analyzing these metrics at a more granular scale, Liberty will be able to pinpoint locations of its system that are at higher risk. These areas can identify where limitations may take place based on data resolution, jurisdictional considerations, and accessibility. By utilizing DRAT, Liberty can identify areas where mitigation work can be done on top of maintaining compliance. Liberty understands that maintaining compliance is the minimum work that should be done to lower overall risk of its system.

Until further analysis following the Quarter 3 of 2024 implementation date of DRAT, Liberty will continue to utilize the analysis performed by CloudFire as a part of its 2023 WMP. Therefore, Liberty will be able to update Table 7-2 as a part of a future WMP update.

Table 7-2: Wildfire Mitigation Work and Routine Compliance Effort Prioritization

Mitigations	**Compliance Requirement**	**Safety and Reliability Work Prioritization**	**WF Risk Reduction Work Prioritization**	**Enhanced WF Risk Mitigations**
Detailed Asset Inspections /Repairs	G.O. 165 OH and UG detailed asset inspections (5-year cycle)	Defined prioritization and remediation timelines prescribed in G.O. 95:	In 2023, prioritizing high WF risk locations, assets/condition codes for level 3. Identified poles	(1) Conducted detailed G.O. 165 inspections for all OH assets including inspection findings, tracking remediations. (2) Pole risk assessment study to be conducted

Mitigations	Compliance Requirement	Safety and Reliability Work Prioritization	WF Risk Reduction Work Prioritization	Enhanced WF Risk Mitigations
		Level 1 findings - remediated immediately Level 2 - HFTD 3 within six months Level 2 - HFTD 2 with fire risk within 12 months; others within 12-36 months Level 3 – within 60 months	replacements re-inspected	early 2023, will refine WF mitigation/prioritization/ decision-making/ investment optimization planning for 2023 and beyond. (3) Developed QA/QC program for detailed inspections.
Vegetation inspections	G.O. 95, Rule 35, PRC 4293	Remediation timelines for work identified during vegetation inspections are described in Section 8.2.3.4 (Priority Conditions 1 through 4)	A detailed description of vegetation inspection methods are contained in Section 8.2.2. LiDAR inspections are conducted on the entire system annually. Ground Based Detailed Inspections are conducted every three years. The entire system is treated in a similar manner.	(1) When performing line clearing operations Liberty follows or exceeds the Rule 35 guidelines set forth in Appendix 'E' of G.O. 95. (2) Implemented a Maintenance Action Threshold ("MAT"), which is a clearance distance that triggers the work scheduling process. The MAT is based on the regulation clearance with a safety margin multiplier of 1.5 (3) May perform additional Hazard Tree inspections, as needed, to address tree mortality or after major storms, high wind events, or fires. The need for these inspections is determined based on the

Mitigations	Compliance Requirement	Safety and Reliability Work Prioritization	WF Risk Reduction Work Prioritization	Enhanced WF Risk Mitigations
				severity of the event and the resulting possibility of damaged trees. (4) May perform separate pre-fire season inspections in designated Public Resource Code (PRC) areas, Extreme (Tier 3) and Very High (Tier 2) fire areas as needed.
Substation Inspections	G.O. 74	Inspect all substations four times a year	N/A - inspections completed on established cycle	Developed QA/QC program for detailed inspections
Intrusive pole inspections	Test and Treat poles (10-year cycle for poles older than)		N/A – inspections completed on established cycle	Developed QA/QC program for detailed inspections

Following DRAT implementation, Liberty will move toward a risk prioritization method that strives to reduce the systems' risks attributed to its assets. Based on the preliminary quantified risk scores produced by Direxyon, risk scores for asset failures should become a key factor in Liberty's decision-making processes.

Based on the preliminary outputs of DRAT and historical knowledge of Liberty's system, Liberty has identified that its AFR is a key component in identifying controllable risk in its service territory. As shown in Table 7-3, when ranking risk by AFR, it is correlated to the older circuits of the system that pose the most risk of an asset failing. From these preliminary results, Liberty will be able to better identify the areas to focus its mitigation work. Once DRAT is implemented in Quarter 3 of 2024, Liberty will also be able to analyze segments of the circuit where it can target the riskiest areas to perform mitigation work, such as traditional hardening, to update its system and reduce the risk of assets failing and minimizing utility caused ignitions. In addition to identifying locations to target mitigation work, DRAT will also be able to target specific asset and equipment types that contribute to AFR Scores.

Table 7-3: Liberty Circuit AFR Risk

AFR Risk Ranking	Circuit	Asset Failure Risk	Fire Risk Score	Composite Risk Score
1	MEY3200	31.75587828	12.24412266	23.89626556
2	MEY3400	29.59332652	10.82709268	23.13973442
3	MEY3100	28.95343811	12.20107026	22.86836935
4	MEY3300	28.62590154	16.46418173	23.33960489
5	STL3101	28.1626272	17.4916161	27.9439408
6	POR32	27.42491253	9.522927366	22.38978307
7	STL3501	27.28014184	12.02970858	22.54609929
8	MEY3500	26.45724218	19.33121787	22.62896871
9	POR31	25.97447853	10.98820784	22.2193865
10	WSH201	24.09703504	9.699994921	20.1671159
11	TRK7203	22.04460967	9.780865584	20.64498141
12	TAH7300	21.24811015	6.085753301	16.62413607
13	KBH5200	20.39107764	8.274852468	16.91135574
14	NST8600	20.19047619	6.910259778	17.71428571
15	TAH5201	19.30944669	6.829100144	16.22604588
16	CEM41	19.2890625	15.90151952	23.1484375
17	CEM42	18.75609756	11.06651664	19.17560976
18	TAH7100	18.12946979	6.213924418	15.75709001
19	KBH4202	18.02692998	11.43895671	19.28797127
20	TPZ1261	17.64815582	23.3308025	24.33849979

~~From the list above, Liberty will plan normal compliance work and will use the Reax risk map where feasible to prioritize asset/vegetation work on an annual basis. Other mitigation efforts outside of this planning activity, like covered conductor projects, will also use the Reax fire risk polygons and subject matter expert knowledge to target specific areas that have previous reliability or safety issues.~~

~~Liberty has identified the following areas as elevated wildfire risk:~~

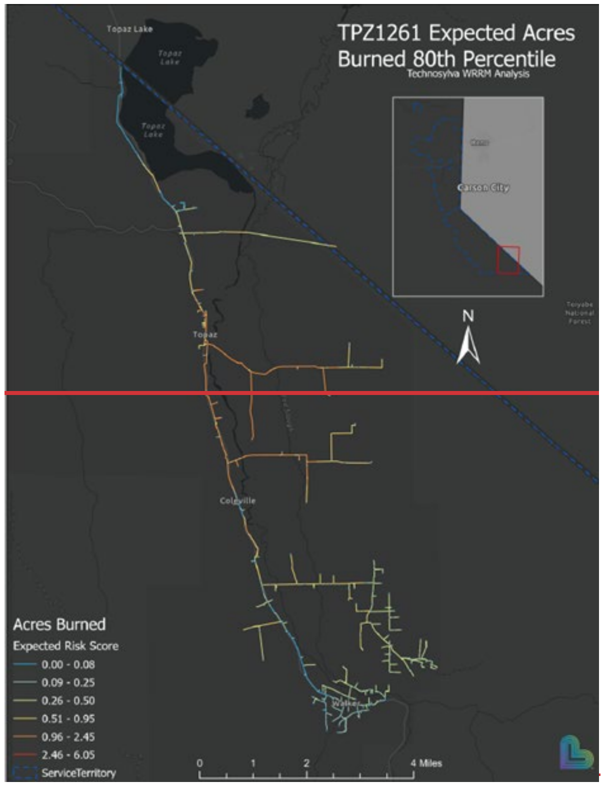
- ~~Topaz~~
- ~~Muller~~
- ~~Meyers~~

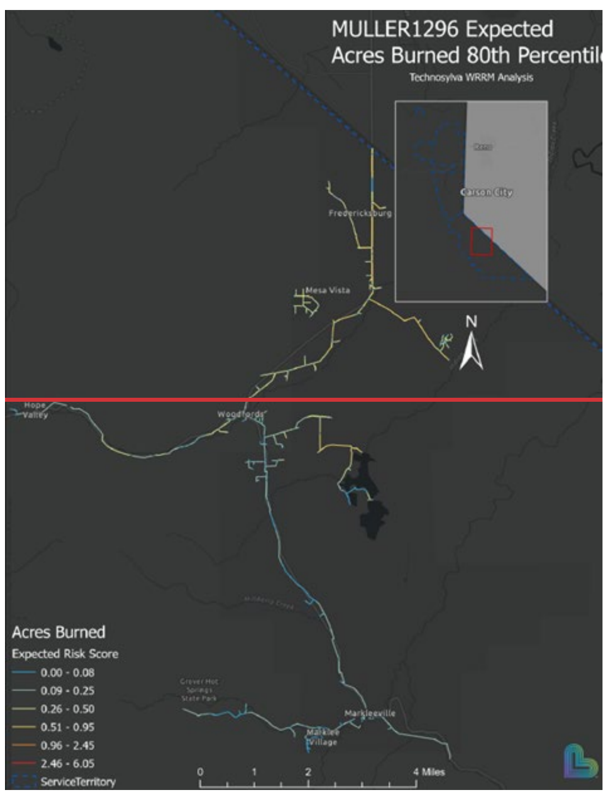
~~Risk identifications were based on Reax' updated wildfire utility risk scoring using new OEIS modeling requirements and incorporating Arup and Liberty-defined MAVFs consequence scoring for wildfire and PSPS risk into the circuit risk scores. Liberty has not assessed the risk drivers impacting the overall risk scores and instead used older studies to support this WMP. Further evaluation of the Reax modeling and the Technosylva WRRM results will better inform Liberty's next WMP submission in 2024.~~

~~Wildfire risk: Figure 7-4 below is an example of Technosylva's WRRM results for Liberty's expected risk (and consequences) for the Topaz and Muller circuits. This map shows the expected acres burned at the 80th percentile. Liberty plans to weigh the expected results to also include structures destroyed, fire behavior, and population impacted for risk desegregation to better target the types of mitigations for each high-risk circuit. These results will also be compared with Reax's quantified study results for Liberty's management to understand the quantified results to better plan for future mitigations by location.~~

~~Liberty is currently conducting a complete analysis of Reax's updated wildfire overall risk assessment to prioritize areas or identify risk drivers.~~

~~Figure 7-4: Technosylva's WRRM results for Liberty's expected risk (and consequences) for the Topaz and Muller circuits~~





7.1.4 Mitigation Selection Process

After the electrical corporation creates a list of top-risk contributing circuits/segments/spans (Section 6.4.2) and prioritized areas based on overall utility risk (Section 7.1.3), the electrical corporation must then identify potential mitigation strategies. It must also evaluate the benefits and drawbacks of each strategy at different scales of application (*e.g.*, circuit, circuit segment, system-wide). In this section of the WMP, the electrical corporation must provide the basis for its decisions regarding which mitigation initiatives to pursue. It must also document how it develops, evaluates, and selects mitigation initiatives.

The electrical corporation should consider appropriate mitigation initiatives depending on the local conditions and setting and the risk components that create the high-risk conditions. There may be a wide variety of potential mitigation initiatives, such as:

- Engineering changes to grid design
- Discretionary inspection and/or maintenance of existing assets
- Vegetation clearances beyond minimum regulatory requirements
- Alternative operational policies, practices, and procedures
- Improved emergency planning and coordination

The electrical corporation may also mitigate risk by combining multiple mitigation initiatives.

The electrical corporation is expected to use its procedures discussed in Section 7 to:

- Develop potential mitigation initiative approaches to address each risk
- Characterize the potential mitigation initiatives to provide decision-makers with information required to support decision-making (*e.g.*, costs, material availability), including an assessment of uncertainties
- Document the results

The electrical corporation must develop a proposed schedule for implementing each mitigation initiative and proposed metrics to monitor implementation and effectiveness of the mitigation initiative. The following subsections provide specific requirements.[51]

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[51] Annual information included in this section must align with Tables 11 and 12 of the QDR.

~~Liberty will use the quantified expected risk circuit ranking as the basis for future mitigation plans. As stated previously, Liberty has assessed risk by circuit for asset risk and tree risk separately and plans to integrate both risk drivers in its future wildfire risk circuit analysis. Each risk type is described and supported throughout the remainder of the mitigation planning.~~

~~Mitigation planning for both asset risk and vegetation risk includes a review of Liberty's previous mitigation plan and performance metrics of initiatives over the last few WMPs to look for correlations and improvements. Because most of the WMP mitigations are compliance-based, such as asset inspection cycles and vegetation clearances around overhead lines, Liberty prioritizes inspections and remediations using the 2022 wildfire risk polygons.~~

~~Vegetation risk: Liberty's service territory is primarily located in Tier 2 and Tier 3 HFTDs with some areas having significant undergrowth along with ingress and egress issues. The geographic characteristics of Liberty's service territory provide a significant level of risk of devastating fires such as the Tamarack Fire and the Caldor Fire, which both occurred in 2021.~~

~~Much of Liberty's service territory is located on forestland and Liberty recognizes the need for additional efforts to reduce accumulation of woody debris that can ignite or contribute to fire spread and intensity. As described in Section 8.2.3, this is accomplished by implementing a Fuel Management Program as a precautionary measure, where feasible, to reduce wildfire risks by removing wood and treating brush and slash after vegetation maintenance is performed. Additional treatments that reduce surface fuels from previous activities and those that further reduce fuel loads are also implemented. This program is intended to align more closely with joint goals of agency partners and the local community, so that vegetation management fuel load is treated in a manner that reduces both the risk of fire ignition and the potential for increased fire intensity.~~

~~Liberty performs LiDAR inspections on an annual basis to identify work that is necessary for compliance with regulations to reduce the likelihood of a fire ignition, to reduce the likelihood of injury to the public, and to improve system reliability. When locations are identified that require vegetation management work, Liberty contractors perform the necessary work as described in Section 8.2.3.3 (Clearance). This includes following or exceeding the Rule 35 guidelines set forth in Appendix 'E' of G.O. 95. Liberty has also implemented a Maintenance Action Threshold ("MAT"), which is a clearance distance that triggers the work scheduling process. The MAT is based on the regulation clearance with a safety margin multiplier of 1.5~~

~~Asset risk: Liberty has an older overhead distribution system with poles dating back to the early 1900's. Vegetation risk heavily weighs into asset risk assessments and work prioritization especially with towering trees near overhead lines. To provide safe and reliable service Liberty identifies assets at greater risk of failure and consequence with using risk-based decision-making model results or subject matter expert judgement to select mitigations above normal operations. Liberty's asset remediation for failed inspections and pole replacements follow compliance timelines that are prioritized by HFTD tier and fire risk. Installing new poles or replacing old poles mitigates asset risk. Over the last three years, Liberty has replaced or installed 1,500 poles for fires, winter storms, covered conductor projects, and pole replacements from failed inspections. Similarly, Liberty has removed or partially removed over 9,000 trees over the last three years for capital projects, dead and dying at-risk CEMA trees, and storms.~~

~~Additional work specific to wildfire mitigation planning, such as covered conductor or emerging technologies, is discussed with SME's and other IOUs to gain insights on mitigations planned and on benchmarking the effectiveness of asset risk mitigations. From these working group discussions, Liberty piloted a fast trip settings and sensitive relay program that has been successful at other IOUs.~~

7.1.4.1 Identifying and Evaluating Mitigation Initiatives

The electrical corporation must describe how it identifies and evaluates options for mitigating wildfire and PSPS risk at various analytical scales. The current guidelines governing this process are derived from the Risk-Based Decision-Making Framework established in the Safety Model and Assessment Proceeding (S-MAP).[52] The S-MAP is currently being updated in CPUC proceeding R. 20-07-013.[53] In due course, the electrical corporation's risk mitigation identification procedure must align with results from this proceeding.[54] The electrical corporation must describe the following:

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[52] 2018 Safety Model Assessment Proceeding (2018 S-MAP), adopted in D.18-12-014 (see S-MAP, step 3, rows 15–25): https://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M250/K281/250281848.pdf

[53] See the Rulemaking 20-07-013 (Order Instituting Rulemaking to Further Develop a Risk-Based Decision-Making Framework for Electric and Gas Utilities) Proceeding Docket (accessed Oct. 27, 2022): https://apps.cpuc.ca.gov/apex/f?p=401:56:0::NO:RP,57,RIR:P5_PROCEEDING_SELECT:R2007013. Also see the Risk Assessment Mitigation Phase (RAMP) proceeding (accessed Oct. 27, 2022): https://www.cpuc.ca.gov/about-cpuc/divisions/safety-policy-division/risk-assessment-and-safety-analytics/risk-assessment-mitigation-phase.

[54] Electrical corporations are not required to incorporate changes made as a result of proceeding R. 20-07-013 in the 2023-2025 WMPs submitted in 2023.

- The procedures for identifying and evaluating mitigation initiatives (comparable to 2018 S-MAP Settlement Agreement, row 26), including the use of risk buy-down estimates (*e.g.*, risk-spend efficiency) and evaluating the benefits and drawbacks of mitigations
- To the extent possible, multiple potential locally relevant mitigation initiatives to address local wildfire risk drivers (see 2018 S-MAP Settlement Agreement, row 29)
- The approach the electrical corporation uses to characterize uncertainties and how the electrical corporation's evaluation and decision-making process incorporates these uncertainties (see 2018 S-MAP Settlement Agreement, rows 29 and 30)
- Two or more potential mitigation initiatives for each risk driver included in the list of prioritized areas including the following information:
    - The initiatives and activities
    - Expected risk reduction and impact on individual risk components
    - Estimated implementation costs
    - Relevant uncertainties
    - Implementation schedule
- How the electrical corporation uses multi-attribute value functions (MAVFs) and/or other specific risk factors (as identified in 2018 S-MAP or subsequent relevant CPUC Decisions) in evaluating different mitigations

Following the implementation of DRAT, Liberty will be able to perform simulations designed around conditions that will supplement the mitigation identification and evaluation process. Liberty will be able to break down the selection process given four key metrics that will supplement its ability to decide and schedule mitigation initiatives: Cost to Implement, Time to Implement, Resources to Implement, and Effectiveness of Implementation.

Cost to Implement is a metric that is output from DRAT that will contribute to the initiative decision-making process. Identifying the budget needed for a mitigation allows Liberty to plan and assess initiatives during a given year based on the budget allocated. Cost to implement will also give insight to the budget that should be allocated to mitigation initiatives, which can be broken down by individual initiatives.

Time to Implement is a key factor in analyzing mitigation initiatives that are evaluated by type and location of a mitigation. For example, if Liberty is evaluating if it should perform a mitigation initiative in a forest service area, it should factor in the time it takes to acquire permits and time to schedule specific needs for accessibility to complete the project. As stated in Section 7.4.3, there are limitations for scheduling given location-based requirements to perform work. Due to the location of much of Liberty's service territory, these limitations exist on most of Liberty's circuits.

Resources to Implement is another key factor to scheduling any work Liberty performs, as there are inherent constraints in the budget, supply chain, and labor categories that Liberty can estimate for given the type and location of an initiative. For example, location of an initiative in difficult terrain leads to higher costs and more labor needed then factoring in the potential for long lead times for material can greatly impact the ability to complete a mitigation initiative. Inversely, some locations in the service territory require less cost, less labor, with the same potential of material availability which would create a different constraint to complete an initiative. These constraints can be input to DRAT to simulate conditions and suggest specific initiatives that can be performed in different time windows.

Effectiveness of Implementation is an output of DRAT as the post-work risk or forecasted risk reduction after a mitigation initiative has taken place. By assessing the risk reduction that would take place by performing mitigation activities, Liberty will be able to identify the assets and locations that will contribute to a lower risk score. Therefore, Liberty needs to consider the effectiveness of implementing a mitigation initiative in its decision-making process.

~~Vegetation Risk Analyses: Liberty has monitored change detection of tree clearance data from LiDAR inspections since 2022, which has informed Liberty where clearance pruning is needed on its system. Liberty has also monitored the decrease in encroachments and workloads utilizing LiDAR data. An analysis of changes detected by LiDAR from data collected in 2021 compared with 2022 is being used to evaluate program effectiveness. The results show the following changes from 2021 to 2022 encroachments:~~

- ~~43% decrease in vegetation within the maintenance clearance zone~~
- ~~8% increase in spans with no vegetation within the defined grow-in zones~~
- ~~4% decrease in spans with one tree within the grow in zone~~
- ~~5% decrease in spans with 2-5 trees within the grow in zone~~
- ~~2% decrease in total trees encroaching or within strike distance to facilities~~

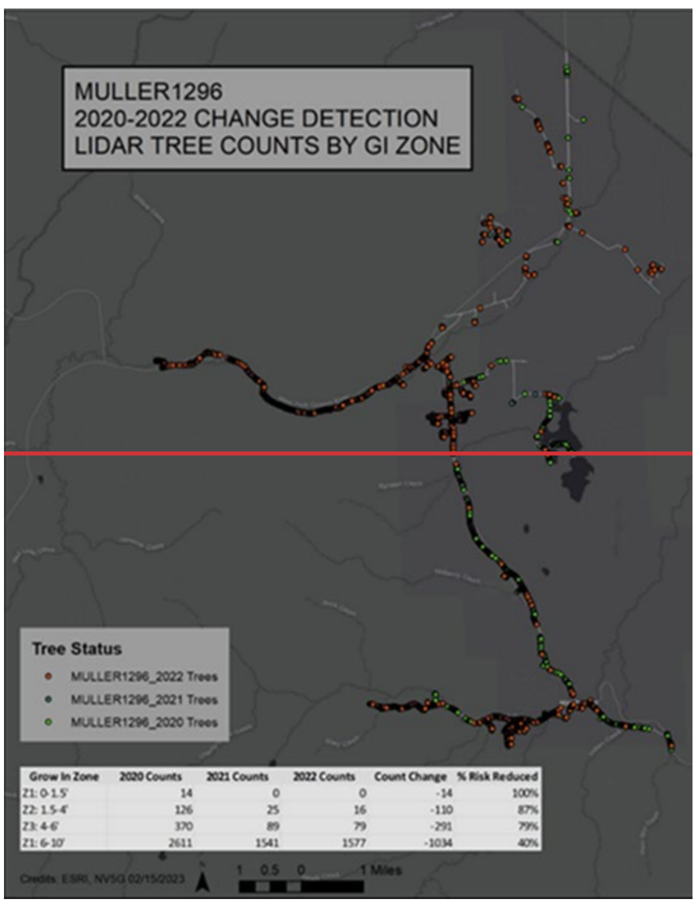
~~Table 7-3: Clearance zones~~

~~Clearance Zone~~	~~2021~~	~~2022~~	~~Change~~	~~Percent Change~~
~~Within maintenance clearance zone~~	~~7,418~~	~~4,213~~	~~-3,205~~	~~-43%~~
~~Approaching maintenance clearance zone~~	~~44,809~~	~~47,775~~	~~2,966~~	~~+7%~~
~~Total trees encroaching or within strike distance to facilities~~	~~257,288~~	~~252,034~~	~~-5,254~~	~~-2%~~

~~Table 7-4: Liberty System Wide Grow-in Detection Results~~

Liberty System Wide Grow In Detection Results (Trees)				
Grow In Zone	**2021 Trees**	**2022 Trees**	**Tree Change**	**% Risk Reduced**
Z1	141	90	-51	36%
Z2	1,683	902	-781	46%
Z3	5,594	3,221	-2,373	42%
Z4	44,809	47,775	2,966	-7%
N/A	205,061	200,046	-5,015	
Total	257,288	252,034	-5,254	
* 2022 Radial Zone criteria was increased 2.5x for 120kV lines				
** 2021 had 3 Lines that were not part of 2022 project.				
*** Z1 & Z2 includes clearance exempt (MWS) trees				

~~Figure 7-5: Vegetation Change Detection~~



7.1.4.2 Mitigation Initiative Prioritization

After identifying and characterizing the mitigation options, the electrical corporation must analyze the options to determine which will reduce risk the most, given limitations and constraints (*e.g.*, resources available for mitigation initiatives). To the greatest extent practicable, the electrical corporation must make these determinations using its existing framework of project prioritization. The electrical corporation must strive to optimize its resources for maximum risk reduction.

The electrical corporation should seek the best integrated portfolio of mitigation initiatives to meet its performance objectives. Objectives may be based on quantified risk assessment results (see Section 6) or other values prioritized by the electrical corporation or broader stakeholder groups (*e.g.*, environmental protection, public perception, resilience, cost). At a minimum, the electrical corporation must do the following:

- Evaluate its potential mitigation initiatives. This evaluation will yield a prioritized list of initiatives. The objective is for the electrical corporation to identify the preferable initiatives for specific geographical areas. (Comparable to 2018 S-MAP Settlement Agreement, rows 12, 26, and 29.)
- Identify the best mitigation initiatives for all geographical areas to create a portfolio of projects expected to provide maximal benefits within known limitations and constraints. (Comparable to 2018 S-MAP Settlement Agreement, rows 12, 26, and 29.)
- Explain how the electrical corporation is optimizing its resources to maximize risk reduction. Describe how the proposed initiatives are an efficient use of electrical corporation resources and focus on achieving the greatest risk reduction with the most efficient use of funds and workforce resources.

This process is expected to be iterative due to the competing nature of performance objectives and their complex interrelationships.

The electrical corporation must describe how it prioritizes mitigation initiatives to reduce both wildfire and PSPS risk. This discussion must include the following:

- A high-level schematic showing the procedures and evaluation criteria used to evaluate potential mitigation initiatives. At a minimum, the schematic must demonstrate the roles of quantitative risk assessment, resource allocation, evaluation of other performance objectives (*e.g.*, cost, timing) identified by the electrical corporation, and subject matter expert (SME) judgment. Where specific local factors, which vary across the service territory, are considered in the decision-making process (*e.g.*, the primary risk driver in a region is legacy equipment), they must be indicated in the schematic. The detail must be sufficiently specific to understand why those local conditions are part of the decision process (*i.e.*, there should not be simply one box in the schematic that is labeled "local conditions," which is then connected to the rest of the process).

- Summary description (no more than five pages) of the procedures and evaluation criteria for prioritizing mitigation initiatives, including the three minimum requirements listed above in this section.

Liberty, as a small multi-jurisdictional utility ("SMJU") company, is excluded from S-MAP modeling requirements. Liberty adheres to the Voluntary Agreement appended to CPUC D.19-04-020 which outlines SMJU risk assessment requirements. Although Liberty is excluded from being required to conduct annual risk analyses and assessments of each relevant risk event affecting its service territory through a RAMP submission, including wildfire risk analyses, it conducts an enterprise risk management assessment in its GRC.

For this WMP, Liberty's mitigation planning was independently assessed based on subject matter expert judgement about the best grid operations portfolio that would work with its planned asset management initiatives. The situational awareness and risk modeling design experts worked collaboratively on the optimal mitigations for monitoring significant weather patterns (i.e., red flag days) and PSPS likelihood event days affecting daily operations planning. Vegetation management developed its own independent evaluation for designing the optimal portfolio of mitigations. As indicated previously, Liberty plans to have a cohesive mitigation portfolio plan approach in its next WMP that incorporates data analytics and risk-informed decision-making assessment and monitoring to improve its overall risk reduction performance over time.

Liberty's current asset management strategy involves prioritizing WMP initiatives that also address the need to replace its aging overhead infrastructure. Initiatives that fall into this category are covered conductor, undergrounding, traditional overhead replacement, microgrids and pole replacements. All of these initiatives are alternatives considered when planning the replacement of its distribution facilities. Implementation of emerging technology and sensitive relay profile ("SRP") are also top priorities.

Most of Liberty's service territory is located in HFTD 2 or HFTD 3 areas. In addition, Liberty considered the Reax fire threat areas to prioritize initiatives in the highest fire threat areas. There are many considerations for determining project prioritization (such as outage history, reliability, capacity considerations, and asset condition), but with respect to location, Liberty prioritizes the highest fire threat areas for projects each year based on the best available wildfire risk analyses performed prior to planning mitigations. This is done for all initiatives. It should be noted that due to the competing needs for system improvements, some projects are planned in areas that are not located in the highest fire threat area but are still in elevated HFTD Tier 2 areas where system hardening for wildfire mitigation is needed for safety and reliability.

For WMP initiatives that include covered conductor, undergrounding, traditional overhead hardening and microgrids, most projects are in or adjacent to Liberty's highest fire threat areas. Refer to the Grid Hardening Map in Appendix C for a summary of past and planned projects. For the enhanced pole replacement initiative, there is work needed throughout the system based on system survey results and compliance remediation timelines. For this initiative, the highest fire threat areas are targeted first. ~~and~~ Liberty then plans for all of the required replacement work by allocating resources accordingly to complete work within the time frames set forth by CPUC general orders. For the SRP Program and emerging technologies initiatives, the highest fire threat areas are prioritized and included in the program plan for this year. Refer to the SRP Program map in Appendix C for an understanding of the extent of that program. For other initiatives, the highest fire threat areas are prioritized but based on competing project resource needs for its work planned throughout the system.

Liberty is currently evaluating wildfire risk results in consultation with its analytics team. Liberty has developed an interim mitigation strategy for its vegetation portfolio and plans to expand this strategy to incorporate assets in the future. See Section 7.2.3 for Liberty's interim mitigation strategy.

Referring to the abilities of DRAT and the decision-making factors in 7.1.4.1, prioritization is subject to the limitations and projected risk benefit for each mitigation. Until Quarter 3 of 2024 Liberty will use the methodology described above.

7.1.4.3 Mitigation Initiative Scheduling

The electrical corporation must report on its schedule for implementing its portfolio of mitigation initiatives. The electrical corporation must describe its preliminary schedules for each initiative and its iterative processes for modifying mitigation initiatives (Section 7.1.4.1).

Mitigation initiatives may require several years to implement. For example, relocating transmission or distribution capabilities from overhead to underground may require substantial time and resources. Since mitigation initiatives are undertaken in high-risk regions, the electrical corporation may need interim mitigation initiatives to mitigate risk while working to implement long-term strategies. Some examples of interim mitigation initiatives include more frequent inspections, fire detection and monitoring activities, and PSPS usage. If the electrical corporation's mitigation initiative requires substantial time to implement, the electrical corporation must identify and deploy interim mitigation initiatives as described in Section 7.2.3.

In its WMP submission, the electrical corporation must provide a summary description of the procedures it uses in developing and deploying mitigation initiatives. This discussion must include the following:

- How the electrical corporation schedules mitigation initiatives.
- How the electrical corporation evaluates whether an interim mitigation initiative is needed and, if so, how an interim mitigation initiative is selected (see Section 7.2.3).
- How the electrical corporation monitors its progress toward its targets within known limitations and constraints. This should include descriptions of mechanisms for detecting when an initiative is off track and for bringing it back on track.
- How the electrical corporation measures the effectiveness of mitigation initiatives (*e.g.*, tracking the number of protective equipment and device settings de-energizations that had the potential to ignite a wildfire due to observed damage/contact prior to re-energization). The mitigation sections of these Guidelines (Sections 8) include specific requirements for each mitigation initiative.

Liberty is currently evaluating wildfire risk results in consultation with its analytics team. Liberty has developed an interim mitigation strategy for its vegetation portfolio and plans to expand this strategy to incorporate assets in the future. See Section 7.2.3 for Liberty's interim mitigation strategy.

Scheduling: Liberty complies with the timing requirements for system facility inspections. Repair or replacement of assets also complies with timing requirements. As weather issues occur~~,~~ (such as winter storms or high wind events)~~,~~ Liberty will conduct~~s~~ additional inspections.

Liberty is actively planning and executing wildfire mitigation initiatives while developing its risk-based decision-making process. On at least an annual basis, Liberty refines the plans and targets for various initiatives. This refinement process includes reviewing plans and emerging issues along with risk and effectiveness data. As documented in Liberty's WMP updates, targets are developed for the next three years. Additionally, Liberty maintains a capital budget for the next five years to facilitate planning for project execution and financial considerations.

Implementation of WMP initiatives can take considerable time to complete. Starting early enough to complete a project when intended is critical. The primary steps for implementing initiative projects are initiation, planning, and execution. Initiation includes scoping the project, estimating the cost, and obtaining approvals. Planning includes design, vegetation management, easement work, permitting, and material procurement. Execution consists of completing the work. Timelines for various initiatives that involve construction are as follows:

- Covered conductor: 12-24 months
- Undergrounding: 18-36 months
- Traditional overhead hardening: 8-24 months
- Line removal: 6-24 months
- Pole replacement: 4-18 months
- Microgrid: 18-36 months
- Tree attachment: 2-18 months
- Animal guard: 8-24 months
- Open wire/grey wire replacement: 1-12 months

Interim or Expedited Mitigations: Initiatives such as covered conductor and undergrounding take considerable time to complete across major sections of the service territory. Interim or expedited mitigations provide some mitigation while construction of other initiatives occurs over extended periods of time.

Liberty's ability to execute a PSPS is an interim mitigation that can effectively mitigate a utility infrastructure-initiated wildfire.

The SRP Program, discussed in Section 8.1.2.6 and Section 8.3.3, is ~~also~~ an expedited ~~interim~~ mitigation. With the use of precise coordinated sensitive relay settings, faults can be quickly cleared to avoid ignition events. In addition, fault indicators are being installed on circuits where SRP will be used. As other mitigations are completed, SRP settings can be adjusted to reach an optimum setting that provides protection but also maintains reliability.

Mitigation Effectiveness: Liberty studies its forced outage and ignition data to assess the condition of its assets and ~~to begin to~~ determine the effectiveness of its wildfire mitigation efforts. Liberty records forced outage data with details that include the location and cause of the outage. As more WMP projects are completed and in service for several years, their effectiveness can be measured.

Following the implementation of DRAT, Liberty will reassess its scheduling, interim mitigation, and mitigation effectiveness process to account for the additional outputs provided by the tool.

7.2 Wildfire Mitigation Strategy

Each electrical corporation must provide an overview of its proposed wildfire mitigation strategies based on the evaluation process identified in Section 7.1.

7.2.1 Overview of Mitigation Initiatives and Activities

The electrical corporation must provide a high-level summary of the portfolio of mitigation initiatives across its service territory. In addition, the electrical corporation must describe its reasoning for the proposed portfolio of mitigation initiatives and why it did not select other potential mitigation initiatives.

Additionally, for each mitigation initiative category, the electrical corporation must provide the following:

- A high-level overview of the selected mitigation initiatives
- An implementation plan, including its schedule and how progress will be monitored
- How the need for any interim mitigation initiatives was determined and how interim mitigation initiatives were selected (see Section 7.2.3)

Liberty selected a portfolio of initiatives that aligns with its current risk methodology and risk mitigation strategy. See sections 7.1.4.2 and 7.1.4.3 for additional discussion on how Liberty selects, prioritizes and schedules its initiatives.

Liberty monitors its initiative schedules on an ongoing basis and reports on its initiative progress and completion of targets through its GIS database and quarterly data submissions to Energy Safety (*i.e.*, QDR). Liberty also monitors its outage database for issues where WMP initiatives have been implemented.

Liberty considers cost and implementation timelines when determining the need for interim mitigation strategies. Refer to Section 7.1.4.3 for additional information on how Liberty determines the need for interim mitigation strategies.

Liberty provides a summary list of WMP mitigation initiatives in Table 7-4~~Table 7-5~~.

Table 7-4~~5:~~ Liberty List and Description of Electrical Corporation-Specific WMP Mitigation Initiatives for 3-year and 10-year Outlooks

WMP Category	**Within 3 Years**	**Within 10 Years**	**Location in WMP**
Grid design, operations, and maintenance	• Build out a Sensitive Relay Profile ("SRP") program throughout Liberty's system to reduce ignition risk. • Install additional reclosers to help with sectionalization. • Install additional fault indicators to help with reliability. • Continue to install covered conductors in high fire risk areas at a reduced rate while ~~we~~ Liberty gathers better data on the risk spend efficiency of this program. • Continue to underground conductor in high fire risk areas where economically feasible. Undergrounding will be considered in all alternative analyses. • Replace or repair poles in territories~~y~~ that have been deemed necessary by our system surveys. • Continue to rebuild or repair high priority overhead conductors in territories~~y~~ to address aging infrastructure and help with reliability and wildfire mitigation. • Pilot the resonant grounding or "Swedish neutral" system on one substation within three years, test its risk spend efficiency and effectiveness. • Continue to consider microgrids, and line removal as an alternative solution to help with wildfire mitigation. ~~Currently planning to bring a new microgrid online along with line removal in 2024~~. • Continue to make progress on tree attachment removals and replacing open wire/grey wire within territory yearly. • Complete installation of animal guards or "green jackets" on exposed substation equipment.	• Continue to install covered conductor in high fire risk areas at a reduced rate while we gather better data on the risk spend efficiency of this program. • Continue ~~to~~ underground conductor in high fire risk areas where economically feasible. Undergrounding is considered as an alternative for any future project. • Replace or repair poles in territory that have been deemed necessary by ~~our~~ system surveys. • Continue to rebuild or repair high priority overhead conductors in territories~~y~~ to address aging infrastructure and help with reliability and wildfire mitigation. • Continue to consider microgrids~~,~~ and line removal as an alternative solution to help with wildfire mitigation. Currently planning to bring a new microgrid online along with line removal in 2024. • Continue to pilot and test effectiveness of Swedish Neutral systems and build out this initiative further if successful.	Section 8.1
Vegetation management	• Complete vegetation risk modeling.	• Implement IVM monitoring program	Section 8.2

WMP Category	Within 3 Years	Within 10 Years	Location in WMP
	• Complete fall-in risk scoring model pilot.	• Develop Utility Arborist training program for Liberty's service area.	
Situational awareness and forecasting	• Determine weather station network capacity. • Implement maintenance program for weather stations. • Research emerging technologies for future fault detection pilot programs. • Work with AlertWildfire to own and operate cameras to track smoke and fires.	• Implement new technologies if available (*i.e.*, AI smoke detection) to identify ignitions more quickly. • Improve weather forecasting capabilities as models improve or additional data becomes available.	Section 8.3
Emergency preparedness	• Update workforce training on incident Command System ("ICS"). • Maintain e~~E~~mergency r~~R~~esponse p~~P~~lans. • Continued engagement with local stakeholders to prepare for and respond to fire-related events. • Enhanced documentation and use of lessons learned to update plans.	• Increase granularity and customization of response plans.	Section 8.4
Community outreach and engagement	• Implement planned communication channels and technologies with customers, communities, and key stakeholders. • Engage CBOs and expand network of contacts in each area of Liberty's service territory, including South Lake Tahoe, North Lake Tahoe, Coleville/Walker, and Loyalton/Portola communities. • Collaborate with CBO networks to support, educate, notify, and prepare AFN communities. • Collaborate with public safety partners to support, educate, notify, and prepare AFN communities. • Support bilingual outreach through the utilization of bilingual outreach coordinator. • Identify improvements to overall accessibility of information available to AFN customers. • Encourage self-identification of AFN customers through targeted outreach and communications.	• Communicate effectively with stakeholders through tailored approaches for outreach, engagement and information exchange with customers, communities and stakeholders based on various groups' unique needs. Identify emerging channels and technologies to better communicate with customers, community, and stakeholders. • Engage CBOs and further expand network of contacts in each area of Liberty service territory, including South Lake Tahoe, North Lake Tahoe, Coleville/Walker, and Loyalton/Portola communities. • Continue to work collaboratively with CBO networks to support, educate, notify, and prepare AFN communities. • Continue to work collaboratively with Public Safety Partners to support, educate, notify, and prepare AFN communities. • Continue to support bilingual outreach efforts. • Identify improvements to overall accessibility of information available to AFN~~.~~ ~~c~~customers.	Section 8.5

WMP Category	Within 3 Years	Within 10 Years	Location in WMP
	• Hold regular PSPS coordination meetings with neighboring and connecting utilities, Tahoe Donner Public Utility District and NV Energy.	• Continue to encourage self-identification of AFN status through targeted outreach efforts and communications. • Ongoing PSPS coordination meetings with Tahoe Donner Public Utility District and NV Energy.	
PSPS	• Reduce the possible duration of PSPS events in customer hours (normalized by fire weather, *e.g.*, Red Flag Warning line mile days). • Reduce the possible duration of PSPS event by reducing recovery time through staff training. • Electric grid system hardening. • Reduce the possible duration of PSPS events in customer hours (normalized by fire weather, *e.g.*, Red Flag Warning line mile days)	• Reduce the total number of customers affected by PSPS events. • Reduce the frequency of PSPS where utility operating protocol requires de-energization of a circuit or portion thereof to reduce ignition probability (total). • Reduce the scope of PSPS events in circuit-events, measured in number of events multiplied by number of circuits targeted for de-energization (total).	Section 9

7.2.2 Anticipated Risk Reduction

In this section, the electrical corporation must present an overview of the expected risk reduction of its wildfire mitigation activities.

The electrical corporation must provide:

- Projected overall risk reduction
- Projected risk reduction on highest-risk circuits over the three-year WMP cycle

7.2.2.1 Projected Overall Risk Reduction

In this section, the electrical corporation must provide a figure showing the overall utility risk in its service territory as a function of time, assuming the electrical corporation meets the planned timeline for implementing the mitigations. The figure is expected to cover at least 10 years. If the electrical corporation proposes risk reduction strategies for a duration longer than ten years, this figure must show that corresponding time frame.

Liberty does not yet have sufficient information to calculate the risk reductions for top-risk circuits and plans to develop an approach in 2023. Liberty is evaluating the risk modeling approach and overall assessment of planned initiatives presented in this WMP. Initial baseline risk analysis and assessments were conducted at the asset and vegetation level separately by circuit based on readily available risk studies and subject matter expert judgment for mitigation planning. Reax updated the wildfire risk modeling framework presented in Section 6.2 and developed the overall wildfire risk and PSPS risk scoring by circuit. Liberty plans to continue evaluating the results of its wildfire and PSPS risk studies throughout the year to better define and support planned initiatives that will effectively target and reduce risk by location.[55]

Analysis to be completed in 2023: Liberty plans to evaluate the risk reduction associated with its planned mitigation activities by re-running its established risk analysis workflow, assuming the mitigation activities have been implemented, and measuring the reduction in overall risk associated with each planned mitigation activity by comparing the post-mitigation risk to the baseline risk. Liberty plans to develop quantitative estimates for the local effects of mitigation

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55 In December 2022, Liberty requested that Reax Engineering update its wildfire risk modeling for the new requirements established by OEIS' Technical Guidelines. In January 2022, Liberty retained Arup to work with Liberty's risk model team and Reax's fire spread modeling results to calculate consequences using MAVF weighting to properly rank wildfire and PSPS risks by circuit. To the extent possible, Arup and the Liberty risk team established an appropriate risk-informed decision-making framework that was presented in Section 6.2.

activities (*e.g.*, expected reduction in ignition rate per line-mile associated with covered conductors) to enable the forecasting of future risk reduction.

In conjunction with this study, Liberty also plans to assess the asset risk reduction and vegetation risk reduction at an operational performance level utilizing IBM's work management platform. IBM's Maximo asset health and predict solution that was customized for Liberty will integrate asset risk and detailed vegetation risk scores to help asset and vegetation managers better assess operational risk to plan and adjust work activities for significant weather event days, including elevated high fire risk days. Asset inspections, repairs, replacements, outages can be uploaded monthly, quarterly, semi-annually for various data sources, and the risk profiles will adjust accordingly based on customized condition modifiers. Liberty does not currently have this data integration approach and these risk reduction performance measurements that enable analysis at the consolidated asset/vegetation level.

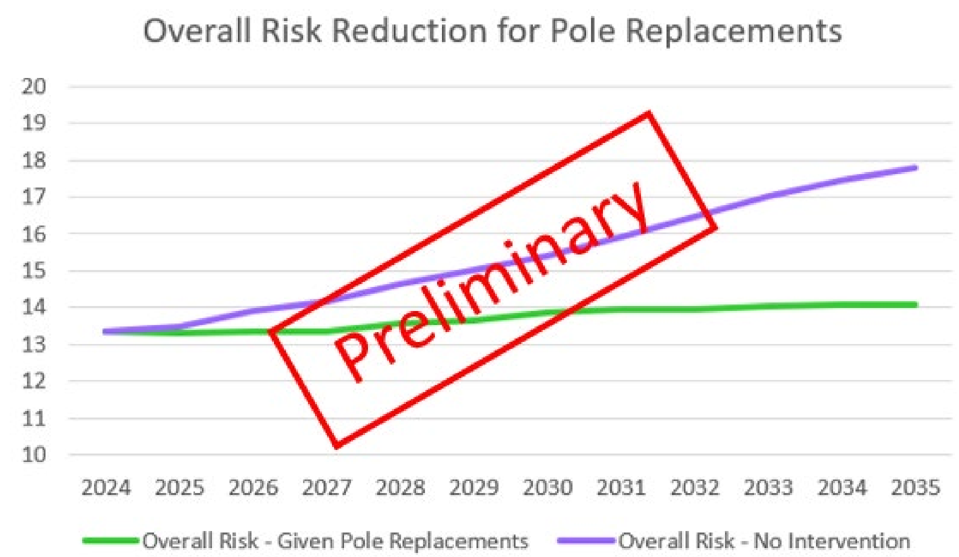
Another ongoing parallel risk study this year will develop risk-informed decision-making process flow charts and tools based on asset intervention schedules for varying budget constraints, asset replacements, and costs to help with long-term risk-informed mitigation strategies. Direxyon has worked with Liberty's risk team since January 2022 to design and calculate wildfire risk using Technosylva's WRRM results for Liberty's service territory.

Once the complete workflow is established to evaluate the risk reduction associated with specific mitigation activities, Liberty will be able not only to calculate future projected overall risk reduction but also to calculate the risk spend efficiency associated with each mitigation activity and prioritize the most cost-effective mitigations accordingly.

Timeline for calculating overall risk reduction: Liberty plans to assess Direxyon's models for costs, risk, and decision-making in Quarter 2 of 2023. Direxyon's Phase 1 was a pilot project related to one asset type, which was distribution poles for Liberty. Liberty is evaluating the scope and timeline for Phase 2 (to be conducted in Quarter 3), and may integrate other asset types that Liberty deems necessary, which could include overhead lines, trees, overhead transformers. This integrated asset and vegetation risk evaluation could also produce the required risk reduction over time with the proper mitigation interventions planned each year. Liberty would need all the data solutions mentioned above to sufficiently analyze and assess detailed asset risk and vegetation risk reductions for each high consequence circuit segment. In Q4, Liberty would analyze the results and assess the results with internal subject matter experts for decision-making integration and long-term planning for 2024 and beyond.

2024 Update: Liberty has been working closely with Direxyon to produce a model that will yield projected risk reduction. As a part of the development of DRAT, forecasted metrics are among the top priorities of functionalities. DRAT has been able to output a preliminary projected overall risk of poles and mitigations regarding pole replacements. As a part of the full implementation, Liberty will be able to quantify projected risk given multiple asset types across the service territory. Figure 7-2 shows the Composite Risk Score projected for 2025-2035 given pole replacements. Liberty's risk score is quantified on a scale of 0-45. This figure is an early output of DRAT where Direxyon and Liberty will continue to collaborate to develop model inputs that can forecast actionable results.

Figure 7-2: Overall Risk Reduction for Pole Replacements, 2025-2035



7.2.2.2 Risk Impact of Mitigation Initiatives

The electrical corporation must calculate the expected "x% risk impact" of each of its mitigation initiative activity targets for each year from 2023–2025. The expected x% risk impact is the expected percentage risk reduction on the last day of each year compared to the first day of that same year. For example:

For protective devices and sensitivity settings, the risk on Jan. 1, 2024 = 2.59×10^{-1}

After meeting its planned initiative activity targets for protective devices and sensitivity settings, the risk on Jan. 1, 2024 = 1.29×10^{-1}

The expected x% risk impact for the protective devices and sensitivity settings initiative in 2024 is:

$$\frac{\text{risk before} - \text{risk after}}{\text{risk before}} \times 100$$

$$\frac{2.59 \times 10^{-1} - 1.29 \times 10^{-1}}{2.59 \times 10^{-1}} \times 100 = 50\%$$

The expected "x% risk impact" numbers must be reported for each planned mitigation initiative activities in the specific mitigation initiative sections of Section 8 (see example tables in Section 8).

Liberty is evaluating the risk modeling approach and overall assessment of planned initiatives presented in this WMP. Initial baseline risk analysis and assessments were conducted at the asset and vegetation level separately by circuit. Liberty plans to continue evaluating the results of wildfire and PSPS risk throughout the year to better define and support planned initiatives that will effectively target and reduce risk by location.

2024 Update: Liberty's risk impact of mitigation activities is under development with Direxyon. The risk score will be available for mitigation work completed in 2024. A preliminary output of the risk score from early 2024 is shown in Figure 7-2 above for pole replacement mitigations. Following the development and scheduled implementation at the end of Quarter 3 of 2024, DRAT will be able to quantify the percent risk impact for covered conductors, pole replacements, fuse replacements, and vegetation mitigations.

7.2.2.3 Projected Risk Reduction on Highest-Risk Circuits Over the Three-Year WMP Cycle

The objective of the service territory risk reduction summary is to provide an integrated view of wildfire risk reduction across the electrical corporation's service territory. The electrical corporation must provide the following information:

- Tabular summary of numeric risk reduction for each high-risk circuit, showing risk levels before and after the implementation of mitigation initiatives. This must include the same circuits, segments, or span IDs presented in Section 6.4.2. The table must include the following information for each circuit:
    - **Circuit, Segment, or Span ID:** Unique identifier for the circuit, segment, or span.
        - If there are multiple initiatives per ID, each must be listed separately, using an extender to provide a unique identifier
    - **Overall Utility Risk:** Numerical value for the overall utility risk before and after each mitigation initiative.

- **Mitigation initiatives by implementation year:** Mitigation initiatives the electrical corporation plans to apply to the circuit in each year of the WMP cycle.

Liberty does not yet have sufficient information to calculate the risk reductions for top-risk circuits and plans to develop an approach in 2023. See Section 7.2.2.1 for Liberty's estimated timeline to develop the baseline risk of assets failing in service given historic outage events by type to calculate the likelihood of the risk events in future with the planned mitigations correlating to the events to estimate risk reduction. The estimated risk reduction calculation will utilize Direxyon's scenario analysis tools to model results from different planned mitigations for each high consequence risk segment.

2024 Update: Liberty has been developing DRAT to quantify projected risk. Liberty plans to complete the development and implementation at the end of Quarter 3 of 2024. At that time, Liberty should be able to project risk reduction on its highest risk circuits over the current three-year WMP cycle.

7.2.3 Interim Mitigation Initiatives

As indicated in Section 7.1.4.3, for each mitigation that will require greater than one year to implement, the electrical corporation must assess the potential need for interim mitigation initiatives to reduce risk until the primary or permanent mitigation initiative is in place. If the electrical corporation determines that an interim mitigation initiative is necessary, it must also develop and implement that initiative as appropriate.

The electrical corporation must provide a description of the following in this section of the WMP:

- The electrical corporation's procedures for evaluating the need for interim risk reduction
- The electrical corporation's procedures for determining which interim mitigation initiative(s) to implement
- The electrical corporation's characterization of each interim risk management/reduction action and evaluation of its specific capabilities to reduce risks, including:
    - Potential consequences of risk event(s) addressed by the improvement/mitigation
    - Frequency of occurrence of the risk event(s) addressed by the improvement/mitigation

Each interim mitigation initiative planned by the electrical corporation for implementation on high-risk circuits must be listed as a mitigation initiative in Section 8. In addition, interim mitigation initiatives must be discussed in the relevant mitigation initiative sections of the WMP and included in the related target tables.

Liberty does not have an interim mitigation program because Liberty does not recognize the usefulness of interim mitigations as a meaningful way of mitigating fire risk, as previously identified "interim" mitigations are not expected to expire after the completion of primary or permanent mitigations. Instead, Liberty has identified resource constraint groupings to implement a metric to measure small vs medium vs large effort mitigations with Small Resource Constraints to Implement Mitigations effectively replacing interim mitigations. Liberty's constraints to implement are a combination of time, labor, budget, permitting, supply chain, and other potential limitations to implement a mitigation initiative effectively. Below are mitigations organized into the identified groupings which Liberty has identified.

Asset Mitigations Planned for 2025:

- Small Resource Constraints to Implement Mitigations
    - Installation of System Automation Equipment – Sensitive Relay Protocols (SRP)

    - Pole Replacements
    - Tree Attachment Removals – Overhead to Overhead
    - Expulsion Fuse Replacements
    - Open/Grey Wire Replacements
    - Animal Guards
- Medium Resource Constraints to Implement Mitigations
    - Covered Conductor
    - Traditional Overhead Hardening
    - Tree Attachment Removals – Overhead to Underground
- Large Resource Constraints to Implement Mitigations
    - Undergrounding
- Unplanned Mitigations
    - Microgrids
    - Line Removal
    - CALFire exempt hardware
    - Substation Equipment Replacement

Vegetation Mitigations:

- Pole Clearing
- Wood and Slash Management
- Fall-in Mitigation, High Species Risk
- Line Clearance Pruning

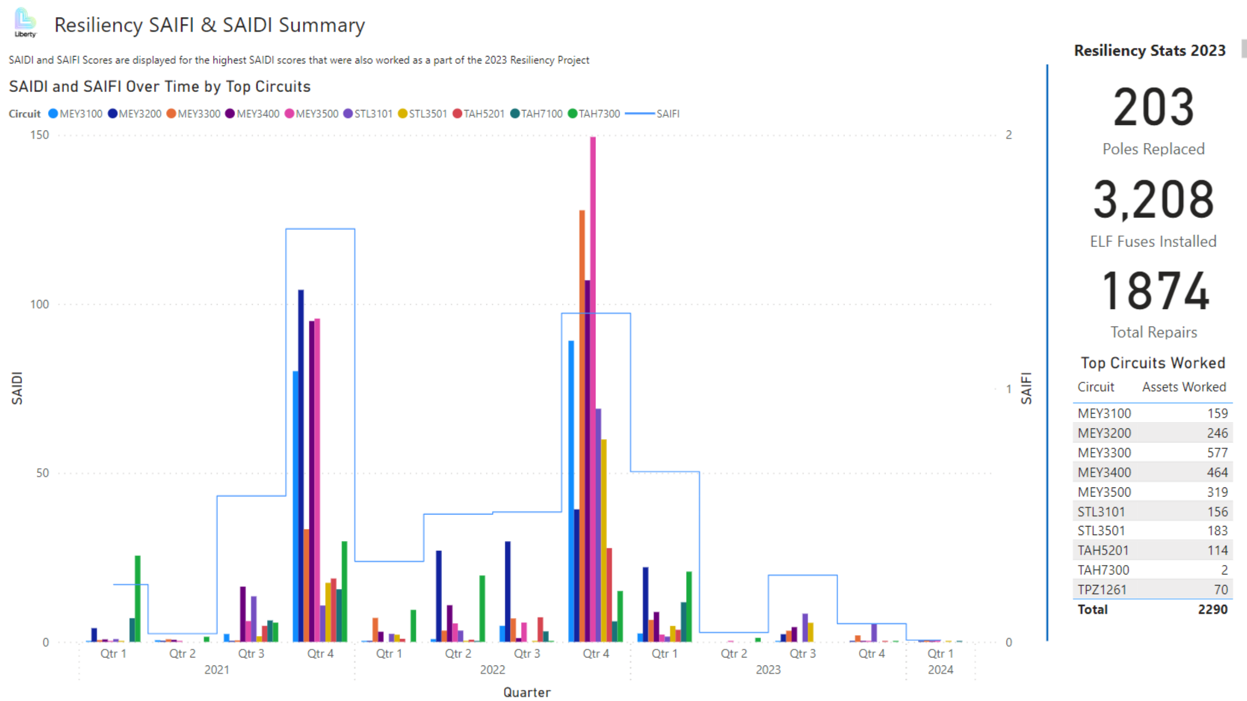
Liberty's Small Resource Constraints grouping is evaluated by having short-time and cost-effective implementation attributes. These mitigation efforts can be implemented within one year of introduction for many of its assets. These mitigations are needed to reduce risk to the system and concurrently reduce the risk of a utility caused ignition. This small constraints category contains mitigations that can be performed system-wide to cover a lot of service territory to effectively lower risk, while medium to large constraint mitigation initiatives are planned and executed in targeted locations. Table 7-5 demonstrates the Constraint Groupings in terms of planning time and service territory each category can cover per year.

Table 7-5: Liberty Mitigation Constraint Groupings

Constraint Group	Planning Time	Territory Coverage /Year
Vegetation	<1 Year	100%
Small	<1 Year	96.999%
Medium	1-2 Years	3%
Large	2+ Years	.001%

Liberty does not assess the risk events in terms of consequence and frequency of occurrence addressed by each mitigation initiative. Since submitting its 2023 WMP, Liberty has experienced a significant reduction in its SAIFI/SAIDI metrics. As Liberty has conducted Small Resource Constraints to Implement Mitigations in response to its 2023 WMP, SAIFI/SAIDI metric improvements are shown in Figure 7-3 below. In general, Liberty identifies risk events as outage, PSPS, and ignition events. Due to the lack of PSPS and ignition events, Liberty does not have historical data. Therefore, the SAIDI/SAIFI metrics are relevant to the continued analysis of Liberty's mitigation strategies.

Figure 7-3: Liberty SAIFI and SAIDI Summary Metrics, 2021-2024



~~As previously discussed, Liberty's risk-informed decision-making framework is under development. Liberty's engineering, planning, and regulatory staff will need three to six months post-product/service delivery of all risk studies to fully engage with internal subject matter experts to evaluate the results of the risk analyses. This includes assessing wildfire and PSPS risk, planning for the appropriate mitigations to reduce the greatest risks, monitoring Liberty's performance plan for effectiveness, and reassessing the planned mitigations for the next plan. See Section 7.2.2.1 for Liberty's interim risk analysis to be performed this year.~~

~~Liberty's Interim Risk Reduction Strategy ("IRRS") developed by its vegetation management group will be expanded this year to include asset management risk reduction measures to account for the sensitive relay protocols program and deployment of early fault detection technologies discussed throughout Section 8.~~

~~The vegetation management group established a Defense-in-Depth strategy that integrates people, technology, and operational capabilities to help prevent vegetation failures. Liberty employs this strategy to reduce the risk of fires, personal injuries, and outages. This is accomplished by implementing the various vegetation management plans and procedures that have been developed in recent years and that in turn complement each other. The Vegetation Management Plan establishes the program requirements and outlines a vegetation management strategy designed to maintain regulatory compliance and mitigate vegetation threats that may impact utility infrastructure. As part of this plan, Liberty performs LiDAR based~~

~~inspections of its system on an annual basis to determine if vegetation is nearing defined clearance zones as set forth in the Liberty VM Plan and applicable laws and regulations. Liberty also performs detailed inspections and maintenance of vegetation along entire circuits where individual trees are examined, and the condition of each is rated and recorded every three years. Additionally, Liberty performs patrol inspections of vegetation along utility rights-of-way to identify obvious hazards. These inspections are focused on the removal of dead and dying trees within and adjacent to the right-of-way.~~

~~Although, each inspection serves a primary purpose within the VM strategy, inspectors are instructed to prescribe work for any vegetation condition that is expected to fail and strike electric facilities or grow into regulated clearance zones prior to the next scheduled inspection and maintenance activities. When conditions are observed that may necessitate additional inspections, it is reported to Liberty for VM inspection planning and prioritization. This multi-faceted approach is designed to achieve and maintain adequate vegetation clearance distances, remediate at risk species, and remove obvious hazard trees with strike potential in an effective and complimentary manner. This approach provides a method of assuring the efficacy of inspections while informing future VM activities.~~

~~Liberty has established a Hazard Tree Management Plan that complements the VM Plan. Its purpose is to identify, document, and mitigate trees that are located within the Utility Strike Zone and are expected to pose a risk to electric facilities based on the tree's observed structural condition and site considerations.~~

~~Liberty's Post Work Verification Procedure defines and implements the VM program oversight requirements. It is used to provide reasonable assurance Liberty is meeting the applicable requirements pertaining to VM.~~

~~Liberty's Vegetation Threat Procedure identifies the methods of prioritization for identified threats on the Liberty system that are discovered through the implementation of the other VM Plans. Identified vegetation threats to public safety and/or electric system reliability are mitigated in accordance with this procedure.~~

~~All plans and procedures are intended to overlap and complement each other. In total they define Liberty's Defense-in-Depth strategy, which leads to mitigating the risk of fires, personal injuries, and outages.~~

8. Wildfire Mitigations

8.1 Grid Design, Operations, and Maintenance

8.1.1 Overview

In this section, the electrical corporation must identify objectives for the next 3- and 10-year periods, targets, and performance metrics related to the following grid design, operations, and maintenance programmatic areas:

- Grid design and system hardening
- Asset inspections
- Equipment maintenance and repair
- Asset management and inspection enterprise system(s)
- Quality assurance/quality control
- Open work orders
- Grid operations and procedures
- Workforce planning

8.1.1.1 Objectives

Each electrical corporation must summarize the objectives for its 3-year and 10-year plans for implementing and improving its grid design, operations, and maintenance.[56] These summaries must include the following:

- Identification of which initiative(s) in the WMP the electrical corporation is implementing to achieve the stated objective, including Utility Initiative Tracking IDs
- Reference(s) to applicable codes, standards, and best practices/guidelines and an indication of whether the electrical corporation exceeds an applicable code, standard, or regulation
- Method of verifying achievement of each objective
- A target completion date
- Reference(s) to the WMP section(s) or appendix, including page numbers, where the details of the objective(s) are documented and substantiated

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56 Annual information included in this section must align with Tables 1 and 12 of the QDR.

Liberty provides objectives for its Grid Design, Operations, and Maintenance WMP initiatives in Table 8-1 for the three-year plan and Table 8-2 for the 10-year plan.

Table 8-1. Liberty Grid Design, Operations, and Maintenance Objectives (three-year plan)

Objectives for Three Years (2023–2025)	**Applicable Initiative(s), Tracking ID(s)**	**Applicable Regulations, Codes, Standards, and Best Practices**	**Method of Verification (*i.e.*, program)**	**Completion Date**	**Reference (section & page #)**
Build out a Sensitive Relay Profile ("SRP") program throughout Liberty's system to reduce ignition risk. Install additional reclosers to help with sectionalization. Install additional fault indicators to help with reliability	WMP-GDOM-GO-01; WMP-GDOM-GH-08; WMP-SA-02	None identified	Annual WMP filings; QDR and GIS submissions	12/31/2025	Section 8.1.2, pp. 156-173
Continue to install covered conductor in high fire risk areas at a reduced rate while we gather better data on the risk spend efficiency of this program.	WMP-GDOM-GH-01	G.O. 95	Annual WMP filings; QDR and GIS submissions	Ongoing	Section 8.1.2, pp. 156-173
Continue to underground conductor in high fire risk areas where economically feasible. Undergrounding is considered as an alternative for any future project.	WMP-GDOM-GH-02	G.O. 128	Annual WMP filings; QDR and GIS submissions	Ongoing	Section 8.1.2, pp. 156-173
Replace or repair poles in territory that have been deemed necessary by our system surveys.	WMP-GDOM-GH-03	G.O. 165	Annual WMP filings; QDR and GIS submissions	Ongoing	Section 8.1.2, pp. 156-173
Continue to rebuild or repair high priority overhead conductor in territory to address aging infrastructure and help with reliability and wildfire mitigation.	WMP-GDOM-GH-05	G.O. 95	Annual WMP filings; QDR and GIS submissions	Ongoing	Section 8.1.2.5, pp. 165-166
Pilot the resonant grounding or "Swedish neutral" system on one substation within three years, test its risk spend efficiency and effectiveness.	WMP-GDOM-GH-06	None identified	Annual WMP filings; QDR and GIS submissions	~~12/31/2025~~ TBD	Section 8.1.2, pp. 156-173
Continue to consider microgrids, and line removal as an alternative solution to help with wildfire mitigation. Currently planning to bring a new microgrid online along with line removal in 2024.	WMP-GDOM-GH-07; WMP-GDOM-GH-09	None identified	Annual WMP filings; QDR and GIS submissions	Ongoing	Section 8.1.2, pp. 156-173

Objectives for Three Years (2023–2025)	Applicable Initiative(s), Tracking ID(s)	Applicable Regulations, Codes, Standards, and Best Practices	Method of Verification (*i.e.*, program)	Completion Date	Reference (section & page #)
Continue to make progress on tree attachment removals and replacing open wire/grey wire within territory yearly.	WMP-GDOM-GH-12a; WMP-GDOM-GH-12e	G.O. 95	Annual WMP filings; QDR and GIS submissions	Ongoing	Section 8.1.2, pp. 156-173
Complete installation of animal guards or “green jackets” on exposed substation equipment.	WMP-GDOM-GH-12c	None identified	Annual WMP filings	12/31/2025	Section 8.1.2, pp. 156-173
Include LiDAR inspections, covered conductor inspections, infrared inspections and drone inspections in detailed asset inspections or other discretionary asset inspections.	WMP-GDOM-AI-01; WMP-GDOM-AI-04	G.O. 95, G.O. 128, G.O. 165	Annual WMP filings; QDR and GIS submissions	12/31/2025	Section 8.1.3, pp. 173-180
Include intrusive pole inspections and substation inspections in Asset Inspection QA/QC program and increase the percentage of QA/QC to 12% for detailed inspections.	WMP-GDOM-AI-01; WMP-GDOM-AI-02; WMP-GDOM-AI-05; WMP-GDOM-AI-06	G.O. 95, G.O. 128, G.O. 165, G.O. 174	Annual WMP filings; QDR and GIS submissions; QA/QC documentation	12/31/2025	Section 8.1.3, pp. 173-180

Table 8-2. Liberty Grid Design, Operations, and Maintenance Objectives (10-year plan)

Objectives for Ten Years (2026–2032)	Applicable Initiative(s), Tracking ID(s)	Applicable Regulations, Codes, Standards, and Best Practices (See Note)	Method of Verification (*i.e.*, program)	Completion Date	Reference (section & page #)
Continue to install covered conductor in high fire risk areas at a reduced rate while we gather better data on the risk spend efficiency of this program.	WMP-GDOM-GH-01	G.O. 95	Annual WMP filings; QDR and GIS submissions	Ongoing	Section 8.1.2, pp. 156-173
Continue to underground conductor in high fire risk areas where economically feasible. Undergrounding is considered as an alternative for any future project.	WMP-GDOM-GH-02	G.O. 128	Annual WMP filings; QDR and GIS submissions	Ongoing	Section 8.1.2, pp. 156-173
Replace or repair poles in territory that have been deemed necessary by our system surveys.	WMP-GDOM-GH-03	G.O. 165	Annual WMP filings; QDR and GIS submissions	Ongoing	Section 8.1.2, pp. 156-173

Objectives for Ten Years (2026–2032)	**Applicable Initiative(s), Tracking ID(s)**	**Applicable Regulations, Codes, Standards, and Best Practices (See Note)**	**Method of Verification (*i.e.*, program)**	**Completion Date**	**Reference (section & page #)**
Continue to rebuild or repair high priority overhead conductor in territory to address aging infrastructure and help with reliability and wildfire mitigation.	WMP-GDOM-GH-05	G.O. 95	Annual WMP filings; QDR and GIS submissions	Ongoing	Section 8.1.2.5, pp. 165-166
Continue to consider microgrids, and line removal as an alternative solution to help with wildfire mitigation. Currently planning to bring a new microgrid online along with line removal in 2024.	WMP-GDOM-GH-07; WMP-GDOM-GH-09	None identified	Annual WMP filings; QDR and GIS submissions	Ongoing	Section 8.1.2, pp. 156-173
Continue to pilot and test effectiveness of Swedish Neutral systems and build out this initiative more if successful.	WMP-GDOM-GH-06	None identified	Annual WMP filings; QDR and GIS submissions	Ongoing	Section 8.1.2, pp. 156-173
Continuous improvement of Asset Inspection programs as technology offers improvements.	WMP-GDOM-AI-01; WMP-GDOM-AI-02; WMP-GDOM-AI-04; WMP-GDOM-AI-05; WMP-GDOM-AI-06	G.O. 95, G.O. 128, G.O. 165, G.O. 174	Annual WMP filings; QDR and GIS submissions; QA/QC documentation	Ongoing	Section 8.1.3, pp. 173-180
Include risk analysis for prioritization of Asset Inspection programs.	WMP-GDOM-AI-01; WMP-GDOM-AI-02; WMP-GDOM-AI-04; WMP-GDOM-AI-05; WMP-GDOM-AI-06	G.O. 95, G.O. 128, G.O. 165, G.O. 174	Annual WMP filings	~~2024~~Ongoing	Section 8.1.3, pp. 173-180

8.1.1.2 Targets

Initiative targets are forward-looking quantifiable measurements of activities identified by each electrical corporation in its WMP. Electrical corporations will show progress toward completing targets in subsequent reports, including QDRs and WMP Updates.

The electrical corporation must list all targets it will use to track progress on its grid design, operations, and maintenance for the three years of the Base WMP. Energy Safety's Compliance Assurance Division and third parties must be able to track and audit each target.[57] For each initiative target, the electrical corporation must provide the following:

- Utility Initiative Tracking IDs.
- Projected targets for each of the three years of the Base WMP and relevant units.
- Quarterly, rolling targets for 2023 and 2024 (inspections only).
- The expected "x% risk impact" for each of the three years of the Base WMP. The expected x% risk impact is the expected percentage risk reduction per year, as described in Section 7.2.2.2.
- Method of verifying target completion.

The electrical corporation's targets must provide enough detail to effectively inform efforts to improve the performance of the electrical corporation's grid design, operations, and maintenance initiatives.

Liberty provides its Grid Design, Operations and Maintenance targets in Table 8-3 and Table 8-4.

[57] Annual information included in this section must align with Table 1 of the QDR.

Table 8-3. Liberty Grid Design, Operations, and Maintenance Targets by Year

Initiative Activity	Tracking ID	2023 Target & Unit	x% Risk Impact 2023[58]	2024 Target & Unit	x% Risk Impact 2024	2025 Target & Unit	x% Risk Impact 2025	Method of Verification
Covered conductor installation	WMP-GDOM-GH-01	5.72 circuit miles	See footnote	5.61 circuit miles	See footnote	2.68 circuit miles[59]	See footnote	QDR; GIS
Undergrounding of electric lines and/or equipment	WMP-GDOM-GH-02	1.37 circuit miles	See footnote	1.25 circuit miles	See footnote	~~1.25~~0.4 circuit miles	See footnote	QDR; GIS
Distribution pole replacements and reinforcements	WMP-GDOM-GH-03	200 poles replaced	See footnote	400 poles replaced	See footnote	400 poles replaced	See footnote	QDR, GIS
Traditional overhead hardening	WMP-GDOM-GH-05	4 circuit miles	See footnote	3.5~~2~~ circuit miles[60]	See footnote	~~2 circuit miles~~None planned	See footnote	QDR, GIS
Microgrids	WMP-GDOM-GH-07	0 microgrids	See footnote	1 microgrid	See footnote	None planned	See footnote	QDR, GIS
Installation of system automation equipment	WMP-GDOM-GH-08	8 automatic reclosers installed	See footnote	8 automatic reclosers installed	See footnote	4 automatic reclosers installed[61]	See footnote	QDR, GIS
Line removal (in HFTD)	WMP-GDOM-GH-09	0 circuit miles	See footnote	1.1 circuit miles	See footnote	None planned	See footnote	QDR, GIS
Tree attachment removals	WMP-GDOM-GH-12a	60 tree attachment removals	See footnote	60 tree attachment removals	See footnote	60 tree attachment removals	See footnote	QDR, GIS

[58] Liberty does not currently have sufficient information to calculate; See Section 7.2.2 for Liberty's planned risk analysis
~~[59] Liberty will assess additional covered conductor projects for 2025 in advance of its 2024 WMP Update.~~
[60] Revised 2024 target per Energy Safety Decision on Liberty Change Order Request in relation to its 2023-2025 Base WMP; July 1, 2024; p.6.
[61] Liberty's target for automatic reclosers is based on studies completed by the UNR and is subject to change based on the results of those studies.

Initiative Activity	Tracking ID	2023 Target & Unit	x% Risk Impact 2023[58]	2024 Target & Unit	x% Risk Impact 2024	2025 Target & Unit	x% Risk Impact 2025	Method of Verification
Expulsion fuse replacement	WMP-GDOM-GH-12b	3,800 fuses	See footnote	~~Target TBD prior to 2024 WMP Update~~500 fuses[62]	See footnote	~~Target TBD prior to 2024 WMP Update~~500 fuses	See footnote	QDR, GIS
Animal guards	WMP-GDOM-GH-12c	4 substation animal guards installed	See footnote	2 substation animal guards installed	See footnote	None planned	See footnote	QDR, GIS
CALFire exempt hardware	WMP-GDOM-GH-12d	None planned	See footnote	None planned	See footnote	None planned	See footnote	QDR, GIS
Open wire/grey wire	WMP-GDOM-GH-12e	2.55 circuit miles	See footnote	5.10 circuit miles	See footnote	5.24 circuit miles	See footnote	QDR, GIS
Substation Equipment Replacement	WMP-GDOM-GH-12f	None planned	See footnote	None planned	See footnote	~~None planned~~1 substation	See footnote	QDR, GIS
Equipment Settings to Reduce Wildfire Risk	WMP-GDOM-GO-01	-	-	15 circuits enabled with SRP[63]	See footnote	7 circuits enabled with SRP	See footnote	QDR, GIS

Table 8-4. Liberty Asset Inspections Targets by Year

Initiative Activity	Tracking ID	Target End of Q2 2023 & Unit	Target End of Q3 2023 & Unit	End of Year Target 2023 & Unit	x% Risk Impact 2023	Target End of Q2 2024 & Unit	Target End of Q3 2024 & Unit	End of Year Target 2024 & Unit	x% Risk Impact 2024	Target End of Q2 2025 & Unit	Target End of Q3 2025 & Unit	Target 2025 & Unit	x% Risk Impact 2025	Method of Verification
Detailed inspections of distribution electric lines and equipment	WMP-GDOM-AI-01	50 circuit miles	100 circuit miles	156.4 circuit miles	See footnote 50	50 circuit miles	100 circuit miles	264.2 circuit miles	See footnote 50	65 circuit miles	195 circuit miles	260.4~~9~~ circuit miles	See footnote 50	QDR, GIS
Intrusive pole inspections	WMP-GDOM-AI-02	0 poles	1,500 poles	3,046 poles	See footnote 50	0 poles	1,500 poles	2,302 poles	See footnote 50	0 poles	500 poles	~~2,411~~2,652 poles	See footnote 50	QDR, GIS

[62] Liberty is updating its 2024 target for expulsion fuse replacements per OEIS Area of Improvement LU-23-14.
[63] Revised 2024 target per Energy Safety Decision on Liberty Change Order Request in relation to its 2023-2025 Base WMP; July 1, 2024; p.6.

Initiative Activity	Tracking ID	Target End of Q2 2023 & Unit	Target End of Q3 2023 & Unit	End of Year Target 2023 & Unit	x% Risk Impact 2023	Target End of Q2 2024 & Unit	Target End of Q3 2024 & Unit	End of Year Target 2024 & Unit	x% Risk Impact 2024	Target End of Q2 2025 & Unit	Target End of Q3 2025 & Unit	Target 2025 & Unit	x% Risk Impact 2025	Method of Verification
Patrol inspections of distribution electric lines and equipment	WMP-GDOM-AI-03	0 circuit miles	592.1 circuit miles	592.1 circuit miles	See footnote 50	0 circuit miles	589 circuit miles	589 circuit miles	See footnote 50	270 circuit miles	540.9 circuit miles	540.9 circuit miles	See footnote 50	QDR, GIS
Other discretionary inspections of distribution electric lines and equipment	WMP-GDOM-AI-04	No current target	No current target	No current target	See footnote 50	No current target	No current target	No current target	See footnote 50	0.5 circuit miles	0.75 circuit miles	~~No current target~~1.0 circuit miles	See footnote 50	QDR, GIS
Quality assurance/quality control of inspections	WMP-GDOM-AI-05	0% of detailed inspections	0% of detailed inspections	1% of detailed inspections	See footnote 50	0% of detailed inspections	0% of detailed inspections	12% of detailed inspections	See footnote 50	0% of detailed inspections	0% of detailed inspections	12% of detailed inspections	See footnote 50	QDR, GIS
Substation inspections	WMP-GDOM-AI-06	24 substations	38 substations	42 substations	See footnote 50	24 substations	38 substations	42 substations	See footnote 50	10 substations	22 substations	42 substations	See footnote 50	QDR, GIS

8.1.1.3 Performance Metrics Identified by the Electrical Corporation

Performance metrics indicate the extent to which an electrical corporation's Wildfire Mitigation Plan is driving performance outcomes. The electrical corporation must:

- List the performance metrics the electrical corporation uses to evaluate the effectiveness of its grid design, operations, and maintenance in reducing wildfire and PSPS risk[64]

For each of these performance metrics listed, the electrical corporation must:

- Report the electrical corporation's performance since 2020 (if previously collected)
- Project performance for 2023-2025
- List method of verification

The electrical corporation must ensure that each metric's name and values are the same in its WMP reporting as its QDR reporting (specifically, QDR Table 2 and QDR Table 3). Metrics listed in this section that are the same as performance metrics required by Energy Safety and reported in QDR Table 2 (Performance Metrics)[65] must match those reported in QDR Table 2. Metrics listed in this section that are not the same as any of the performance metrics identified by Energy Safety and reported in QDR Table 2 must match those reported in QDR Table 3.

The electrical corporation must:

- Summarize its self-identified performance metrics in tabular form
- Provide a brief narrative that explains trends in the metrics

Liberty provides the performance metrics it uses to evaluate the effectiveness of its Grid Design, Operations, and Maintenance WMP initiatives in Table 8-5.

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[64] There may be overlap between the performance metrics the electrical corporation uses and performance metrics required by Energy Safety. The electrical corporation must list these overlapping metrics in this section in addition to any unique performance metrics it uses.

[65] The performance metrics identified by Energy Safety are included in Energy Safety's Data Guidelines.

Table 8-5. Liberty Grid Design, Operations, and Maintenance Performance Metrics Results by Year

Performance Metrics	2020	2021	2022	2023 Projected	2024 Projected	2025 Projected	Method of Verification (*e.g.*, third-party evaluation, QDR)
Equipment-caused ignitions	1	0	1	1 every 2 years	1 every 2 years	1 every 2 years	QDR
Equipment-caused outages	78	80	104	87	87	87	QDR
Grid inspection findings	8,473	450	2,472	1,461	1,461	1,461	QDR
Open work orders (tags)	7,365	7,809	10,547	8,500	6,700	5,960	QDR

8.1.2 Grid Design and System Hardening

In this section the electrical corporation must discuss how it is designing its system to reduce ignition risk and what it is doing to strengthen its distribution, transmission, and substation infrastructure to reduce the risk of utility-related ignitions resulting in catastrophic wildfires.

The electrical corporation is required, at a minimum, to discuss grid design and system hardening for each of the following mitigation activities:

1. Covered conductor installation
2. Undergrounding of electric lines and/or equipment
3. Distribution pole replacements and reinforcements
4. Transmission pole/tower replacements and reinforcements
5. Traditional overhead hardening
6. Emerging grid hardening technology installations and pilots
7. Microgrids
8. Installation of system automation equipment
9. Line removal (in the HFTD)
10. Other grid topology improvements to minimize risk of ignitions
11. Other grid topology improvements to mitigate or reduce PSPS events
12. Other technologies and systems not listed above

In Sections 8.1.2.1 through 8.1.2.12, the electrical corporation must provide a narrative including the following information for each grid design and system hardening mitigation activity:

- **Utility Initiative Tracking ID.**
- **Overview of the activity:** A brief description of the activity including reference to related objectives and targets. Additionally, the overview must identify whether the activity is a program, project, pilot, or study.
- **Impact of the activity on wildfire risk.**
- **Impact of the activity on PSPS risk.**
- **Updates to the activity:** Changes to the initiative since the last WMP submission and a brief explanation as to why those change were made. Discuss any planned improvements or updates to the activity and the timeline for implementation.

8.1.2.1 Covered Conductor Installation

Utility Initiative Tracking ID: WMP-GDOM-GH-01

Overview of the Activity: Liberty has been using line replacements with covered conductor since 2020 as a method to address both wildfire mitigation and the need for system hardening. *Table 8-6* provides information about the covered conductor projects that have been completed through the end of 2022, including information on vegetation management work associated with the covered conductor projects. Liberty completed 9.6 miles out of its target of 9.6 miles for covered conductor projects in 2022.

Table 8-6: Liberty Completed Covered Conductor Projects 2020-2022

Project Name	Year	Design Type	Total Spend	Number of Poles	Mileage	Tree Removals/Trims
7300 Phase 3a	2020	ACS	$1,151,297	12	0.5	28 removals; 14 trims
7300 Phase 3b	2020	ACS	$971,938	13	0.45	
7300 Phase 4	2020	ACS	$926,732	21	0.75	18 removals; 35 trims
7300 Phase 5	2020	ACS	$971,938	20	0.7	11 removals; 27 trims
Vikingsholm	2020	ACS	$1,716,578	26	1.25	44.25 removals; 93 trims (.25 units refer to brush)
Topaz Phase 2	2020	Tree Wire	$591,752	13	0.47	0
Topaz Phase 4	2020	Tree Wire	$1,155,133	41	1.29	24 removals; 3 trims
Topaz Phase 5	2020	Tree Wire	$1,050,650	39	1.23	
3300 Bridge Tract	2021	ACS	$2,618,383	24	0.9	21 removals, 94 trims
Lily Lake	2021	ACS	$3,923,812	51	2.0	23 removals, 80 trims

Project Name	Year	Design Type	Total Spend	Number of Poles	Mileage	Tree Removals/Trims
7300 Ph6	2021	Tree Wire	$1,795,679	27	0.85	250.47 removals, 113.25 trims
Echo Summit	2021	Tree Wire	$1,200,000	15	0.45	348 removals
Brockway 4202	2022	ACS	$1,873,174	16	0.47	14.25 removed, 41.25 pruned
Cathedral Park A	2022	ACS	$2,497,384	40	1.41	15.75 removed, 80 pruned
Hobart 7700	2022	Tree Wire	$2,015,301	84	3.08	1065 total trees worked; not specified between removed or pruned due to being managed as a timber sale
Cathedral Park B	2022	Tree Wire	$1,519,308	57	2.19	293 removed, 73 pruned
Cascade 3400	2022	Tree Wire	$496,179	9	0.26	31 removed, 11 pruned
Topaz Phase 6	2022	Tree Wire	$1,770,972	56	1.53	2 pruned
Fallen Leaf A	2022	Tree Wire	$1,643,477	25	0.66	2 removed, 24 pruned
TOTAL	**2020-2022**		**$29,889,687**	**589**	**20.44**	

Impact of the Activity on Wildfire Risk: Liberty has experienced no forced outages or ignitions due to an event occurring directly on a span containing covered conductor. While forced outages have occurred on circuits where portions of the circuit contain covered conductor, the cause of the forced outage was due to an event occurring elsewhere on the circuit. Additional time is needed to verify the actual effectiveness experienced with covered conductor projects.

Impact of the Activity on PSPS Risk: Liberty has not yet installed enough covered conductor in its system and has not yet obtained enough data about its effectiveness to change its PSPS criteria. However, Liberty anticipates that as more covered conductor and other methods of wildfire mitigation are implemented the need for PSPS events may be reduced in areas of the system, which may ultimately be realized by changing the PSPS criteria for sections of the system. One of Liberty's long-term goals is to avoid the need for conducting a PSPS in portions of the system, which may be accomplished by building resiliency corridors and implementing wildfire mitigation measures to the extent that the need for potential PSPS events may be greatly reduced in larger sections of the system.

Updates to the Activity: For each covered conductor project, Liberty assesses available alternatives to address wildfire mitigation and reliability needs. Alternatives include other grid hardening projects, such as undergrounding or traditional overhead hardening, as well as the implementation of emerging technologies and programs, including a Sensitive Relay Profile ("SRP") Program. Due to the relatively small amount of covered conductor that has been installed in the system and the short period of time that it has been in use, the actual effectiveness of covered conductor in Liberty's system cannot yet be accurately determined. By collecting more data over time and by continuing to participate in the joint IOU workshops and efforts to evaluate covered conductor effectiveness, Liberty plans to refine its assessment on both covered conductor effectiveness and when it is the best alternative for system hardening.

Based on Liberty's current assessments, and while the utility industry continues to measure the effectiveness of covered conductor, Liberty plans to slow it's rate of covered conductor installation while increasing the implementation rate of SRP and system segmentation. By making this adjustment to Liberty's wildfire mitigation efforts, a larger portion of Liberty's system will have measures that help address wildfire mitigation in a shorter timeframe than installing covered conductor alone. Liberty will cover 331 miles of distribution with SRP in 2023, compared to a projected average rate of seven miles per year for covered conductor installation. Although covered conductor costs can vary depending on the project, Liberty's average covered conductor cost is approximately $1.3 million per mile. Liberty's planned SRP implementation in 2023 will cover 331 miles and is estimated to cost approximately $1.5 million in total, which is approximately $4,000 per mile. Furthermore, the large IOUs in California are implementing SRP programs (or fast trip settings), which have generally been considered an extremely effective wildfire mitigation approach. While the implementation of SRP does not remove the need to replace certain aged infrastructure, it does provide an effective approach to mitigate the potential for utility-based ignition events. Liberty will continue to assess its SRP program in relation to other grid hardening approaches. Refer to Section 8.1.2.6 for details about Liberty's plans for SRP implementation.

Liberty assessed traditional overhead hardening as another main alternative to covered conductor projects in 2023. Liberty is completing traditional overhead rebuilds as a wildfire mitigation in areas that are in a high fire threat zone, but where the terrain is not heavily forested. In areas such as this, rebuilding primary line with items such as wider cross arms (avian spacing), stronger wire, and shorter spans can provide adequate and cost-effective system hardening. This type of construction addresses weather, such as high winds and heavy snow, that may cause wire slap and structural failures. Additionally, traditional overhead hardening is not possible in some heavily forested areas because of the inability to achieve sufficient clearance for wider cross arms. Liberty's recent average costs for traditional overhead hardening were approximately $600,000 per mile. This is significantly lower than the average cost of covered conductor. Refer to Section 8.1.2.5 for further information about traditional overhead hardening.

The following is a brief description of the covered conductor projects planned over the next three years. Since filing its first revised 2023 WMP on May 19, 2023, and as shown in an updated Table 8-7, Liberty has increased its covered conductor targets for 2023 and 2024 and will reassess its covered conductor target for 2025 in advance of its 2024 WMP Update. At the time of Liberty's initial and first revised 2023 WMP filings, Liberty did not know whether certain covered conductor projects would be permitted for 2023, as many covered conductor projects take place in areas of Liberty's service territory with significant permitting requirements, processes, and timelines. As reflected in its updated targets for 2023, Liberty was able to obtain permits and materials for covered conductor projects now planned in 2023.

In 2023, Liberty will construct the Celio A and Celio B covered conductor projects with a total mileage of 2.41 miles. Both projects are in the Christmas Valley area of South Lake Tahoe in a HFTD 3 high fire threat district. These projects are portions of the 3300 circuit, which is one of the highest risk circuits based on past risk assessments. The projects will replace aged overhead distribution with tree wire and new poles as needed. The projects were chosen to address wildfire ignition potential and to improve system reliability.

Additionally in 2023, Liberty will construct three covered conductor projects with a total additional covered conductor mileage of 3.31 miles. The Fallen Leaf B project is a 1.53-mile portion of the 3400 circuit, which is one of the highest risk circuits. It is located along the southeast shore of Fallen Leaf Lake in a HFTD 2 high fire threat zone adjacent to an HFTD 3 zone. The project will reduce fire risk and improve reliability by replacing aged infrastructure with new poles and tree wire. The Tahoe City 7300 Phase 7 (0.85 miles) and Phase 8 (0.95 miles) will also now be installed in 2023 along the Lake Tahoe west shore in the Homewood and Tahoma area, which is an HFTD 2 area. These projects will improve a portion of the 7300 circuit with ACS covered conductor to address wildfire mitigation and system reliability. The projects will decrease outage times on this circuit by providing the ability for more customer load to be fed by the 3400 circuit out of the Meyers Substation via field switching.

The Angora Microgrid project is planned to be constructed in 2024 and includes 0.7 miles of tree wire covered conductor. While the details of this project are discussed in the microgrid section, the distribution from the microgrid is included in this section because it will be completed with covered conductor. There is 0.7 miles of aged distribution line that will be rerouted and replaced with covered conductor. This will address system hardening needs for both wildfire mitigation and reliability. This project is a portion of the 3400 circuit which is one of the highest risk circuits. It is located in a HFTD 2 high fire threat zone adjacent to an HFTD 3 zone.

Also in 2024, Liberty plans to construct two covered conductor projects. . The Fallen Leaf C and Fallen Leaf D covered conductor projects are each approximately 0.8 miles for a total of 1.6 miles of aged distribution line that will be replaced with tree wire covered conductor. Like the previous phases of the Fallen Leaf projects, this is a portion of the 3400 circuit, which is one of the highest risk circuits and it is located along the east side of Fallen Leaf Lake in a HFTD 2 high fire threat zone adjacent to an HFTD 3 zone. Liberty is working on the design and permitting for Fallen Leaf C & D in Quarter 3 and Quarter 4 of 2023.

At this time, two covered conductor projects are planned for 2025, including the Tahoe City 7300 Phase 9 and the Tahoe City 7300 Phase 10 covered conductor projects. These projects are located along the Lake Tahoe west shore in the Homewood and Tahoma area, which is an HFTD 2 area. These projects will improve a portion of the 7300 circuit with ACS covered conductor to address wildfire mitigation and system reliability. The projects will decrease outage times on this circuit by providing the ability for more customer load to be fed by the 3400 circuit out of the Meyers Substation via field switching. Liberty will assess additional covered conductor projects for 2025 in advance of its 2024 WMP Update, including two additional projects that are in the preliminary planning stages and total approximately 1.5 miles.

Table 8-7 summarizes the covered conductor projects that are currently planned for the next three years:

Table 8-7: Liberty Planned Covered Conductor Projects 2023-2025

Project Name	Year	Design Type	Total Budgeted	Number of Poles	Mileage
Celio A	2023	Tree Wire	$1,946,230	46	1.61
Celio B	2023	Tree Wire	$2,150,000	25	0.93
Fallen Leaf B	2023	Tree Wire	$2,150,000	51	1.53
7300 Ph7	2023	ACS	$2,613,151	29	0.85
7300 Ph8	2023	ACS	$2,613,151	25	0.93
Angora	2024	Tree Wire	$1,690,000	21	0.70
Fallen Leaf C	2024	Tree Wire	$1,500,000	24	0.80
Fallen Leaf D	2024	Tree Wire	$1,500,000	24	0.80
7300 Ph9	2025	ACS	$494,000	12	0.38
7300 Ph10	2025	ACS	$1,040,000	25	0.80
Projects TBD	2025	TBD	$2,900,000	TBD	1.5
TOTAL			**$20,157,657**	**282**	**7.15**

8.1.2.2 Undergrounding of Electric Lines and/or Equipment

Utility Initiative Tracking ID: WMP-GDOM-GH-02

Overview of the Activity: Costs aside, Liberty considers undergrounding the most effective method for wildfire mitigation and reviews the potential for undergrounding on all projects. The cost for undergrounding is typically higher than conventional overhead replacement and covered conductor projects. In areas where undergrounding includes a fair amount of secondary and customer services, the cost for undergrounding can be over three times that of a covered conductor project. In areas where secondary and service connections are limited, undergrounding may potentially be the best solution, but are analyzed on a case-by-case basis. In addition, other factors, such as the ability to extend or connect to adjacent existing underground or the importance of a section of line, can impact the decision to underground.

Liberty completed 0.24 miles out of its target of 0.36 miles for underground projects in 2022. The completed undergrounding comprised a portion of the Brockway 4202 Resiliency Project. The undergrounding of portions of this project were done to extend underground portions of the circuit near the substation to both improve wildfire mitigation and reliability and relieve congestion of a large amount of infrastructure in the area.

In 2023, Liberty plans to complete 0.11 miles of undergrounding on a portion of the Cascade 3400 project. The primary reason considered in Liberty's decision-making for installing this section as underground versus covered conductor was permitting requirements in a highly sensitive scenic area by Emerald Bay.

In 2024, Liberty is planning to construct an underground project referred to as the Stateline Resiliency Project. The project consists of undergrounding 1.2 miles of distribution on the 2300 and 2200 circuits adjacent to the Stateline Substation. The project will underground portions of two important circuits near their source and will connect to underground sections at each end of the project. Because of the limited number of service connections and the local terrain, the cost for undergrounding this project is reasonable.

Impact of the Activity on Wildfire Risk: Liberty considers undergrounding the most effective replacement method for wildfire mitigation. It is generally considered nearly 100% effective for wildfire mitigation. While it is projected that undergrounding greatly reduces wildfire risk, it will take some time and more implementation to demonstrate the true effectiveness of undergrounding with actual data.

Impact of the Activity on PSPS Risk: When undergrounding is completed in significant portions of the system it can reduce or eliminate the need for PSPS in those portions of the system.

Updates to the Activity: Liberty considers undergrounding as a top method for wildfire mitigation and will continue to consider undergrounding for all projects. In addition, Liberty intends to continue to pursue Rule 20 undergrounding projects.

8.1.2.3 Distribution Pole Replacements

Utility Initiative Tracking ID: WMP-GDOM-GH-03

Overview of the Activity: Liberty replaces and repairs poles to minimize the risk of system faults due to structural failure. Poles are replaced or repaired based on findings during inspections. At a minimum, inspections are conducted in accordance with G.O. 165.

To make significant accelerated progress in wildfire mitigation, Liberty undertook a complete system survey in 2020. During the system-wide survey, inspections were performed on all of Liberty's 22,400 poles. Inspectors identified poles requiring replacement based on G.O. 95 condition Levels 1, 2 or 3. Every pole requiring replacement was assigned a due date based on the condition of the pole and its location. Level 1 poles in HFTD 3 areas were replaced immediately. Level 2 poles in HFTD 3 areas and Level 1 poles in HFTD 2 areas were replaced within six months of inspection. In 2021, 169 Level 2 poles in HFTD 2 areas were replaced, and in 2022, 226 Level 2 poles were replaced out of Liberty's target of 231 pole replacements. Many Level 3 poles still require replacement and will be replaced over the next three years (2023-2035), with 200 pole replacements planned for 2023, 400 pole replacements planned for 2024, and 400 pole replacements planned for 2025.

Liberty also replaces poles based on its Intrusive Pole Inspection Program. Poles that fail intrusive testing are scheduled for replacement. Testing of poles and replacement of failed poles are completed in accordance with G.O. 165

Impact of the Activity on Wildfire Risk: Pole replacements help reduce the risk of system faults due to structural pole failure.

Impact of the Activity on PSPS Risk: Pole replacements in conjunction with other wildfire mitigation initiatives, contribute to the overall system hardening effort that will eventually address wildfire mitigation to the extent that the need for PSPS will be reduced.

Updates to the Activity: Liberty intends to continue to replace or repair poles as needed based on system inspections. In addition, a large number of Level 3 require replacement or repair. Those poles will be replaced over the next three years (2023-2025), with 200 pole replacements planned for 2023, 400 pole replacements planned for 2024, and 400 pole replacements planned for 2025.

8.1.2.4 Transmission Pole/Tower Replacements and Reinforcements

Utility Initiative Tracking ID: WMP-GDOM-GH-04

Overview of the Activity: Liberty has 60kv and 120kv lines that it refers to as transmission lines. Their primary function is to feed substations. These lines are constructed in various manners that include multipole support structures. The poles on these lines are treated the same as the poles for primary distribution. They are inspected, replaced, and repaired in the same manner as primary distribution poles. The poles being replaced or repaired on these lines are included in the overall pole replacement program discussed in Section 8.1.2.3. Liberty did not have a separate initiative in 2022 for transmission pole and tower replacements and reinforcements.

Impact of the Activity on Wildfire Risk: Pole replacements help reduce the risk of system faults due to structural failure.

Impact of the Activity on PSPS Risk: Pole replacements, in conjunction with other wildfire mitigation initiatives, contribute to the overall system hardening effort that will eventually address wildfire mitigation to the extent that the need for PSPS will be reduced.

Updates to the Activity: Liberty intends to continue to replace or repair poles as needed based on system inspections. In addition, many Level 3 poles found during the 2020 full system survey will be replaced over the next three years (2023-2025), with 200 pole replacements planned for 2023, 400 pole replacements planned for 2024, and 400 pole replacements planned for 2025.

8.1.2.5 Traditional Overhead Hardening

Utility Initiative Tracking ID: WMP-GDOM-GH-05

Overview of the Activity: Traditional overhead hardening is one method to address both reliability and wildfire mitigation. Replacing aged infrastructure with new infrastructure that meets current standards and is designed to be reliable even during extreme weather conditions greatly improves reliability and provides wildfire mitigation. Considerations used for traditional overhead hardening can include such things as stronger poles, stronger wire, shorter spans, more space between phases, less sag, greater vegetation clearance, and use of CALFIRE-exempt hardware. In areas that are not heavily forested or where there is sufficient vegetation clearance, traditional overhead hardening can be the most cost-effective solution for system hardening.

Liberty plans to target specific areas for traditional overhead hardening to address reliability and wildfire mitigation. The first area being targeted is the Topaz area, served by the 1261 circuit. This area experiences high winds and has a history of higher-than-average forced outages. While the main Topaz line has already been replaced with covered conductor, the taps and distribution coming off that line have areas where traditional overhead replacement is the most cost-effective solution for system hardening. Replacement work will be conducted in this area over the next several years.

Liberty did not have a WMP initiative or target for traditional overhead hardening in 2022.

Impact of the Activity on Wildfire Risk: Traditional overhead hardening can provide effective wildfire mitigation if completed in the appropriate locations. The planned work in the Topaz area will both improve reliability and reduce wildfire risk.

Impact of the Activity on PSPS Risk: As portions of the system are hardened, combined with increased use of SRPs, the need for PSPS events can be reduced or even eliminated in certain areas. Because these system hardening initiatives are new, effectiveness assessments will be required prior to adjusting PSPS protocols.

Updates to the Activity: Liberty plans to conduct approximately four miles of traditional overhead hardening in the Topaz area in 2023. Approximately two miles of traditional overhead hardening in the same area is planned for 2024 and an additional two miles is planned for 2025.

8.1.2.6 Emerging Grid Hardening Technology Installations and Pilots

Utility Initiative Tracking ID: WMP-GDOM-GH-06

Overview of the Activity: Liberty keeps in close contact with other major utilities, vendors, and consultants familiar with wildfire mitigation through working groups, conferences, and periodic meetings. Through these channels, Liberty identifies emerging technologies that it wants to pursue as pilot projects. Depending on the success of the pilot projects, Liberty then implements as larger initiatives. Refer to Section 8.3.3.2 for additional information on pilot projects that Liberty has pursued related to grid monitoring technology.

Impact of the Activity on Wildfire Risk: Liberty initiatives related to emerging technology and pilot projects focus primarily on the use of microprocessor-based relays and electrical engineering concepts to reduce the frequency and magnitude of fault currents, or compile data to help operations make better decisions to help reduce ignition risk. DFA uses high fidelity meters, designed by Texas A&M Power System Automation Laboratory to send current and voltage signals back to a master server. Digital Automation ("DA") and High-Impedance Fault Detection ("HIFD") and both utilize Schweitzer Engineering Laboratories ("SEL") relays with upgraded software packages designed specifically for the purpose of digital automation or high impedance fault detection. Fast Trips or SRP uses SEL relays in a second group of settings that is activated on high fire threat days.

Impact of the Activity on PSPS Risk: These programs are not expected to impact the need for PSPS in 2023. In the future, these programs, in particular Liberty's SRP program, may reduce the need for PSPS in certain areas. The SRP program puts the relays in a wildfire mode for red flag or high fire threat days and these settings reduce the chance of the protected distribution line causing an ignition due to electric faults because not as much electric energy can be produced. As Liberty gains more experience with its SRP program, it plans to assess whether PSPS protocols should be adjusted.

Updates to the Activity: In 2022, Liberty installed equipment for the following pilot projects: DFA, DA, and HIFD. In 2023, Liberty will test the effectiveness and risk spend efficiency of these programs to forecast the potential future use of these emerging technologies. Additionally, in 2023, Liberty will be expanding the 2022 Fast Trip, or SRP, pilot project because of its effectiveness in reducing ignition risk, and due to its low capital cost, it will allow Liberty to cover a large amount of its system primary conductor in 2023. This is because the relays that protect a distribution line can have a second settings group that is more sensitive on red flag or high fire threat days. Creating these alternative wildfire settings is much less time consuming than rebuilding a line with covered conductor, underground or traditional overhead hardening. Because of this Liberty can reduce the ignition risk on more miles of line.

Liberty will also be researching, scoping, and preparing to pilot another emerging technology, Resonant Grounding or "Swedish Neutral" system. This technology has proven successful at reducing ignition risk through decreasing the magnitude and shortening the duration of fault currents on systems where it is installed. This technology was introduced by other California utilities during the California Utilities Wildfire Risk Reduction working group meeting. Liberty is working with an Australian consultant that has employed this technology at Australian and U.S. utilities. In 2023, Liberty plans to fully scope and design the system. In future years, Liberty plans to pilot this technology on one substation and downstream feeders to test its effectiveness.

8.1.2.7 Microgrids

Utility Initiative Tracking ID: WMP-GDOM-GH-07

Overview of the Activity: Liberty considers the use of microgrids as an alternative in all applicable projects. The type of project where a microgrid could be a cost-effective alternative is one that has a long span of distribution primary that feeds a concentrated and small load. In these situations, a microgrid may be cost-effective because it is a reliable local power source that can eliminate the need to invest in replacing major sections of a distribution line.

Liberty has completed the installation of the Sagehen Microgrid and is planning to install another microgrid, the Angora Microgrid, in 2024. The Sagehen Microgrid allowed for the de-energization of an older distribution line during fire season. By constructing the microgrid, the need to replace the line with covered conductor was eliminated.

Liberty is nearing completion of the design and permitting for the Angora Microgrid Project. This project was identified in a feasibility study for microgrids on four planned covered conductor projects. The study demonstrated that a microgrid is a cost-effective solution for addressing wildfire mitigation and grid hardening needs for one of the four planned covered conductor projects that were studied. The Angora Microgrid Project is planned to be constructed instead of the Angora Ridge Covered Conductor Project. The project consists of constructing two microgrids, removing or de-energizing 1.1 miles of distribution line through very heavily wooded and hard-to-access territory, and rebuilding 0.7 miles of distribution between the microgrid and customers.

Liberty did not complete any microgrid projects in 2022. Liberty did not have any microgrids targeted for 2022.

Impact of the Activity on Wildfire Risk: By allowing for the de-energization or removal of distribution lines, a microgrid can eliminate the possibility of infrastructure ignition events on lines that are removed or taken out of service. While microgrids can provide for the elimination of distribution lines, they typically require some distribution from the microgrid to customers. Liberty intends to rebuild that portion of distribution in such a manner that will minimize wildfire risk by using the same methods it considers for the rest of the system.

Impact of the Activity on PSPS Risk: Because microgrids allow for the de-energization or removal of distribution lines, they can eliminate the possibility of infrastructure ignition events on lines that are removed or taken out of service. Microgrids typically require some distribution from the microgrid to customers, but if that distribution is rebuilt using wildfire mitigation techniques, the need for a PSPS on microgrid-fed sections of distribution can be reduced or eliminated.

Updates to the Activity: Liberty intends to continue to look for microgrid opportunities that are cost effective solutions for wildfire mitigation. As previously noted, the Angora Microgrid is planned to be constructed in 2024. As Liberty plans projects for the coming years, microgrids will be considered when there are applicable conditions

8.1.2.8 Installation of System Automation Equipment

Utility Initiative Tracking ID: WMP-GDOM-GH-08

Overview of the Activity: Liberty continues to install reclosers to help with sectionalization, opportunities for distribution automation, and opportunities for grid topology improvement to reduce the size and number of customers affected by faults on the system. Reclosers also help Liberty more quickly identify and restore power to affected customers.

Liberty completed two of its four targeted automatic recloser installations in 2022.

Impact of the Activity on Wildfire Risk: As mentioned in the Emerging Technologies section, Liberty will be building out a more robust SRP Program to reduce the magnitude and frequency of fault currents that lead to ignition risk. As part of this program, additional reclosers will be installed to the selected lines that are part of the SRP Program to help with sectionalization and line coverage from the protection relays. The SRP program provides an alternate set of settings, “Wildfire Mode,” that Liberty can opt to enable on high fire risk or red flag days. On these days, the relays will sacrifice some reliability for improved sensitivity to detection and clearing faults.

Impact of the Activity on PSPS Risk: The SRP Program will provide more flexibility to Liberty for the process. The criteria for decision-making regarding PSPS events will not change, but these programs can change the criteria variables for the decision-making process.

Updates to the Activity: In 2023, Liberty will be expanding the SRP Program to cover 10 primary distribution lines that originate at the substations. This will cover approximately 300 miles of primary conductor, which will in turn reduce the chances of ignition risk by making the protection relays (substation feeder breaker relays and downstream recloser relays) more sensitive on days that operations opts to put the relays in Wildfire Mode. During relay studies on the selected lines, Liberty will confirm if additional reclosers will help with sectionalization or with relay pickup sensitivity on the selected lines. See Appendix C for the 10 lines Liberty plans to cover with the SRP Program.

8.1.2.9 Line Removal (in HFTD)

Utility Initiative Tracking ID: WMP-GDOM-GH-09

Overview of the Activity: Line removal eliminates the risk of infrastructure caused ignitions in the area where a line is removed. The installation of microgrids is the primary initiative that allows for the removal of distribution lines. Liberty currently has one microgrid project, the Angora Microgrid Project, planned for 2024 that includes removing 1.1 miles of line in a heavily wooded high fire risk area.

Liberty did not have a WMP initiative or target for line removal in HFTD areas in 2022.

Impact of the Activity on Wildfire Risk: All line removals in HFTD areas reduce wildfire risk. Liberty will continue to consider line removals in conjunction with microgrids as a potential alternative when planning projects.

Impact of the Activity on PSPS Risk: If the microgrid and its distribution are constructed in a manner that address wildfire mitigation concerns, the need for a PSPS may be reduced or eliminated in that specific area.

Updates to the Activity: Liberty currently has one microgrid project and its associated line removal planned for 2024. As future projects are planned, microgrids and their associated line removals will continue to be considered.

8.1.2.10 Other Grid Topology Improvements to Minimize Risk of Ignitions

Utility Initiative Tracking ID: WMP-GDOM-GH-10

Overview of the Activity: Liberty did not complete or target any additional grid topology improvements to minimize risk of ignitions in 2022 outside of the other grid hardening initiatives discussed in this Section 8.1.2.

Impact of the Activity on Wildfire Risk: Not applicable

Impact of the Activity on PSPS Risk: Not applicable

Updates to the Activity: Not applicable

8.1.2.11 Other Grid Topology Improvements to Mitigate or Reduce PSPS Events

Utility Initiative Tracking ID: WMP-GDOM-GH-11

Overview of the Activity: Liberty did not complete or target any additional grid topology improvements to mitigate or reduce PSPS events in 2022 outside of the other grid hardening initiatives discussed in this Section 8.1.2.

Impact of the Activity on Wildfire Risk: Not applicable

Impact of the Activity on PSPS Risk: Not applicable

Updates to the Activity: Not applicable

8.1.2.12 Other Technologies and Systems Not Listed Above (Tree attachment removals, expulsion fuse replacement, animal guards, CalFIRE exempt hardware, Open wire/grey wire, Substation equipment replacement)

Utility Initiative Tracking ID: WMP-GDOM-GH-12 (a-f)

Overview of the Activity: In this section, Liberty describes the WMP initiatives that do not fit into the other sections, including tree attachment removals, animal guards, open wire/grey wire, expulsion fuse replacements, and substation equipment replacements. These initiatives are all ongoing initiatives that will extend beyond this three-year WMP cycle.

In 2022, Liberty completed the following additional grid hardening initiatives not captured in Liberty's WMP initiatives 8.1.2.1 through 8.1.2.11:

- Liberty completed 145 tree attachment removals (45 tree attachment removals were targeted).
- Liberty completed 1,858 expulsion fuse replacements (1,500 expulsion fuse replacements were targeted).
- Liberty completed four animal substation guard installations (four animal substation guard installations were targeted).
- Liberty did not have a target for open wire/grey wire.

Impact of the Activity on Wildfire Risk: Each of these initiatives is described below:

Tree Attachments: Liberty is removing conductors from trees and resetting to a new pole with modern materials and specifications. This initiative reduces ignition risk by removing conductors from trees and providing proper insulation.

Animal Guards: This initiative focuses on animal guarding exposed substation equipment with "Green Jackets," which are custom-made insulating jackets that are field verified at each substation and then installed. Once installed, the jackets eliminate exposed parts on equipment, which reduces ignition risk caused by animal or other object contact.

Open Wire/Grey Wire: This initiative replaces old service wire with new service wire. The newer service wire reduces ignition risk due to the modern specifications.

Expulsion Fuse Program: This program explores alternatives to traditional expulsion fuses with engineered fault current limiting fuses. The idea is that the engineered fault current limiting fuses produce less energy, which then reduces wildfire risk. Another approach is to reduce the chance the expulsion fuse will operate during fire season through overreaching sensitive relay profiles or fast trips, and grubbing poles, clearing vegetation around poles with fuses so, if they do operate, there is less fuel creating less ignition risk. Liberty is exploring all of these alternatives.

Impact of the Activity on PSPS Risk: The initiatives listed in this section do not directly affect the criteria used when deciding on a PSPS event.

Updates to the Activity: Updates for each initiative are provided below:

Tree Attachments: Liberty continues to make progress on this initiative. Last year, 60 tree attachments were removed and Liberty plans to remove conductors and set poles for 60 more tree attachments.

Animal Guards: Liberty completed animal guard installations on a large portion of the substations last year. This year, Liberty plans to install animal guards on four more substations. In the future, animal guards will be installed on all new substations.

Open Wire/Grey Wire: In 2022, Liberty replaced just over 50,000 feet of open wire/grey wire. Liberty plans to replace an additional 10,000 feet in 2023.

Expulsion Fuses: At the end of 2022, Liberty became aware that one of the current-limiting fuse options on the market was experiencing failures in the field. Liberty halted expulsion fuse replacements because these current-limiting fuses failed to provide ignition risk reduction. The current-limiting fuse vendor suggested that no more fuses should be installed, and any that were installed needed to be continuously checked to confirm they did not have any air gaps that would lead to excessive heat buildup. In collaboration with other utilities and experts in the field, Liberty determined that removing this particular current-limiting fuse altogether and replacing it with a traditional expulsion fuse—along with adding overreaching sensitive relay profiles to prevent the likelihood of the expulsion fuses operating, grubbing the poles, and clearing vegetation around the expulsion fuses—will reduce ignition risk more than keeping the current-limiting fuses in place.

After research and collaboration with other major IOUs, Liberty has decided to use expulsion limiting fuses ("ELFs") produced by Eaton as the replacement for S&C Fault Tamers. Liberty spent Quarter 1 of 2023 determining which non-expulsion fuse product to pursue and then searched for a supplier to procure enough ELFs to replace the fault tamers in 2023. Liberty aims to replace approximately 3,800 fault tamers with ELFs in 2023 and is on track for its target. As of September 2023, Liberty has installed 3,052 ELFs.

Moving forward, Liberty plans to explore a new non-expulsion limiting fuse product for laterals and in-line fuses. While the ELFs are rated to cover many scenarios of Liberty's system, they are not rated for laterals and in-line fuses. From initial research, S&C SMU Power Fuses appear to be the best product for higher rated non-expulsion fuses. Liberty will finalize this assessment in advance of its 2024 WMP Update and create targets for future years to include in its 2024 WMP Update. As Liberty continues to work toward a goal of zero expulsion fuses in its system, Liberty can utilize its SRP program on higher fire threat days to reduce the ignition risk from expulsion fuse by using reclosers and breakers with fast trip settings that will trip faster than the fuses. Refer to Section 8.1.2.6 for additional details about Liberty's plans for SRP implementation.

8.1.3 Asset Inspections

In this section, the electrical corporation must provide an overview of its procedures for inspecting its assets.

The electrical corporation must first summarize details regarding its asset management inspections in Table 8-8. The table must include the following:

- **Type of inspection**: *i.e.*, distribution, transmission, or substation
- **Inspection program name:** Identify various inspection programs within the electrical corporation
- **Frequency or trigger**: Identify the frequency or triggers, such as inputs from the risk model. Indicate differences in frequency or trigger by HTFD Tier, if applicable
- **Method of inspection**: Identify the methods used to perform the inspection (*e.g.*, patrol, detailed, aerial, climbing, and LiDAR)
- **Governing standards and operating procedures**: Identify the regulatory requirements and the electrical corporation's procedures for addressing them

Liberty provides details regarding its asset management inspections in Table 8-8.

Table 8-8. Liberty Asset Inspection Frequency, Method, and Criteria

Type[66]	**Inspection Program**	**Frequency or Trigger (Note 1)**	**Method of Inspection (Note 2)**	**Governing Standards & Operating Procedures**
Distribution	Detailed Inspections	5-year cycle for OH; 3-year cycle for UG	Detailed	G.O. 165
Distribution	Intrusive Pole Inspections	10-year cycle	Patrol	G.O. 165
Distribution	Patrol Inspections	Annually	Patrol	G.O. 165
Distribution	Other Discretionary Inspections	No specified frequency	Examples include full detailed system survey; LiDAR, infrared, drone	G.O. 165
Substation	Detailed Inspections	Quarterly	Detailed	G.O. 174

Note 1: The electrical corporation must provide electrical corporation-specific risk-informed triggers used for asset inspections.

Note 2: The electrical corporation must provide electrical corporation-specific definitions of the different methods of inspection.

The electrical corporation must then provide a narrative overview of each asset inspection program identified in the above table; Sections 8.2.2.1. provides instructions for the overviews. The sections should be numbered 8.1.3.1 to Section 8.1.3.n (*i.e.*, each asset inspection program is detailed in its own section).The electrical corporation must include inspection programs it is

[66] Liberty does not have a separate program for transmission inspections. Liberty has approximately 75 miles of 60kV lines and 19 miles of 120kV lines that are included in the distribution inspection program.

discontinuing or has discontinued since the last WMP submission; in these cases the electrical corporation must explain why the program is being discontinued or has been discontinued.

Process

In this section, the electrical corporation must provide an overview of the individual asset inspection program, including inspection criteria and the various inspection methods used for each inspection program.

Include relevant visuals and graphics depicting the workflow and decision-making process the electrical corporation uses for the inspection program (see the example in Overview of **the Activity**: Liberty conducts its substation inspections in accordance with its current G.O. 174 Substation Inspection Plan. Most substations that are accessible year-round are inspected on a quarterly basis. Substations that are not accessible for normal daily operations are inspected on an annual basis. Substation inspections can identify issues before they become serious problems. The primary risk to be mitigated from substation inspection is catastrophic failure of equipment leading to ignition of nearby vegetation.

Liberty completed 45 substation inspections out of its target of 45 in 2022.

Frequency or Trigger

In this section, the electrical corporation must identify the frequency (including how frequency may differ by HFTD Tier or other risk designation[s]) or triggers used in the inspection program, such as inputs from the risk model.

If the inspection program is schedule-based, the electrical corporation must explain how it uses risk prioritization in the scheduling of the inspection program to target high-risk areas. If the electrical corporation does not use risk prioritization in the scheduling of the inspection program, it must explain why.

Accomplishments, Roadblocks, and Updates

In this section, the electrical corporation must discuss:

- Noteworthy accomplishments for the inspection program since the last WMP submission
- Roadblocks the electrical corporation has encountered while implementing the inspection program and how the electrical corporation has addressed the roadblocks
- Changes/updates to the inspection program since the last WMP submission including known future plans (beyond the current year) and new/novel strategies the electrical

corporation may implement in the next 5 years (*e.g.*, references to and strategies from pilot projects and research)

Process: Asset inspections are conducted as necessary to promote system reliability and the safe operation of Liberty's electric facilities. Overhead facilities shall meet the requirements of G.O. 95 and underground facilities shall meet the requirements of G.O. 128. When issues are found during inspections, the level of severity shall be included in the inspection documentation so that the timing for corrective action can be determined. All inspections and corrective actions shall be promptly documented to help assure that the program is accurate and effective.

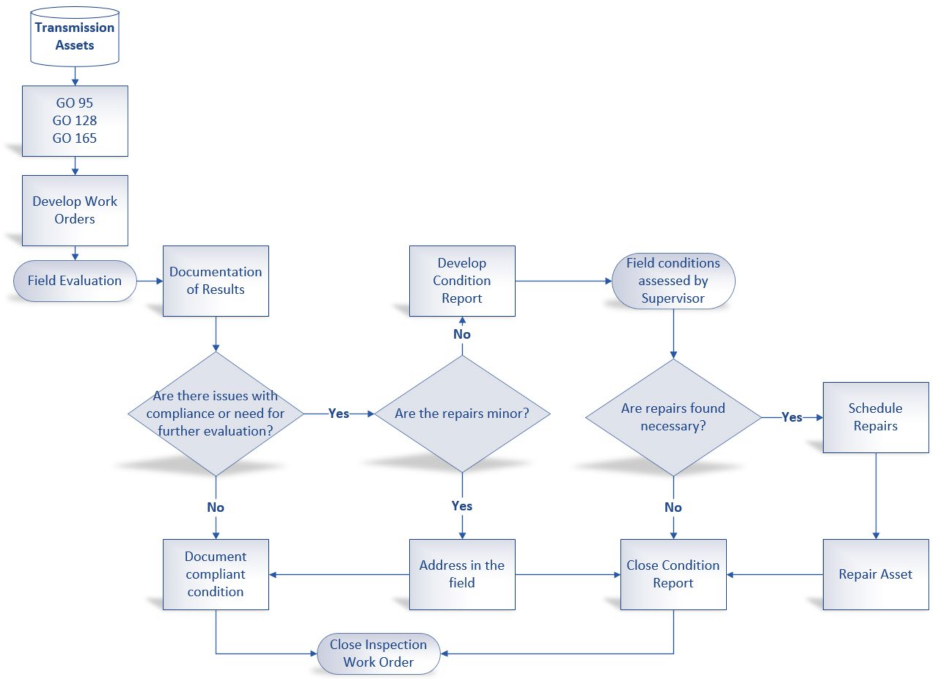
The level of severity and timing for corrective actions identified during inspections shall follow the requirements as specified in G.O. 95. The severity levels and corrective action timing is summarized in Table 8-12.

Table 8-9: Asset Management and Inspection Corrective Action Timing

Severity Level	**Maximum Time for Corrective Action**
Level 1 – Immediate risk of high potential impact to safety or reliability	Take corrective action immediately
Level 2 – Any other risk of at least moderate potential impact to safety or reliability	Six months for fire risks in Tier 3; 12 months for fire risk in Tier 2; 12 months for worker safety; 36 months for other
Level 3 – Any risk of low potential impact to safety or reliability	60 months subject to exceptions for opportunity maintenance (*i.e.*, G.O. 95 Appendix I for exceptions)

See Figure 8-1 for Liberty's asset management and inspection workflow.

Figure 8-1. Liberty Asset Management and Inspections Workflow (OEIS example below)



Frequency or Trigger: Detailed inspection frequency shall follow the requirements set forth in G.O. 165 (Electric Distribution and Transmission Facilities) and G.O. 174 (Substations), including:

- Detailed inspections of overhead poles, devices, and conductors are conducted on a five-year schedule.
- Detailed inspections of underground structures and devices are conducted on a three-year schedule.
- Detailed inspections of padmount devices are conducted on a five-year schedule.
- Patrol Inspections are conducted annually except for circuits undergoing a detailed inspection in the same year.
- Wood poles over 15 years old shall have intrusive inspections done a maximum of every 10 years.
- Ten substations are inspected quarterly, and two substations are inspected annually due to access restrictions. G.O. 174 states that substations shall be inspected as frequently as necessary.

Accomplishments: Liberty has enhanced its QA/QC Program for Asset Inspections as discussed in Section 8.1.6. Liberty has also developed a plan for Level 3 repairs that factors in Liberty's risk map and other risk factors and is considered for operational planning.

Roadblocks: Liberty has overcome resource challenges with the use of contractors.

Updates: Liberty plans to include LiDAR inspections, covered conductor inspections, infrared inspections and drone inspections in detailed asset inspections or other discretionary asset inspections over the 2023-2025 WMP cycle. Liberty also plans to include intrusive pole inspections and substation inspections in its Asset Inspection QA/QC Program and increase the percentage of QA/QC to 12% for detailed inspections by 2025.

8.1.3.1 Detailed Inspections of Distribution Electric Lines and Equipment

Utility Initiative Tracking ID: WMP-GDOM-AI-01

Overview of the Activity: Detailed inspections of distribution and transmission lines and equipment performed in accordance with G.O. 165 guidelines mitigate the risk of equipment failure by identifying aging and deteriorating equipment in the field. When a qualified electrical worker ("QEW") identifies an issue in the field that needs remediation or repair, work orders are generated to address the issue. As equipment failure can lead to electrical system faults and has the potential to cause ignition events, Liberty's detailed inspection programs play a vital role in reducing risk. Liberty inspects approximately 20% of its system annually, which results in the entire system being inspected every five years before starting the cycle again. As this program has a set schedule to maintain compliance, there is currently no risk analysis performed for regional prioritization.

Liberty completed 328.6 miles of detailed asset inspections out of its target of 307.8 miles in 2022.

8.1.3.2 Intrusive Pole Inspections

Utility Initiative Tracking ID: WMP-GDOM-AI-02

Overview of the Activity: Intrusive pole inspections are a G.O. 165-mandated program for the testing and treatment of wood poles that begin to deteriorate and degrade over time. Poles that are thoroughly inspected and/or proactively treated to extend the service life of the asset significantly reduce safety risk to the system and public. In addition to extending the life of existing poles, the program also helps to identify those assets that need to be replaced before they fail. Intrusive pole inspections are currently performed throughout Liberty's service territory annually on a 10-year cycle.

The intrusive pole inspection program tests the integrity of wood poles both visually and through internal examination of the poles to identify damage, decay, and approximate shell thickness. A report identifies poles that pass inspection as well as those that need to be replaced or need remediation, such as pole stubbing or treatment application. This program can reduce replacement costs, extend the life of poles, and increase the safety and reliability of the overall system.

Liberty completed 2,735 intrusive pole inspections out of its target of 2,598 in 2022.

8.1.3.3 Patrol Inspections of Distribution Electric Lines and Equipment

Utility Initiative Tracking ID: WMP-GDOM-AI-03

Overview of the Activity: Patrol inspections are performed throughout Liberty's service territory in accordance with the schedules outlined in G.O. 165. Patrol Inspections are conducted annually except for circuits undergoing a detailed inspection in the same year. A QEW patrols the electric system looking for issues with overhead structures or obvious hazards that impact the safety and reliability of the system.

Liberty completed 503 miles of patrol asset inspections out of its target of 706.3 miles of patrol asset inspections in 2022. Liberty's 2022 target of 706.3 miles was erroneously established and should have been closer to the 503 miles of patrol inspections that were completed.

8.1.3.4 Other Discretionary Inspections of Distribution Electric Lines and Equipment

Utility Initiative Tracking ID: WMP-GDOM-AI-04

Overview of the Activity: In 2020, Liberty performed a full system survey of its overhead assets. As a result of this survey, numerous operations and maintenance ("O&M") repairs were identified. These repairs will reduce the risk of wildfire ignition as well as improve reliability. This initiative was selected to form a baseline of detailed inspections in Liberty's new tracking software as well as facilitate the deployment of resources to reduce wildfire risks within a short timeframe. Liberty plans to complete full system surveys on a periodic basis yet to be determined.

Liberty did not complete any other discretionary asset inspections in 2022. Liberty did not have a target for other discretionary asset inspections in 2022.

Liberty plans to include LiDAR inspections, covered conductor inspections, infrared inspections and drone inspections in detailed asset inspections or other discretionary asset inspections over the 2023-2025 WMP cycle. Specifically, Liberty plans to implement a pilot program in 2023 to assess the viability of integrating infrared technology into inspection cycles. Liberty plans to conduct an infrared pilot program within the Tier 3 HFTD zone of its service territory to evaluate the effectiveness of the technology.

8.1.3.5 Quality Assurance/Quality Control of Inspections

Utility Initiative Tracking ID: WMP-GDOM-AI-05

Overview of the Activity: Refer to Section 8.1.6.

Liberty completed QA/QC on 0.0044% of its detailed asset inspections in 2022. Liberty's target was to QA/QC 0.0050% of the detailed asset inspections in 2022.

8.1.3.6 Substation Inspections

Utility Initiative Tracking ID: WMP-GDOM-AI-06

Overview of the Activity: Liberty conducts its substation inspections in accordance with its current G.O. 174 Substation Inspection Plan. Most substations that are accessible year-round are inspected on a quarterly basis. Substations that are not accessible for normal daily operations are inspected on an annual basis. Substation inspections can identify issues before they become serious problems. The primary risk to be mitigated from substation inspection is catastrophic failure of equipment leading to ignition of nearby vegetation.

Liberty completed 45 substation inspections out of its target of 45 in 2022.

8.1.4 Equipment Maintenance and Repair

In this section, in addition to the information described above regarding distribution, transmission, and substation inspections, the electrical corporation must provide a brief narrative of maintenance programs. As a narrative, the electrical corporation must include its strategy for maintenance, such as whether the electrical corporation replaces or upgrades facilities/equipment proactively (for example, an electrical corporation may monitor dissolved gases in its transformers to detect potential transformer failures to alert engineering and maintenance personnel or component lifecycle management) or if it runs its facilities/equipment to failure. The narrative must include, at minimum, the following types of equipment:

- Capacitors`
- Circuit breakers
- Connectors, including hotline clamps
- Conductor, including covered conductor
- Fuses, including expulsion fuses
- Distribution poles

- Lightning arrestors
- Reclosers
- Splices
- Transmission poles/towers
- Transformers
- Other equipment not listed

Utility Initiative Tracking ID: WMP-GDOM-MR-01

Overview of the Activity: The following describes Liberty's maintenance programs for the specified types of equipment:

- Capacitors: Capacitors are inspected regularly as part of Liberty's G.O. 165 inspection process. Maintenance is performed as necessary in accordance with Liberty's Electric O&M Manual.
- Circuit breakers: Substation circuit breakers are inspected regularly as part of Liberty's G.O. 174 process. Maintenance is performed as necessary in accordance with the particular breaker's operation manual. Oil Circuit Breakers ("OCB") have been targeted for replacement throughout Liberty's system.
- Connectors, including hotline clamps: Connectors are inspected regularly as part of Liberty's G.O. 165 process. Hotline clamps without stirrups are noted, and a follow-up work order is generated to add stirrups in the near future.
- Conductor, including covered conductor: Conductor, including covered conductor, is inspected regularly as part of Liberty's G.O. 165 process. Damaged conductor is identified and a follow-up work order is generated for immediate replacement.
- Fuses, including expulsion fuses: Fuses, including expulsion fuses, are inspected regularly as part of Liberty's G.O. 165 process. Damaged fuse cutouts are identified and a follow-up work order is generated for immediate replacement. As described in Section 8.1.2.12, Liberty completed 1,848 expulsion fuse replacements in 2022 as part of its grid hardening efforts. Liberty's expulsion fuse program explores alternatives to traditional expulsion fuses with engineered fault current limiting fuses. Engineered fault current limiting fuses produce less energy, which reduces wildfire risk. Another approach is to reduce the chance the expulsion fuse will operate during fire season through overreaching sensitive relay profiles or fast trips and grubbing poles and clearing vegetation around poles with fuses so, if the fuses do operate, there is less fuel creating less ignition risk. Liberty is exploring these alternatives. At the end of 2022, Liberty

became aware that one of the current-limiting fuse options on the market was experiencing failures in the field. Liberty halted expulsion fuse replacements because these current-limiting fuses failed to provide ignition risk reduction. The current-limiting fuse vendor suggested that no more fuses should be installed, and any that were installed needed to be continuously checked to confirm they did not have any air gaps that would lead to excessive heat buildup. In collaboration with other utilities and experts in the field, Liberty determined that removing this particular current-limiting fuse altogether and replacing it with a traditional expulsion fuse—along with adding overreaching sensitive relay profiles to prevent the likelihood of the expulsion fuses operating, grubbing the poles, and clearing vegetation around the expulsion fuses—will reduce ignition risk more than keeping the current-limiting fuses in place.

- Distribution poles: Distribution poles are inspected regularly as part of Liberty's G.O. 165 process. Intrusive pole inspections are done on a 10-year cycle and detailed inspections on a five-year cycle. Patrols are completed annually on the system for circuits not on the detailed inspection schedule for that year. Any pole identified as needing repairs or replacement based on a QEW's assessment is identified and a follow-up work order is generated with timeline for replacement or repair based on G.O. 165 guidelines. A pole loading calculation is completed for all pole replacements, in compliance with G.O. 95.
- Lightning arrestors: Lightning arrestors are inspected regularly as part of Liberty's G.O. 165 process. Lightning arrestors are run to failure and replaced if found in a failed state during inspection or routine work
- Reclosers: Reclosers are inspected regularly during G.O. 165 inspections and during normal operations. Issues are reported to Liberty's Substation Department and are scheduled for maintenance and repair. Liberty recently completed replacement of all oil filled reclosers with solid dielectric reclosers.
- Splices: Splices are inspected regularly as part of Liberty's G.O. 165 process. Damaged splices are identified, and a follow-up work order is generated for immediate replacement.
- Transmission poles/towers: Transmission poles are inspected regularly as part of Liberty's G.O. 165 process. Intrusive pole inspections are completed on a 10-year cycle and detailed inspections on a five-year cycle. Patrols are completed annually on the system for circuits not on the detailed inspection schedule for that year. Any pole identified as needing repair or replacement based on a QEW's assessment is identified and a follow-up work order is generated with timeline for replacement or repair based

on G.O. 165 guidelines. A pole loading calculation is completed for all pole replacements to comply with G.O. 95.

- Transformers: Substation transformers are sampled for Dissolved Gas Analysis (“DGA”) by exception (*e.g.*, if the substation team feels a transformer should be tested due to a differential lockout). These substation transformers are inspected as part of Liberty’s G.O. 174 process. Any maintenance or repair is completed in accordance with the transformer manufacturer’s recommendations. Other overhead, padmount, and submersible transformers are inspected as part of Liberty’s G.O. 165 process. If transformers are identified as needing maintenance, repair or replacement, a work order is generated, and the work is scheduled to be complete in accordance with G.O. 165 guidelines.

As required, Liberty has prioritized Level 1 and Level 2 findings for repairs, targeting its highest HFTD zones first. Liberty has developed an approach for Level 3 findings that is based on Liberty’s updated fire risk map and Liberty’s pole risk assessment. Liberty’s plan utilizes its Pole Risk of Failure categories of low, medium, and high. For example, a pole can be designated a Level 3 priority because there was an issue to the high voltage signage. While this condition needs to be remediated within five years, it typically will not result in a pole falling in-service, and thus has a low risk of failure. However, if a Level 3 pole has a condition code of cracked pole, the risk of failure is moderate due to the structural integrity being compromised. Liberty plans to complete Level 3 findings by Q4 2025, as required.

8.1.5 Asset Management and Inspection Enterprise System(s)

In this section, the electrical corporation must provide an overview of inputs to, operation of, and support for centralized asset management and inspection enterprise system(s) updated based upon inspection results and activities such as hardening, maintenance, and remedial work. This overview must include discussion of:

- The electrical corporation’s asset inventory and condition database.
- Describe the electrical corporation’s internal documentation of its database(s).
- Integration with systems in other lines of business.
- Integration with the auditing system(s) (see QA/QC section below).
- Describe internal procedures for updating the enterprise system including database(s) and any planned updates.

- Any changes to the initiative since the last WMP submission and a brief explanation as to why those changes were made. Include any planned improvements or updates to the initiative and the timeline for implementation.

Liberty houses a SQL database that is connected to its Fulcrum database, which is used to manipulate and collect data associated with asset inventory and conditions. Liberty's internal documentation of the database is being created on an ongoing basis. Python and SQL scripts are used to maintain two separate schemas for transactional and reporting use cases in the SQL database with plans to illustrate and narrate the structure of these processes after maturation of the system has occurred in the next year. Liberty's Asset Management system is manually connected to ArcGIS with plans of connecting to an ERP system within the next year to connect two sources of data into one. Liberty's Asset Management system is not currently directly connected to its auditing system. The two systems are manually updated within Fulcrum on a yearly basis to conduct necessary activities with plans of integrating the systems within the next year.

Liberty updates the SQL database on a quarterly basis via Python and SQL scripts to supplement QDR reporting to OEIS. Liberty plans to update this more frequently to support business process decisions in the upcoming year. Previously, Liberty used Fulcrum solely to collect, store, and report data. Liberty has since implemented the connection of the SQL database to Fulcrum to support automated data updates and reporting. Liberty plans to update the data collection, storage, and reporting processes to further automation, create more advanced analytics use cases such as those explained in Sections 6.5 and 6.7, and produce holistic analysis of Liberty's system.

8.1.6 Quality Assurance and Quality Control

In this section, the electrical corporation must provide an overview of its quality assurance and quality control (QA/QC) activities for asset management and inspections. This overview must include:

- Reference to procedures documenting QA/QC activities.
- How the sample sizes are determined and how the electrical corporation ensures the samples are representative.
- Qualifications of the auditors.
- Documentation of findings and how lessons learned based on those findings are incorporated into trainings and/or procedures.

- Any changes to the initiative since the last WMP submission and a brief explanation as to why those changes were made. Include any planned improvements or updates to the initiative and the timeline for implementation.
- Tabular information that includes:
    - Sample sizes
    - Type of QA/QC performed (*e.g.*, desktop or field)
    - Resulting pass rates, starting in 2022
    - Yearly target pass rate for the 2023-2025 WMP cycle

Utility Initiative Tracking ID: WMP-GDOM-AI-05

Overview of the Activity: Liberty's Asset Inspection QA/QC Program was initially established as described in the 2022 WMP. Liberty is in the process of enhancing the Asset Inspection QA/QC Program with the implementation anticipated in the third quarter of 2023.

The Asset Inspection QA/QC Program is intended to confirm that the inspection and corrective action process for existing electric distribution and transmission assets are conducted and documented in an accurate and effective manner. The program is designed to provide reasonable assurance that Liberty's electric system is maintained adequately to serve Liberty customers in a safe and reliable manner. The program is designed to meet the compliance requirements of G.O. 165 and G.O. 174 for inspection frequency, record-keeping, and reporting. The program also manages and documents the required corrective actions, timelines, and the completion of any needed corrective actions in accordance with G.O. 95 and G.O. 128.

Quality Control inspections are completed through statistical sampling and appropriate sample sizes to gauge acceptable quality levels ("AQL") and conformance levels ("CL") based on the selected margin of error ("MoE"). The procedure includes personnel qualification requirements, sampling methodology, sample size by priority, process assessment (QA), results evaluation (QC), description of post inspection verification (*i.e.*, desktop review, field review), and types of QC inspections (*i.e.*, overhead poles, devices and conductors, underground structures and devices, padmount devices, intrusive pole inspections).

Liberty provides information on its Asset Inspections QA/QC Program in Table 8-13.

Table 8-10: Liberty Asset Inspection QA/QC Program Sample Size and Units

Inspection Type	Cycle	Total Circuit Miles	Total Units	Annual Circuit Miles	Annual Units	Statistical Sampling		
						CL/MoE	%	Annual Sample Units
OH Poles, Devices, and Conductors	5-year	707	Units N/A	142	Units N/A	95/10	12%	17 miles
UG Structures and Devices	3-year	Miles N/A	1,783	Miles N/A	595	99/7	16%	95 structures
Padmount Devices	5-year	Miles N/A	3,350	Miles N/A	670	99/7	9%	63 devices
Intrusive Pole	10-year	Miles N/A	24,700	Miles N/A	2,470	99/7	1%	34 poles
Substations	Quarterly	Miles N/A	12	Miles N/A	42	Does not apply	5%	2 substations

Sample Size Determination: Liberty uses industry-accepted protocols/calculations to determine statistically valid sample sizes of work types that are to be reviewed. Figure 8-2 provides an example of how the statistically valid sample sizes are determined.

Figure 8-2: Liberty Asset Inspection QA/QC Program Sample Size Calculation Example

Sample Size Calculation Example

Common Confidence Levels:

CL	Z-Score
99%	2.576
95%	1.96
90%	1.645

Standard Deviation (Std Dev):	50%	*Remains Constant*
Margin of Error (MoE):	5%	*Can Vary 1-10%*
Population Size:	2,500	

Sample - Underlying Calculations:

$$\text{Sample Size} = \frac{[\text{Z-Score}^2 \times \text{Standard Deviation} \times (1 - \text{Standard Deviation}) / \text{Margin of Error}^2]}{[(\text{Z-Score2} \times \text{Standard Deviation} \times (1 - \text{Standard Deviation}) / \text{Margin of Error2} \times \text{Population Size})) + 1]}$$

$$\text{Sample Size} = [2.576^2 \times 0.5 \times (1 - 0.5) / 0.05^2] / [(2.576^2 \times 0.5 \times (1 - 0.5) / 0.05^2 \times 2500)) + 1]$$

$$\text{Sample Size} = 663.578 / 1.2654$$

Sample Size = $\boxed{524}$

QA/QC Process Implementation: Liberty employs internal and external processes as part of its overall QA/QC strategy:

- *Internal*: A post inspection documentation review, or desktop review, is performed by Liberty to assess if all required information has been submitted by the vendor. This review is also used to determine if the invoices are accurate. The review is completed on 100% of submitted invoices. Liberty also conducts a post inspection validation review, or field review, on an as-needed basis to confirm contractor QC inspections are being performed as described in the specification.
- *External*: QC inspections shall be conducted on transmission and distribution facilities to provide reasonable assurance of reliable, high-quality, and safe operation of the electric facilities. Overhead facilities shall meet the requirements of G.O. 95 and underground facilities shall meet the requirements of G.O. 128.

Qualifications: Third-party quality control field inspections are performed by appropriately trained and qualified entities whose function and organizational reporting is independent of the electric operations organization. A statistically valid sample of the assets inspected shall be re-inspected by a third party, using QEWs.

Documentation of findings and how the lessons learned from those findings are incorporated into trainings and/or procedures: Liberty implemented its inspection QA/QC in 2022 with a

0.5% sample of detailed inspections that were re-inspected by third-party inspectors. Minimal differences were noted by the third-party inspectors, who found only very minor infractions during the re-inspections if differences were noted at all. In light of the minor differences between inspections, Liberty has no plans to make changes to training and/or procedures at this time.

Updates to Initiative: Liberty has developed a new QA/QC documented procedure for use in 2023. The new plan will include various forms of inspections currently done by Liberty (detailed, intrusive, substation) and a larger sample size for better QA/QC results.

An Acceptable Quality Level ("AQL"), or Target Pass Rate, must be based on historical QC data. This is an industry-accepted practice for any QC review. Although Liberty completed some QC inspections in 2022, it was not until Quarter 2 of 2023 that Liberty developed its formal Asset Inspection QA/QC program. QC inspections, based on Liberty's formal Asset Inspection QA/QC program, are scheduled to be performed in Q4 of 2023. Because Liberty has very limited data to date, it is difficult to establish a target AQL or Target Pass Rate.

A review of other California utility WMPs demonstrates that there are no industry standards for pass rates and that rate vary widely from utility to utility. For example, SCE's Target Pass Rate for Overhead Detailed QC Inspections in 2023 was 95%, which is likely based on its 2022 Pass Rate of 96% and possibly other historical data. PG&E provided no 2023 Target Pass Rates for its inspection types. PG&E's 2022 Pass Rate for Transmission and Distribution varied between 79.3% and 80.9% for field audits. SDG&E's Target Pass Rate for Distribution Overhead Detailed Inspections in 2023 was 100%, which is likely based on its 2022 Pass Rate of 100%.

In its 2023 WMP, Liberty listed all inspection types that are included in its Asset Inspection QA/QC program. Two of those inspection types, "UG Structures and Devices" and "Padmount Devices," are not related to wildfire mitigation and do not include Yearly Target Pass Rates.

Given the above information and data limitations, Liberty has developed Yearly Target Pass Rates for 2023 for its wildfire mitigation related asset inspections (*i.e.,* OH Poles, Devices, and Conductors, Intrusive Poles, and Substation Inspections). Liberty's 2023 Target Pass Rates are based on the 2022 QA/QC inspection results for OH Poles, Devices, and Conductors, which is the only category of asset inspections that Liberty completed QA/QC for in 2022. In 2022, Liberty completed QA/QC field audits for 27 records in the OH Poles, Devices, and Conductors asset category. Of those 27 records, 23 were verified, resulting in an approximate pass rate of 85%. Based on the 2022 QA/QC pass rate of 85%, Liberty has established its 2023 Target Pass Rate for all categories of wildfire mitigation related asset inspections (*i.e.,* OH Poles, Devices, and Conductors, Intrusive Poles, and Substation Inspections) at 80%. Similar to SCE and PG&E,

Liberty will determine Target Pass Rates for 2024-2025 after the previous year results are available.

Tabular Information: This is a newly developed QA/QC program. Current pass rates and pass rate targets are not currently available. Pass rates and targets will be established and implemented for use during its 2023 QA/QC of inspections.

8.1.7 Open Work Orders

In this section, the electrical corporation must provide an overview of the procedures it uses to manage its open work orders resulting from inspections that prescribe asset management activities. This overview must include a brief narrative that provides:

- Reference to procedures documenting the work order process. The electrical corporation must provide a summary of these procedures or provide a copy in the supporting documents location on its website.
- A description of how work orders are prioritized based on risk.
- A description of the plan for eliminating any backlog of work orders (*i.e.*, open work orders that have passed remediation deadlines), if applicable.
- A discussion of trends with respect to open work orders.

In addition, each electrical corporation must:

- Graph open work orders over time as reported in the QDRs (Table 2, metrics 8.a and 8.b).
- Provide an aging report for work orders past due.

Since 2020, Liberty has utilized the Fulcrum system to track its asset inspections and resulting work orders. The Fulcrum system includes both desktop and mobile application functions and allows Liberty to track, organize and report on asset management activities. Through Fulcrum, Liberty tracks the status (*i.e.*, pass/fail) and asset information for each asset inspected. Additionally, there are specified condition codes and priority levels (*i.e.*, Levels 1, 2, 3 per G.O. 165 and non-G.O. infractions) for each type of failed condition and fields for completed work. This system also captures additional information about an asset so that different services on an asset can be identified and tracked (*e.g.*, grey wire service, fuse type, open wire secondary, etc.). The data that is recorded in Fulcrum is uploaded into Liberty's GIS database for mapping and WMP reporting.

How work orders are prioritized based on risk: Liberty assigns priority codes based on G.O. 165 Table 18, Level 1, 2, or 3 for each maintenance or capital work order. This is tracked in the

Fulcrum application. Further, Liberty uses its risk-based mapping to prioritize work in higher fire threat areas first.

Plan for eliminating any backlog of work orders (*i.e.*, open work orders that have passed remediation deadlines), if applicable: As of May 1, 2023, Liberty halted its detailed inspections of overhead assets for 2023 in an effort to eliminate its backlog of open work orders and prioritize repairs to infractions found during the full system survey completed in 2020. Liberty will continue with a target of 40.3 miles of detailed underground inspections and will resume detailed inspection targets for overhead assets on January 1, 2024. Liberty's full system survey completed in 2020 included all overhead lines that are normally inspected over a five-year period. Liberty will remain compliant with General Orders 95 and 165 during 2023 without completing any overhead detailed inspections. The safety risk of halting detailed overhead inspections in 2023 is minimal. In addition to previous inspections and repair work, Liberty will monitor its system as part of its 2023 Resilience Project, which will impact 15 feeders, or one-third of Liberty's circuits. Liberty will also continue to make repairs and replace poles across both Tier 2 and Tier 3 areas in its service territory in 2023.

Both contract crews and internal crews are working to expedite the process to reduce the backlog of open work orders. To complete this work, Liberty has five internal inspectors, one contract inspector, four internal maintenance crews, three contract maintenance crews, and five internal troublemen. Liberty's 2023 staffing has sufficed to comply with asset management and inspection regulatory requirements and WMP implementation. Thus, Liberty did not attempt to obtain additional asset management workforce in 2023. As work on Liberty's Resilience Project concludes in 2023, resources will shift toward completing open and past due work orders. Liberty plans to complete repairs and associated work from its backlog of work orders by December 31, 2025. To complete this work, Liberty will target an estimated 1,500 completed repairs per quarter through 2025.

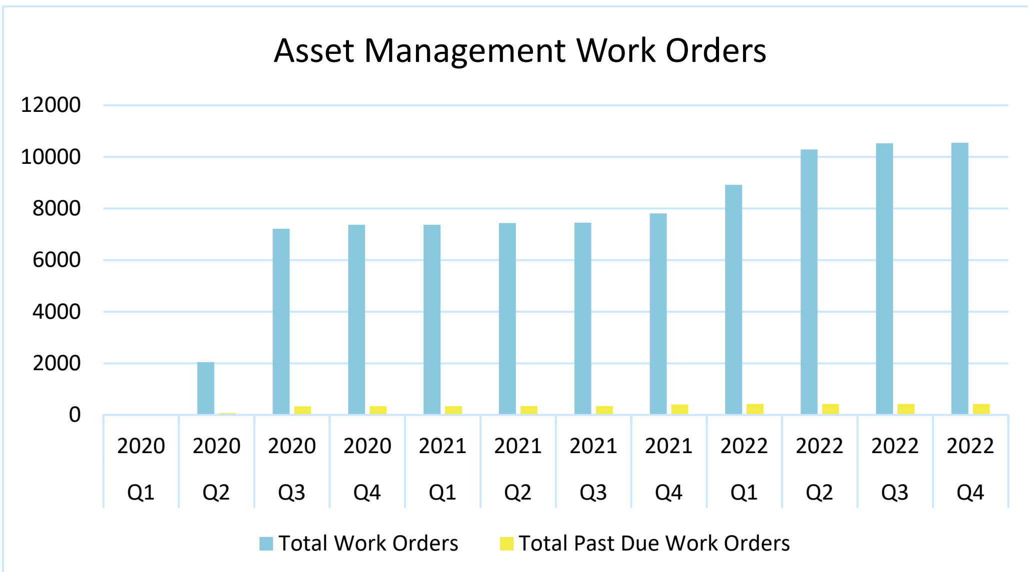
Trends with respect to open work orders: Liberty's open work orders have steadily grown since completing the full system survey in 2020.

Liberty provides an aging report for work orders past due in Table 8-11 and a graph of its open work orders over time in Figure 8-3.

Table 8-11: Number of Past Due Asset Work Orders Categorized by Age

HTFD Area	0-30 Days	31-90 Days	91-180 Days	181+ Days
Non-HFTD	0	1	0	40
HFTD Tier 2	11	46	0	285
HFTD Tier 3	0	0	25	23

Figure 8-3: Graph of Liberty Open Work Orders over Time



8.1.8 Grid Operations and Procedures

8.1.8.1 Equipment Settings to Reduce Wildfire Risk

In this section, the electrical corporation must discuss the ways in which operates its system to reduce wildfire risk. The equipment settings discussion must include the following:

- Protective equipment and device settings
- Automatic recloser settings
- Settings of other emerging technologies (*e.g.*, rapid earth fault current limiters)

For each of the above, the electrical corporation must provide a narrative on the following:

- Settings to reduce wildfire risk

- Analysis of reliability/safety impacts for settings the electrical corporation uses
- Criteria for when the electrical corporation enables the settings
- Operational procedures for when the settings are enabled
- The number of circuit miles capable of these settings
- An estimate of the effectiveness of the settings

Utility Initiative Tracking ID: WMP-GDOM-GO-01

Overview of initiative: Liberty initiated a pilot program in 2022 to use fast tripping and add more fault indicators to reduce wildfire risk during high fire threat days. Fast trips are a means to trip the circuit faster at the substation breaker/recloser or line recloser device, which reduces the energy released at the fault location and greatly reduces the time to clear the fault. Liberty's whole system can employ fast trip settings used for personnel protection and these settings can also be used for wildfire mitigation. Through collaborative studies with the University of Nevada, Reno ("UNR") Electrical Engineering Department, protective settings are established and adjusted during highest fire threat days in conjunction with enhanced coordination with downstream fuses and upstream devices. Employing fast trip settings can also reduce the need for use of PSPS in some instances.

In 2023, Liberty will expand its fast trip program in a collaborative research project with UNR. Liberty is expanding the program to include 12 additional feeders and associated devices in the highest fire threat areas of its service territory. The addition of more line reclosers will allow Liberty to better sectionalize and have protective devices closer to the fault locations.

Liberty is also piloting high impedance fault detection ("HIFD") in 2023 as another sensitive relay profile on one circuit in its HFTD 3 area in South Lake Tahoe. Liberty is also exploring the use of rapid earth fault current limiters in its HFTD 3 area and is currently targeting a 2024 pilot program for this technology.

<u>Analysis of reliability/safety impacts for fast trip settings</u>: The use of fast trip settings will have an impact on system reliability. Liberty expects a higher SAIDI/SAIFI rate during high fire threat days when fast tripping is used. There are no safety impacts to using fast tripping. The fault clearing time is essentially the same as a "hot line" setting used for personnel protection on a line performing "hot work" (work while the line is still energized avoiding outages to customers).

<u>Criteria for when Liberty enables fast trip settings</u>: Liberty works with weather and fire science experts to assist in making decisions regarding the enabling of fast trip settings. Liberty management will take all pertinent data into consideration before implementing a settings

change for wildfire mitigation with the understanding of the possible effects on reliability to its customers.

Operational procedures for when fast trip settings are enabled: Personnel performing line patrols while fast trip settings are implemented are instructed to patrol all overhead lines, including lateral lines, because the device will trip faster than a fuse can be operated. The enhanced use of fault indicators should help to locate the fault area more quickly.

Estimate of the effectiveness of fast trip settings: The effectiveness of fast trip settings in Liberty's service territory is currently unknown, as the program is still in the piloting phase. Liberty monitors and shares information with other utilities that are deploying similar approaches.

8.1.8.2 Grid Response Procedures and Notifications

The electrical corporation must provide a narrative on operational procedures it uses to respond to faults, ignitions, or other issues detected on its grid that may result in a wildfire including, at a minimum, how the electrical corporation:

- Locates the issues
- Prioritizes the issues
- Notifies relevant personnel and suppression resources to respond to issues
- Minimizes/optimizes response times to issues

Utility Initiative Tracking ID: WMP-GDOM-GO-02

Overview of initiative:

Locating issues: Many issues requiring grid response procedures are located with the assistance of customer calls during an outage or witnessing an abnormal event (*e.g.*, loud bang, flash, arcing, etc.). Fault indicators and blown fuses also help to direct personnel to the right location. On a larger scale, recloser or breaker trips can indicate issues downstream of that device.

Prioritization of issues: Liberty prioritizes issues requiring grid response procedures by:

- Safety to the public and employees
- Wildfire risk
- Critical customer impact
- Customer count

Notifications to relevant personnel and suppression resources: Liberty will call System Control to quickly de-energize a circuit if deemed an immediate safety or wildfire risk. Liberty will call emergency services (*i.e.*, 911) for suppression resources if personnel onsite are unable to suppress immediately.

Minimizing and optimizing response time: Liberty dispatch operations tracks the location of personnel in the field so that they can be more efficiently sent to the location of the issue.

8.1.8.3 Personnel Work Procedures and Training in Conditions of Elevated Fire Risk

The electrical corporation must provide a narrative on the following:

- The electrical corporation's procedures that designate what type of work the electrical corporation allows (or does not allow) personnel to perform during operating conditions of different levels of wildfire risk, including:
    - What the electrical corporation allows (or does not allow) during each level of risk
    - How the electrical corporation defines each level of wildfire risk
    - How the electrical corporation trains its personnel on those procedures
    - How it notifies personnel when conditions change, warranting implementation of those procedures
- The electrical corporation's procedures regarding deployment of firefighting staff and equipment (*e.g.*, fire suppression engines, hoses, water tenders, etc.) to worksites for site-specific fire prevention and ignition mitigation during on-site work

Utility Initiative Tracking ID: WMP-GDOM-GO-03

Overview of initiative: Liberty has designated the type of work activities that may be performed in its service territory under certain Fire Potential Index ("FPI") Operating Conditions (*e.g.*, low condition, moderate condition, high condition, very high condition, and Extreme or Red Flag Warning condition). As conditions increase in severity, activities that present an increased risk of ignition have additional mitigation requirements. Where risk cannot be mitigated, work activity will cease. Work procedures and proper training help mitigate the risk of an ignition while performing at-risk activities that are necessary to maintain and operate the Liberty electric system.

The following summarizes the work activity guidelines for each of Liberty's Operating Conditions:

- *Low Fire Risk*: As determined by the Wildfire Prevention Department, Low or "Normal" Fire Risk is defined as periods during which the potential for wildfires and associated ignition risks are low but may sometimes still exist within Tier 2 or 3 of the HFTD. Some O&M activities may have stipulations and additional fire mitigation activities may be required. The Low Fire Risk status is the default operational state and the FPI is indicated as "Blue."
- *Moderate Fire Risk*: As determined by the Wildfire Prevention Department, Moderate Fire Risk is defined as periods during which the potential for wildfires and associated ignition risks are not elevated but still exist within Tier 2 or 3 of the HFTD. Some O&M activities may have stipulations and additional fire mitigation activities may be required. The FPI is indicated as "Green."
- *High Fire Risk*: As determined by the Wildfire Prevention Department, High Fire Risk is defined as periods of increasing risk of wildfires and associated ignition risks within Tier 2 or 3 of the HFTD. Many O&M activities have stipulations and additional fire mitigation activities are sometimes required. The High Fire Risk status is indicated as "Yellow."
- *Very High Fire Risk*: As determined by the Wildfire Prevention Department, Very High Fire Risk is defined as periods of increasing risk of wildfires and associated ignition risks within Tier 2 or 3 of the HFTD. Many O&M activities have stipulations and additional fire mitigation activities are required. The Very High Fire Risk status is indicated as "Orange."
- *Extreme Fire Risk*: As determined by the Wildfire Prevention Department, Extreme Fire Risk is defined as periods of significant risk of wildfires and the associated ignition risks within Tier 2 or 3 of the HFTD. All O&M activities have stipulations, and significant fire mitigation activities are required. Most overhead work activities will cease, except where not performing the work would create a greater risk than performing the work. In cases where at-risk work needs to be performed, a Liberty Fire Safety Monitor or Leader is assigned, and additional mitigation steps are implemented. The Extreme Fire Risk status is indicated as "Red."

The safety of Liberty's customers, personnel, and cooperating agencies are considered during the development and subsequent refinements of Liberty's work procedures and training. Liberty's Fire Prevention Plan ("FPP") requires that employees, contractors, and consultants who conduct activities in the wildland areas of the service territory receive this training on an annual basis. The training includes definitions of at-risk work, wildland areas, FPI, and a matrix that can be used to determine the minimum fire prevention requirements for at-risk activities. Information is also provided related to working on or adjacent to wildland fires, reporting wildland fires, and guidance for taking fire suppression action.

Liberty has refined and updated its FPI Operating Conditions since 2020 and plans to continue to conduct training on fire prevention and emergency actions at any ignition found. Liberty will continue refining procedures designed to prevent ignitions from Liberty equipment or activities throughout our service area. Liberty's Wildfire Prevention Division continues to explore other opportunities to improve FPI Operating Conditions and safety training processes to train personnel to be prepared to work in elevated fire risk conditions. Procedures and training are reviewed annually, and feedback from attendees, other IOUs/agencies, and from public safety partners is incorporated into future training.

Liberty has a fire weather dashboard that provides seven-day forecasts for multiple zones and regions within the service territory for FPI and PSPS weather thresholds. The forecast is updated every six hours and can be accessed 24 hours per day. Liberty crews monitor the dashboard and follow the FPP operating procedures based on current conditions. Additionally, Liberty's wildfire mitigation team conducts weekly meetings during fire season to discuss current and forecasted fire weather conditions and communicates the weekly forecast to all operations field crews. In 2023, Liberty is working to develop a safety tailboard application that will automatically populate current FPI forecast based on crew location which will further assist crews with situational awareness and operating restrictions in the areas they are working.

Liberty's Fire Prevention Plan describes work restrictions for certain at-risk activities based on FPI conditions. Depending on the FPI fire risk rating, some activities will require the designation of a Fire Safety Monitor or a Fire Safety Leader.

- *Fire Safety Monitor*: Designated field supervisor or crew member responsible for fire safety requirement oversight during Elevated Fire Risk working conditions.
- *Fire Safety Leader*: Designated field supervisor or crew member who has a dedicated role for fire safety requirement oversight during Extreme Fire Risk working conditions.

Additionally, Liberty's field crews are equipped with fire prevention and suppression tools throughout all areas of the service territory

8.1.9 Workforce Planning

In this section, the electrical corporation must report on qualifications and training practices regarding wildfire and PSPS mitigation for workers in the following target roles:

- Asset inspections.
- Grid hardening.
- Risk event inspection.

For each of the target roles listed above, the electrical corporation must:

- List all worker titles relevant to the target role.
- For each worker title, list and explain minimum qualifications, with an emphasis on qualifications relevant to wildfire and PSPS mitigation. Note if the job requirements include:
    - Going beyond a basic knowledge of G.O. 95 requirements to perform relevant types of inspections or activities.
    - Being a "Qualified Electrical Worker" (QEW). If so, define what is required by the electrical corporation for it to consider a worker to be a QEW in terms of certifications, qualifications, experience, etc.
- Report the percentage of electrical corporation and contractor full-time employees (FTEs) in the target role, with specific job titles.
- Report plans to improve qualifications of workers relevant to wildfire and PSPS mitigation work. The electrical corporation must explain how it is developing training programs that teach electrical workers to identify hazards that could ignite wildfires.

Liberty provides its Asset Management, Grid Hardening, and Risk Event Inspections workforce qualifications and training practices in Table 8-12, Table 8-13, and Table 8-14.

Table 8-12. Liberty Workforce Planning, Asset Inspections

Worker Title	Minimum Qualifications for Target Role	Special Certification Requirements	Electrical Corporation % FTE Min Quals	Electrical Corporation % Special Certifications	Contractor % FTE Min Quals	Contractor % Special Certifications	Reference to Electrical Corporation Training/Qualification Programs
Inspector Foreman	• Journeyman lineman • Minimum two years journeyman lineman experience • Class A Driver's License • Expert knowledge of G.O. 95 and company's construction standards.	None	16.7%	No special certification required	None	No special certification required	• Fulcrum application and database training • On the job training of company standards and G.O. 95
Inspector	• Journeyman lineman • Minimum one year journeyman lineman experience • Class A Driver's License • General knowledge of G.O. 95 and company's construction standards	None	83.3%	No special certification required	None	No special certification required	• Fulcrum application training • On the job training of company standards and G.O. 95
Qualified Electrical Worker ("QEW")	• Journeyman lineman • Minimum one-year journeyman lineman experience • Class A Driver's License • General knowledge of G.O. 95 and Liberty's construction standards	None	0%	No special certification required	None	No special certification required	• Fulcrum application training • On the job training of company standards and G.O. 95

Table 8-13. Liberty Workforce Planning, Grid Hardening

Worker Title	Minimum Qualifications for Target Role	Special Certification Requirements	Electrical Corporation % FTE Min Quals	Electrical Corporation % Special Certifications	Contractor % FTE Min Quals	Contractor % Special Certifications	Reference to Electrical Corporation Training/Qualification Programs
Engineer IV	• Must possess a Bachelor of Science in Electrical Engineering or an equivalent engineering degree from an accredited four-year college or university • Must hold PE certification	None	6.5%	No special certification required	None	No special certification required	SEL, GIS, CAD, OCalc, Quadra, OSI PI, Aspen Oneliner
Capital Administrator	• Associates or Bachelor's degree in Construction Administration, Accounting or a related field or a minimum of three years of technical experience with a utility or other related field • Working knowledge of accounting, project management and construction management practices	None	3.2%	No special certification required	None	No special certification required	Great Plains Job Cost Training, FERC Code Training, SOX Policy Training, Capital Expenditure Policy Training, Excel Training
Project Manager	• Associates or Bachelor's degree in Project Management, Construction Administration, Engineering in a related field or a PMP certification and a minimum of five years of technical experience with a utility or other related field. Must have a demonstrated working knowledge of project management and construction management practices.	None	6.5%	No special certification required	None	No special certification required	PM Basics, Capital Expenditure Policy Training, Great Plains training, MS Project, Excel Training, Electrical Distribution 101, OH & UG Const Training
Lineman	• Journeyman lineman • Class C Driver's license	None	38.7%	No special certification required	None	No special certification required	• On the job training of company standards and G.O. 95 • On the job training of covered conductor

Worker Title	Minimum Qualifications for Target Role	Special Certification Requirements	Electrical Corporation % FTE Min Quals	Electrical Corporation % Special Certifications	Contractor % FTE Min Quals	Contractor % Special Certifications	Reference to Electrical Corporation Training/Qualification Programs
							installation (ACS and Tree Wire)
Lineman Working Foreman	• Journeyman lineman • Minimum two years' experience as Journeyman Lineman • Class C Driver's license	None	12.9%	No special certification required	None	No special certification required	• On the job training of company standards and G.O. 95 • Hendrix training of covered conductor installation (ACS and Tree Wire)
Inspector	• Journeyman lineman • Minimum one year journeyman lineman experience • Class A Driver's License • General knowledge of G.O. 95 and company's construction standards	None	16.1%	No special certification required	None	No special certification required	• On the job training of company standards and G.O. 95 • On the job training of covered conductor installation (ACS and Tree Wire) • On the job training of internal QA/QC process • Fulcrum application training

Worker Title	Minimum Qualifications for Target Role	Special Certification Requirements	Electrical Corporation % FTE Min Quals	Electrical Corporation % Special Certifications	Contractor % FTE Min Quals	Contractor % Special Certifications	Reference to Electrical Corporation Training/Qualification Programs
Inspector Foreman	• Journeyman lineman • Minimum two years journeyman lineman experience • Class A Driver's License • Expert knowledge of G.O. 95 and company's construction standards	None	3.2%	No special certification required	None	No special certification required	• On the job training of company standards and G.O. 95 • On the job training of covered conductor installation (ACS and Tree Wire) • On the job training of internal QA/QC process • Fulcrum application and database training
Substation Electrician	• Must have successfully completed the Electrician Apprentice training program or equivalent • Must be qualified to perform switching	None	3.2%	No special certification required	None	No special certification required	• On the job training of substation equipment maintenance and replacement • On the job training of PZM application
Substation Electrician Working Foreman	• Journeyman Electrician • Minimum two years' experience as journeyman electrician • Must be qualified to perform switching.	None	3.2%	No special certification required	None	No special certification required	• On the job training of substation equipment maintenance and replacement

Worker Title	Minimum Qualifications for Target Role	Special Certification Requirements	Electrical Corporation % FTE Min Quals	Electrical Corporation % Special Certifications	Contractor % FTE Min Quals	Contractor % Special Certifications	Reference to Electrical Corporation Training/Qualification Programs
							• On the job training of PZM application
Job Facilitator	• Journeyman lineman • Minimum two years' experience as journeyman lineman • Class C Driver's License	None	6.5%	No special certification required	None	No special certification required	• On the job training of company standards and G.O. 95 • On the job training of covered conductor installation (ACS and Tree Wire) • On the job training of internal QA/QC process • Fulcrum application and database training

Table 8-14. Liberty Workforce Planning, Risk Event Inspection

Worker Title	Minimum Qualifications for Target Role	Special Certification Requirements	Electrical Corporation % FTE Min Quals	Electrical Corporation % Special Certifications	Contractor % FTE Min Quals	Contractor % Special Certifications	Reference to Electrical Corporation Training/Qualification Programs
QEW	• Journeyman lineman • Minimum one-year journeyman lineman experience • Class A Driver's License • General knowledge of G.O. 95 and Liberty's construction standards	None	0%	No special certification required	0%	No special certification required	• Fulcrum application training • On the job training of company standards and GO95 • Annual Fire Prevention Plan training

8.2 Vegetation Management and Inspections

8.2.1 Overview

In accordance with Public Utilities Code section 8386(c)(9), each electrical corporation's WMP must include plans for vegetation management.

In this section, the electrical corporation must identify objectives for the next 3- and 10-year periods, targets, and performance metrics related to the following vegetation management programmatic areas:

- Vegetation inspections
- Vegetation and fuels management
- Vegetation management enterprise system
- Environmental compliance and permitting
- Quality assurance/quality control
- Open work orders
- Workforce panning

Liberty conducts Vegetation Management ("VM") inspection and maintenance activities to improve the reliability of its Transmission and Distribution ("T&D") systems and to comply with regulatory requirements established by the California Public Utilities Commission ("CPUC") General Order ("G.O.") 95, California Public Resource Codes ("PRC"), and Title 14 California Code of Regulations ("CCR") by establishing maintenance and inspection procedures. In addition to regulatory compliance, Liberty VM activities conform to relevant American National Standards Institute ("ANSI") A300 Standard Practices and ANSI Z133 Safety Requirements.

8.2.1.1 Objectives

Each electrical corporation must summarize the objectives for its 3-year and 10-year plans for implementing and improving its vegetation management and inspections.[67] These summaries must include the following:

- Identification of which initiative(s) in the WMP the electrical corporation is implementing to achieve the stated objective, including Utility Initiative Tracking IDs

[67] Annual information included in this section must align with the QDR data.

- Reference(s) to applicable codes, standards, and best practices/guidelines and an indication of whether the electrical corporation exceeds an applicable code, standard, or regulation
- Method of verifying achievement of each objective
- A completion date for when the electrical corporation will achieve the objective
- Reference(s) to the WMP section(s) or appendix, including page numbers, where the details of the objective(s) are documented and substantiated

Liberty presents information regarding its VM 3-year plan in Table 8-15 and its VM 10-year plan in Table 8-16.

Table 8-15. Liberty Vegetation Management Implementation Objectives (three-year plan)

Objectives for Three Years (2023–2025)	**Applicable Initiative(s), Tracking ID(s)**	**Applicable Regulations, Codes, Standards, and Best Practices (See Note)**	**Method of Verification (*i.e.*, program)**	**Completion Date**	**Reference (section & page #)**
Complete vegetation risk modeling	Clearance, VFM-05; Fall-In Mitigation, VFM-06	G.O. 95, Rule 35, PRC 4293	WMP reporting, report from 3rd party project manager, QA/QC	December 2025	Section 6, pp. 64-110
Complete fall-in risk scoring model pilot	Fall-In Mitigation, VFM-06; High-Risk Species, VFM-07	PRC 4293	WMP reporting, report from vegetation inspection consultant	December 2025	None in the 2023 WMP; in development

Table 8-16. Liberty Vegetation Management Implementation Objectives (10-year plan)

Objectives for Ten Years (2026–2032)	**Applicable Initiative(s), Tracking ID(s)**	**Applicable Regulations, Codes, Standards, and Best Practices (See Note)**	**Method of Verification (*i.e.*, program)**	**Completion Date**	**Reference (section & page #)**
Implement IVM monitoring program	Fire Resilient Rights-of-Way, VFM-04; Environmental Permitting, Managing Community Impacts, and Program Development Activities, ESG-01	ANSI A300 Part 7 – Integrated Vegetation Management	3rd party environmental consultant	December 2032	Section 8.2.2, pp. 212-223; Section 8.2.3, pp. 224-236
Develop Utility Arborist training program for Liberty's service area	Environmental Permitting, Managing Community Impacts, and Program Development Activities, ESG-01	Applicable ANSI A300 Standards	Benchmarking, Internal verification	December 2032	None in the 2023 WMP; in development

8.2.1.2 Targets

Initiative targets are forward-looking quantifiable measurements of activities identified by each electrical corporation in its WMP. Electrical corporations will show progress toward completing targets in subsequent reports, including QDRs and WMP Updates.

The electrical corporation must list all targets it will use to track progress on its vegetation management and inspections for the three years of the Base WMP. Energy Safety's Compliance Assurance Division and third parties must be able to track and audit each target.[68] For each initiative target, the electrical corporation must provide the following:

- Utility Initiative Tracking IDs.
- Projected targets for each of the three years of the Base WMP and relevant units.
- Quarterly, rolling targets for 2023 and 2024 (inspections only).
- The expected "x% risk impact" For each of the three years of the Base WMP. The expected x% risk impact is the expected percentage risk reduction per year, as described in Section 7.2.2.2.
- Method of verifying target completion.

The electrical corporation's targets must provide enough detail to effectively inform efforts to improve the performance (*i.e.*, reduction in ignition probability or wildfire consequence) of the electrical corporation's vegetation management and inspections initiatives.

Liberty provides its VM initiative targets in Table 8-17 and its VM inspection initiative targets in Table 8-18. The targets contained in the following tables are forward-looking estimates only. The completion of the units described in the tables can vary based on environmental conditions and other factors.

[68] Annual information included in this section must align with Table 1 of the QDR.

Table 8-17. Liberty Vegetation Management Initiative Targets by Year

Initiative Activity	Liberty WMP Tracking ID	2023 Target & Unit	x% Risk Impact 2023[69]	2024 Target & Unit	x% Risk Impact 2024	2025 Target & Unit	x% Risk Impact 2025	Method of Verification
Pole Clearing	WMP-VM-VFM-01	4,960 subject poles	See footnote	4,960 subject poles	See footnote	4,960 subject poles	See footnote	Post-work verification, completed work orders, invoice review, GIS pole and asset data updates, field verification of poles
Wood and Slash Management	WMP-VM-VFM-02	280 acres	See footnote	280 acres	See footnote	280 acres	See footnote	Post-work verification, completed work orders, invoice review, load tag reports
Clearance	WMP-VM-VFM-05	-	-	-	-	700 circuit miles	See footnote	Post-work verification, completed work orders, invoice review
Fall-In Mitigation, High-Risk Species	WMP-VM-VFM-06	220 circuit miles	See footnote	220 circuit miles	See footnote	220 circuit miles	See footnote	Post-work verification, completed work orders, invoice review

Table 8-18. Liberty Vegetation Inspections Targets by Year

Initiative Activity	Tracking ID	Target End of Q2 2023 & Unit	Target End of Q3 2023 & Unit	End of Year Target 2023 & Unit	x% Risk Impact 2023[70]	Target End of Q2 2024 & Unit	Target End of Q3 2024 & Unit	End of Year Target 2024 & Unit	x% Risk Impact 2024	Target End of Q2 2025 & Unit	Target End of Q3 2025 & Unit	End of Year Target 2025 & Unit	x% Risk Impact 2025	Method of Verification
Vegetation Management Inspection Program - Detailed	WMP-VM-INSP-01	88 circuit miles inspected	151 circuit miles inspected	220 circuit miles inspected	See footnote	110 circuit miles inspected	165 circuit miles inspected	220 circuit miles inspected	See footnote	110 circuit miles inspected	165 circuit miles inspected	220 circuit miles inspected	See footnote	QC of inspections, invoice review, documentation of span inspections, schedule and plan monitoring and tracking
Vegetation Management Inspection Program - LiDAR	WMP-VM-INSP-03	0 circuit miles inspected	700 circuit miles inspected	700 circuit miles inspected	See footnote	0 circuit miles inspected	700 circuit miles inspected	700 circuit miles inspected	See footnote	0 circuit miles inspected	700 circuit miles inspected	700 circuit miles inspected	See footnote	Inspection data verification
QA/QC	WMP-VM-QAQC-01	114 circuit miles inspected	171 circuit miles inspected	229 circuit miles inspected	See footnote	114 circuit miles inspected	171 circuit miles inspected	229 circuit miles inspected	See footnote	120 circuit miles inspected	229 circuit miles inspected	229 circuit miles inspected	See footnote	QC inspection data, invoice review, scheduling of QC activities to align with maintenance work

69 Liberty does not currently have sufficient information to calculate; See Section 7.2.2 for Liberty's planned risk analysis
70 Liberty does not currently have sufficient information to calculate; See Section 7.2.2 for Liberty's planned risk analysis

8.2.1.3 Performance Metrics Identified by the Electrical Corporation

Performance metrics indicate the extent to which an electrical corporation's Wildfire Mitigation Plan is driving performance outcomes. The electrical corporation must:

- List the performance metrics the electrical corporation uses to evaluate the effectiveness of its vegetation management and inspections in reducing wildfire and PSPS risk[71]

For each of these performance metrics listed, the electrical corporation must:

- Report the electrical corporation's performance since 2020 (if previously collected)
- Project performance for 2023-2025
- List method of verification

The electrical corporation must ensure that each metric's name and values are the same in its WMP reporting as its QDR reporting (specifically, QDR Table 2 and QDR Table 3). Metrics listed in this section that are the same as performance metrics required by Energy Safety and reported in QDR Table 2 (Performance Metrics)[72] must match those reported in QDR Table 2. Metrics listed in this section that are not the same as any of the performance metrics identified by Energy Safety and reported in QDR Table 2 must match those reported in QDR Table 3.

The electrical corporation must:

- Summarize its self-identified performance metric(s) in tabular form
- Provide a brief narrative that explains trends in the metrics

Table 8-19 provides the performance metrics that Liberty uses to evaluate the effectiveness of its VM program in reducing wildfire and PSPS risk.

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[71] There may be overlap between the performance metrics the electrical corporation uses and performance metrics required by Energy Safety. The electrical corporation must list these overlapping metrics in this section in addition to any unique performance metrics it uses.

[72] The performance metrics identified by Energy Safety are included in Energy Safety's Data Guidelines.

Table 8-19. Liberty Vegetation Management and Inspection Performance Metrics Results by Year

Performance Metrics	2020	2021	2022	2023 Projected	2024 Projected	2025 Projected	Method of Verification (*e.g.*, third-party evaluation, QDR)
Vegetation-caused ignitions	0	1	0	1 every 4 years	1 every 4 years	1 every 4 years	QDR, CPUC reportable ignitions
Vegetation-caused outages	18	18	109[73]	33	33	33	QDR
Open vegetation work orders	6,789	4,839	3,407	4,881	4,881	4,881	QDR

[73] Of the 109 vegetation-caused outages in 2022, 45 occurred during winter storm events. These were previously captured in the "Other" category in the OEIS QDR template prior to 2022.

8.2.2 Vegetation Management Inspections

In this section, the electrical corporation must provide an overview of its procedures for vegetation management inspections, including the following:

The electrical corporation must first summarize details regarding its vegetation management inspections in Table 8-20. The table must include the following:

- **Type of inspection**: distribution, transmission, substation, etc.
- **Inspection program name:** Identify various inspection programs within the electrical corporation (*e.g.*, routine, enhanced vegetation, high-risk species, and off-cycle)
- **Frequency or trigger**: Identify the frequency or triggers, such as inputs from the risk model. Indicate differences in frequency or trigger by HTFD Tier, if applicable
- **Method of inspection**: Identify the methods used to perform the inspection (*e.g.*, patrol, detailed, sounding or root examination, aerial, and LiDAR)
- **Governing standards and operating procedures**: Identify the regulatory requirements and the electrical corporation's procedures for addressing them

Liberty summarizes the details regarding its vegetation management inspection programs in Table 8-20.

Table 8-20. Example of Vegetation Management Inspection Frequency, Method, and Criteria

Type	**Inspection Program**	**Frequency or Trigger**	**Method of Inspection**	**Applicable VM Plans and Procedures**	**Governing Standards & Operating Procedures**
Transmission and Distribution	Routine; Hazard	Annual – all circuits	LiDAR inspections	VM-02,[74] VM-03,[75] VM-07[76]	G.O. 95, Rule 35 (Case 13 and Case 14); PRC § 4293; PRC § 4295; CCR §§ 1250-1258
Transmission and Distribution	Routine; Hazard	Every three years – all circuits	Detailed Inspections (ground based)	VM-02, VM-03, VM-05, VM-07	G.O. 95, Rule 35 (Case 13 and Case 14); PRC § 4293; PRC § 4295; CCR §§ 1250-1258
Transmission and Distribution	Routine	Annual - all circuits (performed by Electric Operations)	Patrol Inspections (ground based)	VM-02, VM-03, VM-05, VM-07	G.O. 95, Rule 35 (Case 13 and Case 14); PRC § 4293; CCR §§ 1250-1258
Transmission and Distribution	High-Risk, Off-Cycle, Post-Event Inspections	As needed	Ground Based Inspections	VM-02, VM-03, VM-05, VM-07	G.O. 95, Rule 35 (Case 13 and Case 14); PRC § 4293; CCR §§ 1250-1258

74 Liberty Vegetation Management Plan.
75 Liberty Hazard Tree Management Plan.
76 Liberty Vegetation Management Inspection Manual.

Type	Inspection Program	Frequency or Trigger	Method of Inspection	Applicable VM Plans and Procedures	Governing Standards & Operating Procedures
Transmission and Distribution	Pole Brushing	Annual - All Non-Exempt Poles; State (“SRA”) and Federal (“FRA”) Responsibility Areas Only	Ground Based Inspections	VM-02, VM-07	PRC § 4292; CCR §§ 1250-1255
Substation	Weed and Brush Control Inspections		Ground Based Inspections	VM-02, VM-07	G.O. 174; PRC § 4292; PRC § 4293; CCR §§ 1250-1258
Transmission, Distribution and Substation	QC Inspections	See Section 8.2.5	Ground Based Inspections	VM-02, VM-03, VM-05, VM-07	G.O. 95, Rule 35 (Case 13 and Case 14); PRC § 4293; PRC § 4295; CCR §§ 1250-1258

The electrical corporation must then provide a narrative overview of each vegetation inspection program identified in the above table; Sections 8.2.2.1. provides instructions for the overviews. The sections should be numbered 8.2.2.1 to Section 8.2.2.n (*i.e.*, each vegetation inspection program is detailed in its own section). The electrical corporation must include inspection programs it is discontinuing or has discontinued since the last WMP submission; in these cases, the electrical corporation must explain why the program is being discontinued or has been discontinued.

Vegetation Management Inspections

Liberty's VM Program includes various inspection types. These are described in Liberty's Plans and Procedures and summarized below. Liberty's detailed, patrol, and LiDAR VM inspection programs are also summarized in Sections 8.2.2.1 through 8.2.2.3.

Routine Inspections (T&D): Liberty conducts vegetation inspections of applicable transmission and distribution lines, poles, and equipment to identify vegetation management work needed to maintain compliance with applicable regulations, potential required clearance distance ("RCD") encroachments, hazard trees, and clearance exempt trees.

Routine inspection methods include Light Detection and Ranging ("LiDAR"), conducted annually on all circuits, and ground based, detailed inspections that are conducted every three years on each circuit.

System-wide LiDAR inspections are completed on an annual basis to assess compliance with applicable vegetation to conductor clearance regulations and identify any vegetation concerns.

Detailed inspections of entire circuits are performed to prescribe pruning and removal of vegetation as a safeguard against grow-ins or fall-ins and to comply with required laws and regulations. Liberty performs these inspections and resultant work once every three years on each circuit to manage risk posed by vegetation to overhead lines. Detailed inspection cycles may vary to account for vegetation growth rates, site characteristics, environmental conditions, or other factors that can affect the timing of corrective actions.

Supplemental ground-based inspections are performed by qualified Electric Operations personnel throughout the year. Identified conditions that may require vegetation-related work are documented and reported to VM personnel and scheduled for inspection or remediation.

High-Risk, Off-Cycle, Post-Event Inspections (T&D): Liberty conducts additional inspections, as needed, based on environmental conditions or other factors.

Liberty may perform additional hazard tree inspections, as needed, to address tree mortality or after major storms, high wind events, or fires. The need for these inspections is determined based on the severity of the event and the resulting possibility of damaged trees.

Liberty may perform separate pre-fire season inspections in designated Public Resource Code ("PRC") areas, Extreme (Tier 3) and Very High (Tier 2) fire areas as needed.

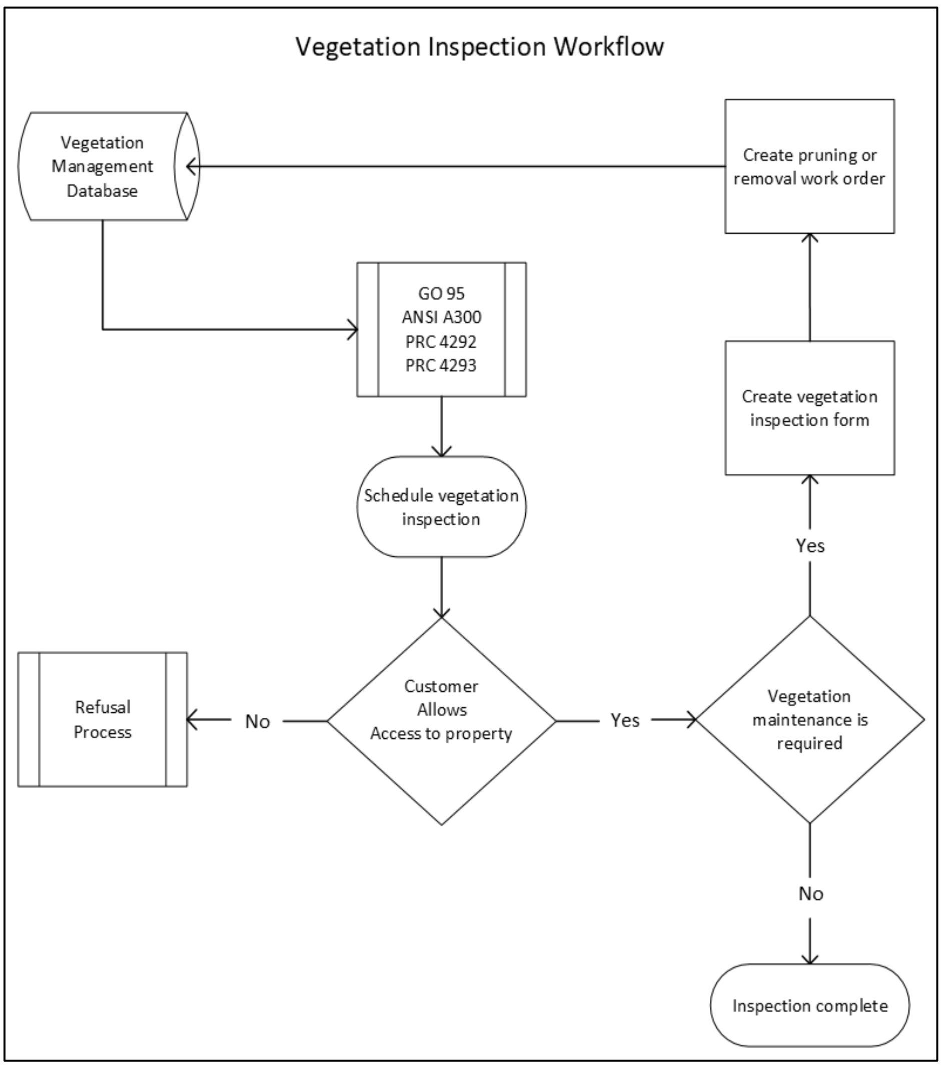
Pole Brushing (T&D): Liberty performs pole brushing inspections on all non-exempt poles in state and federal responsibility areas annually. Inspections are performed to assess compliance with regulations and document any work that is required.

Weed and Brush Control Inspections - (Substation): Liberty performs routine inspections, vegetation management, and other maintenance activities at 12 substations. Inspections determine control methods, which include manual and mechanical clearing and chemical applications. Work will occur at regular intervals to maintain accessibility, safety, and adherence to appropriate governmental regulations and Liberty policies. A minimum of two site visits will occur per facility, per year. Additional site visits may be required for sites that do not receive herbicide applications.

QC Inspections (T&D, Substation): See Section 8.2.5 for a description of QC inspections.

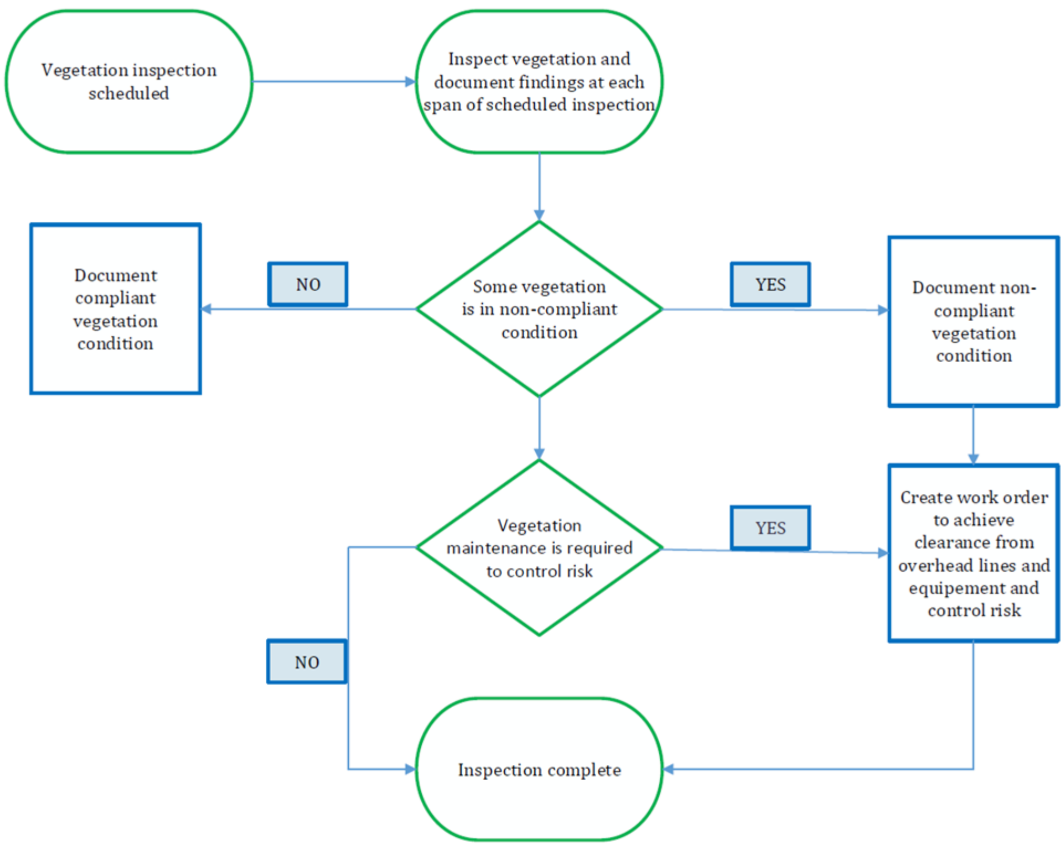
Liberty provides an overview of its VM Inspection Program in Figure 8-4.

Figure 8-4: Liberty VM Inspection Overview



Process: Liberty conducts several inspection types utilizing different inspection methods to manage vegetation growing along or adjacent to its electrical facilities. The types of vegetation inspection and methods of inspection are detailed in Section 8.2.2. Liberty provides a visual of its VM Inspection process in *Figure 8-5*.

Figure 8-5: Liberty VM Inspection Process



Frequency or Triggers: Although the frequency differs, Liberty performs routine and detailed inspections throughout its service territory in the same manner. Frequency of inspections are detailed in Table 8-20 above. Liberty's service territory is primarily located in HFTD areas, and the entire system is treated in a similar manner.

Liberty monitors vegetation conditions using several sources of information for VM inspection planning and prioritization. Factors taken into consideration when planning and prioritizing inspections of vegetation include the type of inspection and maintenance work, vegetation density, maintenance history, regional fire risk rating based on CPUC fire threat areas and Reax fire risk ratings, customer tree inspection requests, and observations from field employees and contractors.

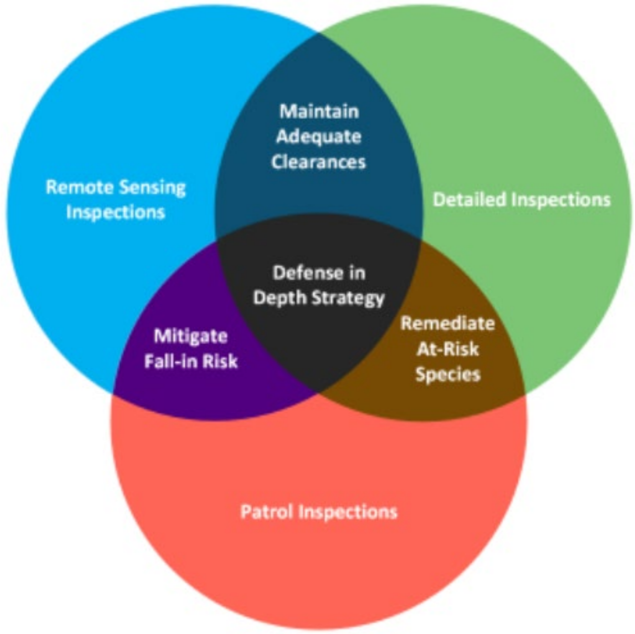
Using a combination of inspections and management practices, Liberty has developed a defense-in-depth strategy to mitigate vegetation threats and maintain clearances to reduce wildfire risk (See *Figure 8-6*). This multi-faceted approach is designed to achieve and maintain adequate vegetation clearance distances, remediate at risk species, and remove obvious hazard trees with strike potential in an effective and complementary manner. This approach provides a method of assuring the efficacy of inspections while informing future VM activities.

Liberty performs LiDAR inspections of vegetation to achieve clearances around electrical infrastructure on an annual basis. Liberty mitigates vegetation encroachments identified by LiDAR inspections within maintenance action thresholds ("MAT") before the next fire season after inspections.

Liberty performs patrol inspections (high-risk, off-cycle, post event inspections) to locate and remove obvious hazard trees. These inspections are performed on an as-needed basis on specific circuits or line segments and are triggered by known local conditions, tree health and risk data derived from LiDAR inspections, vegetation conditions reported by the public or line-operations, or storm, wildfire or other events that can bring changes to normal vegetation conditions.

Liberty performs detailed inspections on every circuit every three years to comply with applicable regulations and governing standards. Detailed inspections are intended to be implemented on a three-year maintenance cycle schedule and typically target vegetation threats identified by a Level 2 Assessment (see Section 8.2.3.4: Fall-In Mitigation) and removal of incompatible trees within the right-of-way. Liberty attempts to align detailed inspections and maintenance with right-of-way reclamation and fire-resilient rights-of-way projects (see Section 8.2.3.7: Fire Resilient Rights-of-Way) wherever feasible.

Figure 8-6: Diagram of Liberty's Vegetation Threat Mitigation Strategy



Accomplishments: The following are Liberty's major accomplishments during the 2020-2022 WMP cycle:

- Liberty utilized emerging technologies to inform its inspection programs. Liberty has been using LiDAR data to identify circuits and regions with highest tree density, encroachments, and change detection from year to year. Liberty uses this data to evaluate routine inspection schedules of circuits and verify that its inspection methodology and subsequent maintenance work is effective. In addition to helping inform its program strategies, Liberty utilizes LiDAR data to schedule off-cycle inspections to evaluate specific tree encroachments or line segments.
- In 2022, Liberty utilized REAX fire risk ratings to prioritize pole brushing inspections in the highest rated risk areas of the service territory.
- Liberty began offering wood removal and disposal services to residential customers system-wide in 2022. Prior to 2022, Liberty performed wood removal for residential customers upon request. Liberty also updated its Tree Work Notification Form and notification policy to include the option for wood removal for tree removals to residential customers at the time of inspection.
- Liberty successfully achieved 2022 QC inspection target metrics and used the opportunity to perform additional QC inspections, develop tools for monitoring project and program performance, evaluate LiDAR inspection data accuracy, and evaluate tree

listing practices of ground-based inspections with alignment to program procedures and scope.

- Liberty hosted training sessions, reviews of procedures, and benchmarks with inspectors throughout 2022 to align with best practices and its internal policies.

Roadblocks: The following are roadblocks that Liberty encountered over the 2020-2022 WMP cycle:

- Liberty's service territory presents a variety of challenges to the inspection program. Liberty's system operates through six counties, four National Forests, four State of California Department of Transportation (Caltrans) districts, and various other public lands, special interest groups, and governing agencies. Liberty strives to manage the expectations of external stakeholders and adheres to requirements detailed in special uses permits, memoranda of understanding, and other work notification requirements. Increases in workload and work required to reduce fuel loading on the landscape have resulted in more exhaustive permitting requirements, including the need for Liberty to perform archeological surveys and obtain environmental permits for routine maintenance work on state and federal lands. These permitting requirements and the review process of Liberty's stakeholders have contributed to delays in scheduling of maintenance work and create inefficiencies during the work planning and notification process.
- Increased legislation has contributed to ongoing adaptation of inspection processes, procedures, scope, and criteria for data collection. Adjustments in other components of the VM program and the addition of new VM initiatives requires the need to review current inspection program methodology and make the necessary changes in the inspection program to align with the other components of the VM program.
- Liberty has a significant amount of absentee private landowners in its service territory. Many of Liberty's customers own vacation or rental properties in the service territory. Opportunities for onsite notification, review of inspection results and planned work can be infrequent. Notifications often require mailing required tree removal paperwork and correspondence that goes beyond standard notification processes at the landowner request so that they understand the work to be performed.
- Most of the service territory sits at or above 6,200-foot elevation and receives significant high-country snowfall during the winter months. Inclement winter conditions can impede inspections altogether, contributing to scheduling delays or loss of production. Liberty plans its ground-based inspections on its most inaccessible circuits

during spring, summer, and fall months as much as possible. Even in late spring and early summer, the highest elevation circuits may be inaccessible due to snowpack.

- Liberty's inspection program has been impacted by natural disasters such as wildfires in neighboring regions and within the territory footprint. Wildfires and other natural disasters impact the inspection program by needing to resource workforce for restoration efforts for natural disasters that occur inside and outside the service territory.

Changes/updates to Liberty's VM inspection program:

- Liberty has developed an Inspection Manual (VM-07) to provide details and guidance on its inspection processes and responsibilities. Additionally, a Notification and Refusal Policy (VM-06) has been developed to provide consistent guidance on notification expectations, timelines, and strategies for conflict resolution. These procedures are companion pieces to Liberty's portfolio of VM policies and procedures already developed.
- Liberty began providing compatible plant training to its VM inspectors in 2022 as part of a long-term Integrated Vegetation Management ("IVM") plan. Training included field visits to become acquainted with compatible plants, understory species, ecological zones, and how the landscape reacts to disturbances such as mechanical treatments or wildfire. Liberty plans to begin initial surveys of ecozones in rights-of-way to identify compatible plant composition, site characteristics, and geographic influences for ongoing monitoring research

8.2.2.1 Vegetation Management Inspection Program – Detailed Inspections

Process

In this section, the electrical corporation must provide an overview of the individual vegetation inspection program, including inspection criteria and the various inspection methods used for each inspection program.

Include relevant visuals and graphics depicting the workflow and decision-making process the electrical corporation uses for the inspection program.

Frequency or Triggers

In this section, the electrical corporation must identify the frequency or triggers used in the inspection program, such as inputs from the risk model. It must also identify how the frequency or trigger might differ by HFTD Tier or other risk designation.

If the inspection program is based on a schedule, the electrical corporation must explain how it uses risk prioritization in the scheduling of the inspection program to target high-risk areas. If the electrical corporation does not use risk prioritization in the scheduling of the inspection program, it must explain why.

Accomplishments, Roadblocks, and Updates

In this section, the electrical corporation must discuss:

- Noteworthy accomplishments for the inspection program since the last WMP submission
- Roadblocks the electrical corporation has encountered while implementing the inspection program and how the electrical corporation has addressed the roadblocks
- Changes/updates to the inspection program since the last WMP submission including known future plans (beyond the current year) and new/novel strategies the electrical corporation may implement in the next 5 years (*e.g.*, references to and strategies from pilot projects and research)

Process: Detailed inspections of entire circuits are performed to prescribe pruning and removal of vegetation as a safeguard against grow-ins or fall-ins and to comply with required laws and regulations. Liberty performs these inspections and resultant work once every three years on each circuit to manage risk posed by vegetation to overhead lines. Detailed inspection cycles may vary to account for vegetation growth rates, site characteristics, environmental conditions, or other factors that can affect the timing of corrective actions.

Frequency or Trigger: Liberty performs detailed inspections on every circuit every three years to comply with applicable regulations and governing standards. Detailed inspections are intended to be implemented on a three-year maintenance cycle schedule and typically target vegetation threats identified by a Level 2 Assessment (see Section 8.2.3.4: Fall-In Mitigation) and removal of incompatible trees within the right-of-way. Liberty attempts to align detailed inspections and maintenance with right-of-way reclamation and fire-resilient rights-of-way projects (see Section 8.2.3.7: Fire Resilient Rights-of-Way) wherever feasible.

8.2.2.2 Vegetation Management Inspection Program – Patrol Inspections

Process: Supplemental ground-based inspections are performed by qualified Electric Operations personnel throughout the year. Identified conditions that may require vegetation-related work are documented and reported to VM personnel and scheduled for inspection or remediation.

Frequency or Trigger: Liberty performs patrol inspections (high-risk, off-cycle, post event inspections) to locate and remove obvious hazard trees. These inspections are performed on an as-needed basis on specific circuits or line segments and are triggered by known local conditions, tree health and risk data derived from LiDAR inspections, vegetation conditions reported by the public or line-operations, or storm, wildfire or other events that can bring changes to normal vegetation conditions.

8.2.2.3 Vegetation Management Inspection Program – LiDAR Inspections

Process: System-wide LiDAR inspections are completed on an annual basis to assess compliance with applicable vegetation to conductor clearance regulations and identify any vegetation concerns.

Frequency or Trigger: Liberty performs LiDAR inspections of vegetation to achieve clearances around electrical infrastructure on an annual basis. Liberty mitigates vegetation encroachments identified by LiDAR inspections within maintenance action thresholds (“MAT”) before the next fire season after inspections.

8.2.3 Vegetation and Fuels Management

In this section, the electrical corporation must discuss the following mitigation initiatives associated with vegetation and fuels management:

1. Fuels management
2. Clearance
3. Fall-in mitigation
4. Substation defensible space
5. High-risk species
6. Fire-resilient right-of-way
7. Emergency response vegetation management

In the following subsections, the electrical corporation must provide an overview of its vegetation and fuels management initiatives. These overviews should include figure(s) that depict the workflow and decision process used for vegetation and fuels management.

In addition to figure(s), the electrical corporation must provide a narrative overview of each vegetation and fuels management initiative. The discussion must include the following:

- **Utility Initiative Tracking ID.**
- **Overview of the initiative:** A brief description of the initiative including reference to related objectives and targets.
- **Governing standards and electrical corporation standard operating procedures:** Reference to the appropriate code and electrical corporation procedure. If any standard exceeds regulatory requirements, the electrical corporation must reference the document that the electrical corporation uses as a basis for exceeding the regulatory requirements.
- **Updates to the initiative:** Changes to the initiative since the last WMP submission and a brief explanation as to why those change were made. Discuss any planned improvements or updates to the initiative and the timeline for implementation.

8.2.3.1 Pole Clearing

In this subsection, the electrical corporation must provide an overview of pole clearing activities, including:

- Pole clearing per Public Resources Code section 4292
- Pole clearing outside the requirements of Public Resources Code section 4292 (*e.g.*, pole clearing performed outside of the State Responsibility Area)

Tracking ID: WMP-VM-VFM-01

Overview of initiative: Liberty owns approximately 23,000 wood poles that support distribution and transmission facilities. Most of Liberty's service territory is located on land that is under the jurisdiction of the State of California or the federal government for fire protection services. Liberty only conducts pole clearing in State ("SRA") and Federal Responsibility Areas ("FRA"). There are currently 4,960 poles that require clearing on an annual basis in SRA and FRA.

Liberty completed 701 miles of vegetation management to achieve clearances around electric lines and equipment out of its target of 701 miles of vegetation management to achieve clearances around electric lines and equipment in 2022.

Governing standards and electrical corporation standard operating procedures: Public Resources Code (PRC) § 4292, California Code of Regulations (CCR) §§ 1250-1255, Vegetation Management Plan (VM-02), Vegetation Management Inspection Manual (VM-07).

Updates to the initiative: There are currently no anticipated updates to this initiative.

8.2.3.2 Wood and Slash Management

In this subsection, the electrical corporation must provide an overview of how it manages all downed wood and "slash" generated from vegetation management activities, including references to applicable regulations, codes, and standards.

Tracking ID: WMP-VM-VFM-02

Overview of initiative: Liberty recognizes the need for additional efforts to reduce accumulation of woody debris that can ignite or contribute to fire spread and intensity. Liberty has implemented a Fuel Management Program as a precautionary measure, where feasible, to reduce wildfire risks by removing wood and treating brush and slash after vegetation maintenance is performed. Additional treatments that reduce surface fuels from previous activities and those that further reduce fuel loads are also implemented. This program is intended to align more closely with joint goals of agency partners and the local community, so vegetation management fuel load is treated in a manner that reduces both the risk of fire ignition and the potential for increased fire intensity.

Liberty completed 515 acres of fuel management and reduction of slash from vegetation management activities out of its target of 280 acres of fuel management and reduction of slash from vegetation management activities in 2022.

Table 8-21: Fuel Management Projects Acres Treated

Project Name	% Acres Treated	Acres Treated
Detailed/Patrol Residential Wood Hauling	63.66	350.7
Sagehen Project	2.74	15.13
Cathedral B	1.43	7.89
CTC Firewood Bucking	13.89	76.55
Tamarack Fire Cleanup - BLM	3.08	17
Tamarack Fire Cleanup - Shay Creek	0.09	0.5
Tamarack Fire Cleanup - HTNF	1.08	6
625 Line Wood Removal - TNF	0.54	3
USFS Decking Locations	0.04	0.25
Storm Cleanup	0.18	1
625 Hand Thin	2.83	15.64
Bureau of Indian Affairs	0.30	1.68
USFS Wood Haul	7.94	43.79
BLM	1.39	7.7
US Fish and Game	0.72	4
TOTALS	**100**	**550.83**

Table 8-22: Tons of Biomass Removed

Customer Category	% Tons of Biomass Removed	Tons of Biomass Removed
Residential Wood Hauling	61.16	1223
Agency Wood Hauling	38.84	776.53
Totals	**100**	**1999.53**

Governing standards and electrical corporation standard operating procedures: No governing standard exists. Liberty's VM standard is to work creatively and cooperatively with landowners to reduce fuel from line clearance work, where possible, in a manner that is environmentally sound.

Updates to the initiative: Liberty is working toward coordinating fuel treatments in a timely manner. Liberty is seeking alternatives to repurpose biomass, such as wood chips, compost, and firewood.

8.2.3.3 Clearance

In this subsection, the electrical corporation must provide an overview of clearance activities, including:

- Clearances established in excess of the minimum clearances in Table 1 of G.O. 95
- The bases for the clearances established

Tracking ID: WMP-VM-VFM-05

Overview of initiative: Liberty's VM Program is designed to improve the reliability of Liberty's Transmission and Distribution systems and to comply with regulatory requirements established CPUC G.O. 95, California PRC, and Title 14 CCR by establishing maintenance and inspection procedures. The following details Liberty's clearance requirements.

Clearances for Lines and Equipment Operating at Less than 2.4kV:

Power lines, or their supporting structures operating at less than 2,400 volts, do not have mandated vegetation to conductor clearance requirements. These types of lines include open-wire secondary and coated triplex or quadruplex aerial cable (including service drops), and guy wires. The following clearances at time of pruning shall apply:

- *Open Wire Secondary*: Four feet minimum from tree to open wire conductor at the time of pruning. Trees scheduled for pruning for open wire secondary will be inventoried based on tree growth characteristics to avoid tree line contact with conductors.
- *Coated Aerial Cable*: Prune for strain or abrasion only. Trees scheduled for pruning will be identified as showing evidence of strain or abrasion with wires. Trees will be allowed to contact coated aerial cable or service drops that show no sign of strain or abrasion.
- *Guy and Support Wires*: Prune for strain or abrasion; two feet minimum clearance from tree or portion of tree that is in contact with guy and support wire above the insulator (guy bob).

Clearances for Lines and Equipment Operating at 12kV to 25kV:

The following clearances are to be achieved during VM work for these distribution voltage classes:

- Slow and medium growth potential – 12 feet
- Fast growth potential – 15 feet
- Removal of overhanging limbs that can contact facilities due to structural characteristics or due to snow/ice loading conditions.

Clearances for Lines and Equipment Operating at 60kV or Greater:

Liberty owns and operates numerous 60kV and 120kV power lines that assist in transmitting high-voltage electricity from substation to substation. Due to the importance of maintaining electric reliability on these lines, it is necessary that the standards for tree pruning and removal are greater than that of lower voltage distribution lines. In addition to the state-mandated vegetation to conductor clearance, and in order to maintain system reliability, the following are to be addressed during VM work:

- Remove branches that overhang the electrical conductors
- Remove trees within the wire zone
- Remove defected, dead, decayed or suppressed trees within the border zone

60kV Clearance Objectives:

- Slow to medium growth potential – 12 feet
- Fast growth potential – 15 feet

120kV Clearance Objectives:

- Slow to medium growth potential – 30 feet
- Fast growth potential – 35 feet

Refer to Table 8-36 for information on radial clearance requirements.

Table 8-23: Radial Clearance Requirements

Voltage	Regulation Clearance Distance (RCD)[77]	Maintenance Action Threshold (MAT)[78]	Maintenance Clearance Distance (MCD)[79]
12kV – 25kV	4 feet	6 feet	12-15 feet
60kV	4 feet	6 feet	12-15 feet
120kV	10 feet	15 feet	30-35 feet

77 Clearance distance between conductors and vegetation that is mandated by regulations.

78 Clearance distance that triggers the work scheduling process to prevent vegetation from encroaching into the RCD. The MAT is based on the regulation clearance with a safety margin multiplier of 1.5.

79 When possible, clearance distance to be achieved at time of work. Minimum clearances based on Rule 35, Appendix ‘E’.

Liberty completed 701 miles of vegetation management to achieve clearances around electric lines and equipment out of its target of 701 miles of vegetation management to achieve clearances around electric lines and equipment in 2022.

Governing standards and electrical corporation standard operating procedures: G.O. 95, Rule 35; G.O. 95, Appendix E; PRC § 4293; CCR §§ 1250-1258; Vegetation Management Plan (VM-02); Hazard Tree Management Plan (VM-03); Vegetation Management Inspection Manual (VM-07).

Updates to the initiative: There are currently no anticipated updates to this initiative.

8.2.3.4 Fall-In Mitigation

In this subsection, the electrical corporation must provide an overview of its actions taken to identify and remove or otherwise remediate trees that pose a high risk of failure or fracture that could potentially strike electrical equipment (*e.g.*, danger trees or hazard trees).

Tracking ID: WMP-VM-VFM-06

Overview of initiative: Liberty has developed a Hazard Tree Management Plan (VM-03) for the purpose of identifying, documenting, and mitigating trees that are located within the utility strike zone and are expected to pose a risk to electric facilities based on the tree's observed structural condition and site considerations. The plan includes an overview of tree risk associated with electric lines and equipment, inspection types, risk assessment levels, work priority levels, and mitigation actions.

Levels of Assessment: Identification of trees that pose a high risk of failure are typically performed by completing the following levels of assessment:

- *Level 1*: Limited Visual Assessment per ANSI A300 (Part 9) Tree Risk Assessment and in accordance with Liberty's Hazard Tree Management Plan. This is accomplished by conducting an assessment from one side of the tree (side nearest the electric facilities) and can be ground-based, vehicle-based, or aerial-based, as appropriate for the site conditions, type of infrastructure, and tree population being considered. A Level 1 assessment focuses on identifying obvious tree defects that are observable from the side of the tree nearest the electric facilities. If a condition of concern is identified during the Level 1 assessment, recommendations are developed regarding possible mitigation. If the Level 1 assessment cannot sufficiently determine the severity of the condition, a Level 2 assessment is conducted. Structural and site conditions that indicate a possible hazardous condition and could pose a risk to electric facilities are listed below. These are considered when performing a tree risk assessment.

- *Level 2*: A detailed ground-based visual assessment of an individual tree and its surrounding site. A Level 2 assessment may include walking completely around the tree—looking at the site, buttress roots, trunk, and branches. Many trees that pose a potential risk to electric facilities are located on private property and beyond the edge of the utility easement of right-of-way, which may restrict access. Severe terrain or other obstacles may also prevent access. As such, there may be a limited opportunity or ingress to do a 360-degree assessment of an individual tree.

Table 8-24: Hazard Tree Attributes

Hazard Tree Attributes
Basal wound
Bleeding or resinous
Bulges and/or swellings
Cankers, including bleeding & gall rust
Cavities
Codominant or multiple stems from base or higher on trunk
Conks indicating heart rot, root rot, sap rot or canker rot
Cracks including shear
Dead branches and/or top
Dieback of twigs and/or branches
Embedded wires or cables
Excessive lean toward electrical facilities or excessive bow
Fire damage
Foliage – off color, flagging or loss
Hazard beam
History of limb failure(s) on tree
Included bark
Insect activity such as frass from termites, bark beetles or carpenter ants
Lightning damage
Live crown ration below 30%
Mistletoe – dwarf or broad-leaf
Nesting holes – birds, mammals, insects
Past poor pruning practices
Roots injured, exposed, undermined, or uplifted
Seam
Species failure patterns

Hazard Tree Attributes
Unnatural or structurally unsound canopy weight distribution
Weak, unsound branch attachments

Table 8-25: VM Site Attributes

Site Attributes
Areas known to be affected by introduced tree pathogens
Areas of recent clearing/new edge
Change in drainage
Change in grade
Construction – including trenching, paving or road construction
Cultural disturbance to landscape – natural or unnatural
Diseased center – dead tree in middle and dying trees around it
High stand density with single species composition
High winds (fire watch)
History of failure(s) at site
History of repeated outages on circuit
Fire damage
Recent thinning or logging
Slope (by grade or percentage)
Soils prone to slides
Specific conditions like high winds
Storm damage

Work Priority Levels:

Trees that have been identified are mitigated based on risk. VM-05, Vegetation Threat Procedure, describes the criteria for work priority determination:

- *Priority 1 Conditions*: Any observed tree, or parts thereof, that is failing or expected to imminently fail and contact electric facilities or any observed tree, or parts thereof, where it appears that contact has occurred with electric facilities.
    - *P1 Mitigation*: Clear the threat within 24 hours.
- *Priority 2 Conditions*: Any observed tree, or parts thereof, that is not a Priority 1 condition but is likely to fail and impact electric facilities prior to issuing a planned maintenance work order (failure may be expected within 6 months).
    - *P2 Mitigation*: Clear the threat within 30 days.

- *Priority 3 Conditions*: Any observed tree, or parts thereof, that is not a Priority 1 or Priority 2 condition but there is a probability of failure and contact with electric facilities within 2 years.
    - *P3 Mitigation*: Add to the tree inventory for creating and scheduling a planned maintenance work order. The threat shall be re-assessed or mitigated within 9 months.
- *Priority 4 Conditions*: Any observed tree, or parts thereof, that is not considered a Priority 1, Priority 2, or Priority 3 condition, is currently stable, may be in decline or defective, but is not expected to fail and contact electric facilities.

Figure 8-7: Liberty VM-05 Threats Procedure Field Guide Card

Priority 1 Conditions

Clear the threat within 24-hours

- Any observed tree, or parts thereof, that is failing or expected to imminently fail and contact electric facilities
- Any observed tree, or parts thereof, where it appears that contact has occurred with electric facilities

Priority 2 Conditions

Clear the threat within 30-days

- Any observed tree, or parts thereof, that is not a Priority 1 condition but is likely to fail and impact electric facilities prior to issuing a planned maintenance work order (failure may be expected within 6 months)

Priority 3 Conditions

Add to the tree inventory for creating and scheduling of a planned maintenance work order

The threat shall be re-assessed or mitigated within 9-months

- Any observed vegetation condition, resulting from tree growth, that is not a Priority 1 or Priority 2 condition but requires work prior to the next inspection (12 to 18-months) to maintain the RCD

Priority 4 Conditions

Add to the tree inventory for future monitoring

- Any observed tree, or parts thereof, that is not considered a Priority 1, Priority 2, or Priority 3 condition, is currently stable, may be in decline or defective, but is not expected to fail and contact electric facilities

Potential Tree or Limb Failures Liberty

Mitigation Actions: Remediation of the fall-in risk is dependent on the likelihood of failure (whole tree or partial tree failure) and site characteristics. The following are mitigation actions Liberty will take:

- *Complete tree removal*: Will eliminate the future risk of the tree and is usually reserved for when facility protect mitigation is not feasible.
- *Facility protect*: In some situations, complete tree removal may not be required to mitigate the risk the tree poses to electric facilities. If appropriate, and the fall-in risk is not caused or exacerbated by site conditions, portions of a tree can be pruned or removed to mitigate the risk.

- *Monitoring*: Assessed trees may be monitored when considered stable and not expected to pose a risk to electrical facilities but show signs of emerging hazard tree attributes or changing site conditions.

Liberty completed 203 miles of removal and remediation of trees with strike potential to electric lines and equipment out of its target of 171 miles of removal and remediation of trees with strike potential to electric lines and equipment in 2022.

Governing standards and electrical corporation standard operating procedures: G.O. 95, Rule 35; G.O. 95 Appendix E; PRC § 4293; CCR §§ 1250-1258; Vegetation Management Plan (VM-02); Hazard Tree Management Plan (VM-03); Vegetation Management Inspection Manual (VM-07).

Updates to the initiative: There are currently no anticipated updates to this initiative.

8.2.3.5 Substation Defensible Space

In this subsection, the electrical corporation must provide an overview of its actions taken to reduce ignition probability and wildfire consequence due to contact with substation equipment.

Tracking ID: WMP-VM-VFM-03

Overview of initiative: Liberty performs routine inspections, vegetation management, and other maintenance activities for 12 substations. Control methods include manual, mechanical, and chemical methods. Work occurs at regular intervals to maintain accessibility, safety, and adherence to all appropriate governmental regulations and Liberty policies. Herbicides, insecticides, and rodenticides are specified in and are to be applied as per the Pest Control Recommendations ("PCRs"), the Pest Control Advisor ("PCA") and pesticide container labels. The PCA will provide recommendations based on the ability to meet program objectives and minimize negative impacts to the community and environment.

A minimum of two site visits will occur per facility, per year. Herbicide applications and vegetation management activities will occur under the direction of the PCA. Additional cycle visits may be required for sites that do not receive herbicide applications.

- *Facility Interiors*: Substations are to be kept free of vegetation and debris by performing routing maintenance, which includes weed, vegetation, and debris removal prior to and in conjunction with herbicide treatments.
- *Facility Perimeters*: Routine maintenance includes weed and vegetation removal prior to and in conjunction with herbicide treatments. This includes a minimum five foot (5') wide clearance, measured horizontal, along the outside of the perimeter fence and a minimum height clearance of 10 feet above ground level along the outside of the perimeter fence.

Governing standards and electrical corporation standard operating procedures: G.O. 174; PRC § 4293; PRC § 4292; CCR §§ 1250-1258; Vegetation Management Plan (VM-02); Vegetation Management Inspection Manual (VM-07).

Updates to the initiative: There are currently no anticipated updates to this initiative.

8.2.3.6 High-Risk Species

In this subsection, the electrical corporation must provide an overview of its actions, such as trimming, removal, and replacement, taken to reduce the ignition probability and wildfire consequence attributable to high-risk species of vegetation.

Tracking ID: WMP-VM-VFM-07

Overview of initiative: Liberty's methodology of addressing high-risk species does not differ from that described in initiative 8.2.3.4, Fall-In Mitigation.

Liberty completed 223 miles of remediation of at-risk species out of its target of 238 miles of remediation of at-risk species in 2022.

Governing standards and electrical corporation standard operating procedures: G.O. 95, Rule 35; G.O. 95 Appendix E; PRC § 4293; CCR §§ 1250-1258; Vegetation Management Plan (VM-02); Hazard Tree Management Plan (VM-03); Vegetation Threats Procedure (VM-05); Vegetation Management Inspection Manual (VM-07).

Updates to the initiative: There are currently no anticipated updates to this initiative.

8.2.3.7 Fire-Resilient Rights-of-Way

In this subsection, the electrical corporation must provide an overview of its actions taken to promote vegetation communities that are sustainable, fire-resilient, and compatible with the use of the land as an electrical corporation right-of-way. It must also provide an overview of its actions to control vegetation that is incompatible with electrical equipment and with the use of the land as an electrical corporation right-of-way. This may include, but is not limited to, the following activities: the strategic use of herbicides, growth regulators, or other chemical controls; tree-replacement programs; promotion of native shrubs; prescribed fire; or fuel treatment activities not covered by another initiative.

Tracking ID: WMP-VM-VFM-04

Overview of initiative: Liberty continues to work with the National Forests on enhanced right-of-way maintenance projects, to target encroaching and hazardous trees and to preventatively remove incompatible tree species from the right-of-way. The enhanced maintenance projects reduce future maintenance entries, protect infrastructure, increase fire-resiliency and are the initial step of the integrated vegetation management ("IVM") program.

The Liberty IVM program continues to be developed with the intent of promoting a stable, low growing community of compatible shrub species. Liberty VM staff and contractors are trained to identify and collect data to document native and culturally significant shrub species.

Liberty launched its inaugural tree-replacement program in June 2022, with the intent of distributing native plant species, in conjunction with the Arbor Day Foundation and a local nursery. Approximately 700 shrubs were distributed as part of the program to give back to the community and send the "right tree, right place" message to landowners. Liberty completed 6.3 miles of its VM resiliency corridors program out of its target of 6 miles of its VM resiliency corridors program in 2022.

Governing standards and electrical corporation standard operating procedures: G.O. 174; PRC § 4293; PRC § 4292; CCR §§ 1250-1258; Vegetation Management Plan (VM-02); Vegetation Management Inspection Manual (VM-07).

Updates to the initiative: There are currently no anticipated updates to this initiative.

8.2.3.8 Emergency Response Vegetation Management

In this subsection, the electrical corporation must provide an overview of the following emergency response vegetation management activities:

- Activities based on weather conditions:
  - Planning and execution of vegetation management activities, such as trimming or removal, executed based on and in advance of a Red Flag Warning or other weather condition forecast that indicates an elevated fire threat in terms of ignition probability and wildfire potential.
- Post-fire service restoration:
  - Vegetation management activities during post-fire service restoration, including, but not limited to, activities or protocols that differentiate post-fire vegetation management from programs described in other WMP initiatives; supporting documentation for the tool and/or standard the electrical corporation uses to assess the risk presented by vegetation after a fire; and how the electrical corporation includes fire-specific damage attributes in its assessment tool/standard. The description of such activities must differentiate between those emergency actions initiated to restore power while active fire suppression is ongoing and actions that occur following active fire suppression during the

post-fire suppression repair and rehabilitation phases of fire protection operations.

Tracking ID: WMP-VM-VFM-08

Overview of initiative:

Activities based on weather conditions**:** Liberty regularly monitors weather forecasts during fire season in preparation for elevated fire risk or Red Flag Warnings. Liberty's line operations will conduct patrols in advance of fire weather to identify any immediate abnormal field conditions on impacted circuits. If vegetation threats are identified, they are reported immediately to the vegetation management department. In areas of the service territory that are under Red Flag Warning, or other predicted fire weather forecast, Liberty reviews recent vegetation inspection records and open work orders to determine if accelerated vegetation maintenance is required to reduce potential risk based on weather conditions

Post-fire restoration: Liberty will conduct high-risk, off-cycle, post event inspections consisting of Level 1 and Level 2 assessments per ANSI A300 Part 9 of fire damaged vegetation capable of striking electrical infrastructure (see Section 8.2.3.1 Fall-In Mitigation). The severity of fire-damage at the site and specific vegetation populations and trees are assessed.

Assessments that occur during active restoration of electrical infrastructure and ongoing fire suppression are conducted to identify and mitigate significantly damaged trees exhibiting 50% or more crown loss, severe trunk damage or scorching, and are an immediate or critical risk to restoration efforts or the repaired infrastructure.

Assessments that occur post fire suppression activities are conducted to assess the impact of wildland fire on site conditions and any vegetation capable of striking electrical infrastructure. Mitigation measures are selected after determining tree and site conditions. In some cases, ongoing evaluation of the site and vegetation conditions on future planned maintenance cycles is effective and helps informs wildland fire impacts on sites, vegetation populations, and specific species.

Governing standards and electrical corporation standard operating procedures: G.O. 95, Rule 35; G.O. 95 Appendix E; PRC § 4293; CCR §§ 1250-1258; Vegetation Management Plan (VM-02); Hazard Tree Management Plan (VM-03); Vegetation Threats Procedure (VM-05); Vegetation Management Inspection Manual (VM-07).

Updates to the initiative: There are currently no anticipated updates to this initiative.

8.2.4 Vegetation Management Enterprise System

In this section, the electrical corporation must provide an overview of inputs to, operation of, and support for a centralized vegetation management enterprise system updated based upon inspection results and management activities such as trimming and removal of vegetation. This overview must include discussion of:

- The electrical corporation’s vegetation inventory and condition database(s).
- Describe the electrical corporation’s internal documentation of its database(s).
- Integration with systems in other lines of business.
- Integration with the auditing system(s) (see Section 8.2.5, “Quality Assurance and Quality Control”).
- Describe internal procedures for updating the enterprise system including database(s) and any planned updates.
- Any changes to the initiative since the last WMP submission and a brief explanation as to why those changes were made. Include any planned improvements or updates to the initiative and the timeline for implementation.

Description of Liberty Databases: Liberty utilizes a third-party data collection and work management software program for vegetation inspections and maintenance. Liberty integrates inspection and maintenance activities documented on the work management system with other program managements processes and tools. Liberty integrates tree inventories and asset information derived from LiDAR inspections and enterprise GIS data into the software to inform vegetation inspections and maintenance activities.

The main function of the primary data collection and work management software is to document tree work inventories, notifications, assign work orders to vegetation management crews, and document completion of the work. Liberty relies on geospatial data to integrate vegetation management data into other software and utilizes map-based work management programs.

Table 8-26. Location Data Collection Attributes

Location Form		
Attributes Used	**Selection List**	**Status**
Physical Address	N/A	On (Required)
Physical City	N/A	On (Required)
Physical State	N/A	On (Required)
Ownership Type	Ownership Type	On (Required)
APN	N/A	On (Required)
HFTD	High Fire Threat District	On (Required)
Customer Name	N/A	On
Phone Number	N/A	On
Email Address	N/A	On
Mailing Address	N/A	On
Mailing City	N/A	On
Mailing State	Mailing State	On
Mailing Zip Code	N/A	On
Refusal	Refusal	On (Toggle, Determines Color)
Location Comments	N/A	On
Latitude	N/A	On
Longitude	N/A	On
ID	N/A	On (Cannot Remove)
Created By	N/A	On (Cannot Remove)
Date Created	N/A	On (Cannot Remove)
WorkGroup	N/A	On (Cannot Remove)
Year	N/A	On (Required, Cannot Remove)
Category	N/A	Off
Photos	N/A	Off
Section	N/A	Off
Shape	N/A	Off
Item	N/A	Off

Table 8-27. Vegetation Data Collection Attributes

Tree Form		
Attributes Used	**Selection List**	**Status**
Locations	N/A	On (Association Linked, Required)
Tree ID	N/A	On
Species	Species	On
Quantity	N/A	On (Required)
DBH	N/A	On
Height	N/A	On
Tree Health	Tree Health	On
Defect Type	Tree Defect	On
ROW Position	ROW Position	On
MWS	N/A	On (Toggle)
SEZ	N/A	On (Toggle)
Latitude	N/A	On
Longitude	N/A	On
Photos	N/A	On
ID	N/A	On (Cannot Remove)
Created By	N/A	On (Cannot Remove)
Date Created	N/A	On (Cannot Remove)
WorkGroup	N/A	On (Cannot Remove)
Year	N/A	On (Required, Cannot Remove)
Item	N/A	Off
Category	N/A	Off
Comments	N/A	Off
Quantity	N/A	Off
Section	N/A	Off
Status	N/A	Off

Table 8-28. Work Order Data Collection Attributes

Work Order Form		
Attributes Used	**Selection List**	**Status**
Tree	N/A	On (Association Linked, Required)
Work Status	Status	On (Required, Determines Color)
Inspection Type	Inspection Type	On (Required)
Project Type	Project Type	On (Required)
District	District	On (Required)
Line Type	Line Type	On (Required)
Circuit	Circuit	On (Required)
Section	Section	On (Required)
Span ID	N/A	On (Required)
Pole Number	N/A	On (Required)
Priority Level	Priority Level	On (Required)
Vegetation Threat	Vegetation Threat	On (Required)
Work Type	Work Type	On (Required)
Cleanup Method	Cleanup Method	On (Required)
1st. Contact Attempt	Contact Attempt	On (Required)
1st. Contact Attempt Date	N/A	On (Required)
2nd. Contact Attempt	Contact Attempt	On
2nd. Contact Attempt Date	N/A	On
Contact Attempt Comments	N/A	On
Special Considerations	N/A	On (Toggle)
24 Hours Notice Requested	N/A	On (Toggle)
Roadside	N/A	On (Toggle)
TRPA Tree	N/A	On (Toggle)
TRPA Authorized	N/A	On
TWNF Received	N/A	On
Work Order Comments	N/A	On
Assigned WorkGroup	N/A	On
Assigned Crew	N/A	On
Photos	N/A	On
ID	N/A	On (Cannot Remove)
Created By	N/A	On (Cannot Remove)
Date Created	N/A	On (Cannot Remove)
WorkGroup	N/A	On (Cannot Remove)
Year	N/A	On (Required, Cannot Remove)
Category	N/A	Off
Quantity	N/A	Off
Section	N/A	Off
Signature1	N/A	Off
Item	N/A	Off
Job Number	N/A	Off
Latitude	N/A	Off
Longitude	N/A	Off

Liberty also utilizes supplemental third-party inventory management software to analyze and review LiDAR acquisition data, inventory clearance-exempt trees, emergency response, and vegetation caused outage investigations.

Internal Documentation of Databases: Liberty exports vegetation management inspection data and work orders from its software quarterly for regulatory reporting. This data is saved on Liberty's internal server access database and Liberty's GIS system.

Integration with Systems in Other Lines of Business: Asset and span data derived from Liberty's annual LiDAR inspections of vegetation is integrated with Liberty's GIS to update changes made to Liberty's electrical system as needed. Vegetation density along circuits and other attributes found from LiDAR inspections are analyzed in combination with Reax data and HFTD regions to identify areas of the electrical system that are the highest risk.

Liberty integrates tree and work order inventory data with a third-party program management tracking system to oversee schedules, project status, workloads, identify project owners, and overall vegetation management annual workplan implementation and completion.

Figure 8-8: VM Project Management Tracking Systems

Liberty

File Automation Forms

2023 Inspection Plan

Grid View Filter Off

	Division	Circuit	Section	Line Miles	Inspection Type	Inspection Status	Miles Inspected	Percent Complete	Planned Inspection Start Date	Actual Inspection Start Date	Planned Inspection Complete Date	Actual Inspection Complete Date	Actual Quarter Inspection Completed	Inspection Completed	Total Project Units	Agency Permitting Required
1	SLT	160 Line	1	0.54	Detailed	Complete	0.54	100%	01/09/23	01/11/23	01/13/23	01/17/23	Q1	☑	11	CTC
2	SLT	634 Line	1	0.48	Detailed	Complete	0.48	100%	01/09/23	01/11/23	01/13/23	01/17/23	Q1	☑	0	N/A
3	SLT	Stateline 2200	1	0.31	Detailed	Complete	0.31	100%	01/09/23	01/10/23	01/13/23	01/11/23	Q1	☑	0	N/A
4	NLT	Hobart 7700	1	4.65	Detailed	Complete	4.65	100%	01/09/23	01/10/23	01/20/23	01/25/23	Q1	☑	21	USFS
5	NLT	Tahoe City 5201	1	2.34	Patrol	Complete	2.34	100%	01/09/23	01/10/23	02/10/23	01/23/23	Q1	☑	24	TRPA
6	NLT	Tahoe City 5201	2	3.18	Patrol	Complete	3.18	100%	01/09/23	01/10/23	02/10/23	01/13/23	Q1	☑	5	CTC TRPA
7	NLT	Tahoe City 5201	3	3.08	Patrol	Complete	3.08	100%	01/09/23	01/10/23	02/10/23	01/20/23	Q1	☑	16	CTC
8	SLT	Stateline 2300	1	2.9	Detailed	Complete	2.9	100%	01/16/23	01/11/23	02/10/23	01/27/23	Q1	☑	66	TRPA
9	NLT	Tahoe City 5201	4	6.68	Patrol	Complete	6.68	100%	01/09/23	01/10/23	02/17/23	01/18/23	Q1	☑	3	TRPA
10	NLT	Kings Beach 5200	1	4.82	Detailed	Complete	4.82	100%	01/16/23	01/20/23	02/17/23	02/03/23	Q1	☑	79	CTC USFS TRPA
11	SLT	Meyers 3400	1	15.97	Patrol	Active	7.69	48%	01/09/23	01/13/23	02/24/23			☐	24	CTC TRPA
12	NLT	Kings Beach 4202	1	9.24	Detailed	Active	4.35	47%	01/23/23	01/13/23	03/03/23			☐	34	USFS TRPA
13	SLT	Meyers 3400	5	3.6	Patrol	Active	1.99	55%	02/13/23	01/24/23	03/10/23			☐	20	State Park TRPA
14	SLT	Stateline 3501	1	2.39	Detailed	Active	2.3	96%	02/13/23	02/02/23	03/10/23			☐		
15	NLT	Tahoe City 5201	5	5.99	Patrol	Complete	5.99	100%	02/13/23	01/13/23	03/17/23	01/25/23	Q1	☑	44	CTC USFS TRPA
16	NLT	Kings Beach 5200	2	5.86	Detailed	Planned		0%	02/20/23		03/17/23			☐		
17	SLT	Meyers 3400	2	11.34	Patrol	Active	5.63	50%	02/13/23	01/23/23	03/24/23			☐	29	CTC USFS
18	SLT	Stateline 3501	2	4.25	Detailed	Planned		0%	02/27/23		03/24/23			☐		
19	SLT	Meyers 3400	3	8.64	Patrol	Active	7.38	85%	02/20/23	01/24/23	04/07/23			☐	29	USFS TRPA
20	SLT	Stateline 3501	3	3.46	Detailed	Planned		0%	03/13/23		04/14/23			☐		
21	NLT	Glenshire 7400	1	8.42	Detailed	Planned		0%	03/06/23		04/21/23			☐		
22	NLT	629 Line	1	5.19	Patrol	Planned		0%	03/13/23		04/21/23			☑		
23	NLT	Kings Beach 5200	3	7.67	Detailed	Planned		0%	03/20/23		04/21/23			☐		
24	NLT	609 Line	1	9.97	Patrol	Planned		0%	03/20/23		04/28/23			☐		
25	SLT	Stateline 3501	4	3.7	Detailed	Planned		0%	03/27/23		04/28/23			☐		
26	NLT	Tahoe City 7100	3	4.02	Detailed	Planned		0%	04/17/23		05/19/23			☐		
27	NLT	Kings Beach 5200	4	4.85	Detailed	Planned		0%	04/24/23		05/19/23			☐		
28	NLT	Glenshire 7400	2	4.01	Detailed	Planned		0%	04/24/23		05/26/23			☐		
29	NLT	Glenshire 7600	1	5.24	Detailed	Planned		0%	05/01/23		06/09/23			☐		
30	NLT	Squaw Valley 7201	3	1.9	Detailed	Planned		0%	05/22/23		06/09/23			☐		

Liberty

File Automation Forms

2023 Maintenance Plan

Grid View Filter Off

	Division	Circuit	Section	Line Miles	Project Type	Project Status	Total Project Units	Units Completed	Units Incomplete	Percent Complete	Planned Quarter	Tree Work Start Date	Tree Work Complete Date	Tree Work Comple...	Actual Quarter Completed	Notes
1	NLT	Tahoe City 7300	6	13.51	Patrol	Active	354	217	137	61%	Q1			☐		
2	SLT	160 Line	1	0.54	Detailed	Planned	11		11	0%	Q1			☐		CTC Submitted
3	NLT	Hobart 7700	1	4.65	Detailed	Planned	21		21	0%	Q1			☐		10 Capital Units not inc
4	NLT	Kings Beach 4202	1	9.24	Detailed	Planned	25			0%	Q1			☐		
5	SLT	Meyers 3400	1	15.97	Patrol	Planned	16		16	0%	Q1			☐		
6	NLT	Prosser Tap	1	0.095	Detailed	Planned	4		4	0%	Q1			☐		
7	SLT	Stateline 2200	1	0.31	Detailed	Complete	0		0	0%	Q1			☑		
8	SLT	Stateline 2300	1	2.9	Detailed	Planned	66		66	0%	Q1			☐		5 TRPA Trees- Needs t
9	NLT	Tahoe City 5201	1	2.34	Patrol	Planned	24		24	0%	Q1			☐		
10	NLT	Tahoe City 5201	2	3.18	Patrol	Planned	5		5	0%	Q1			☐		
11	NLT	Tahoe City 5201	3	3.08	Patrol	Planned	16		16	0%	Q1			☐		
12	NLT	Tahoe City 5201	4	6.68	Patrol	Planned	3		3	0%	Q1			☐		
13	NLT	Tahoe City 5201	5	5.99	Patrol	Planned	44		44	0%	Q1			☐		
14	NLT	Tahoe City 7300	7	5.49	Patrol	Planned	166		166	0%	Q1			☐		
15	SLT	634 Line	1	0.48	Detailed	Planned	0		0	0%	Q1			☐		
16	NLT	Glenshire 7400	1	8.42	Detailed					0%	Q2			☐		
17	NLT	Glenshire 7400	2	4.08	Detailed					0%	Q2			☐		
18	NLT	Kings Beach 5200	1	4.82	Detailed	Planned	79		79	0%	Q2			☐		
19	NLT	Kings Beach 5200	2	5.86	Detailed					0%	Q2			☐		
20	NLT	Kings Beach 5200	3	7.67	Detailed					0%	Q2			☐		
21	NLT	Kings Beach 5200	4	4.85	Detailed					0%	Q2			☐		
22	SLT	Meyers 3400	2	11.34	Patrol					0%	Q2			☐		
23	SLT	Meyers 3400	3	8.64	Patrol					0%	Q2			☐		
24	SLT	Stateline 3501	1	2.39	Detailed					0%	Q2			☐		
25	SLT	Stateline 3501	2	4.25	Detailed					0%	Q2			☐		
26	SLT	Stateline 3501	3	3.46	Detailed					0%	Q2			☐		
27	SLT	Stateline 3501	4	3.7	Detailed					0%	Q2			☐		
28	NLT	Tahoe City 7100	1	1.91	Detailed					0%	Q2			☐		
29	NLT	Tahoe City 7100	2	5.7	Detailed					0%	Q2			☐		
30	NLT	Tahoe City 7100	3	4.02	Detailed					0%	Q2			☐		

<u>Integration with Auditing Systems (QA/QC)</u>: Liberty provides exports of vegetation inspections and completed work to the qualified vendor to conduct QC reviews of the work. The QC vendor incorporates inspection and completed work data into a separate third-party database to perform and document their QC reviews.

Procedures for Updating the Enterprise System and Databases: Liberty periodically reviews data collection attributes for conformance with regulatory requirements and best management practices. Updates and reconfigurations to the work management software are based on evolving needs of the industry and feedback from key users of the software.

Changes to the Initiative Since Last WMP Submission: Upon completion of the 2022 workplan, Liberty made minor adjustments to vegetation inspection, and work order attributes to align with guidelines set forth by OEIS and to maintain consistency with external stakeholders. Liberty also identified efficiencies for end users of the software and implemented procedures to document specific tasks within the work order (tree work and cleanup) and work order close out. Liberty does not anticipate any changes to the initiative but will continue to evaluate the feasibility and effectiveness of alternative systems to manage workloads, tree inventories, and program data.

8.2.5 Quality Assurance and Quality Control

In this section, the electrical corporation must provide an outline of its quality assurance and quality control (QA/QC) activities for vegetation management. This overview must include:

- Reference to procedures documenting QA/QC activities.
- How the sample sizes are determined and how the electrical corporation ensures the samples are representative.
- Who performs QA/QC (internal or external, is there a dedicated team, etc.).
- Qualifications of the auditors.
- Documentation of findings and how the lessons learned from those findings are incorporated into trainings and/or procedures.
- Any changes to the procedures since the last WMP submission and a brief explanation as to why those changes were made. Include any planned improvements or updates to the initiative and the timeline for implementation.
- Tabular information:
    - Sample sizes
    - Type of QA/QC performed (*e.g.*, desktop or field)
    - Resulting pass rates, starting in 2022
    - Yearly target pass rate for the 2023-2025 Base WMP cycle

Tracking ID: WMP-VM-QAQC-01

Overview of Initiative: Liberty's QA/QC Program is applicable to both vegetation inspections and vegetation management work conducted on private, federal, and agency land. The QA/QC Program provides VM program oversight to provide reasonable assurance that vegetation inspection and maintenance work is being effectively performed.

The QA/QC Program is aligned with Liberty's Post Work Verification Procedure (VM-04), which outlines strategies for performing quality control inspections on the yearly workload. This is completed through statistical sampling and appropriate sample sizes to gauge acceptable quality levels ("AQL") and conformance levels ("CL") based on the selected margin of error ("MoE"). The procedure includes personnel qualification requirements, sampling methodology, sample size by priority, process assessment ("QA"), results evaluation ("QC"), description of post work verification (*i.e.*, desktop review, field review), and types of QC inspections (*i.e.*, pre-inspections, tree pruning and removal, hazard trees, pole brushing, reporting accuracy, inventory reconciliation).

Liberty provides information regarding its VM QA/QC Program sample size and units in Table 8-29.

Table 8-29. Liberty Vegetation Management QA/QC Program Sample Size and Units

Work Type	**Category**	**Annual Circuit Miles**	**Annual Hazard Miles**	**Annual Poles**	**Statistical Sampling**		
					CL/MoE	**%**	**Units**
Completed Tree Work	Transmission and Distribution	707	Miles N/A	Poles N/A	99/7	32%	229 Miles
Detailed Pre-Inspection	Transmission and Distribution	236	Miles N/A	Poles N/A	Does not apply	33%	77 Miles
Hazard Tree Work[80]	Transmission and Distribution	Miles N/A	2,500	Poles N/A	99/5	21%	524 Trees
Pole Brushing	Transmission and Distribution	Miles N/A	Miles N/A	4,960	99/5	12%	585 Poles

80 Estimate only. Hazard Tree Work can vary significantly each year depending on various field conditions.

<u>Sample Size Determination</u>: Liberty uses industry accepted protocols/calculations to determine statistically valid sample sizes of work types that are to be reviewed. Figure 8-9 shows an example of how the statistically valid sample sizes are determined:

Figure 8-9: Sample Size Calculation Example

Sample Size Calculation Example

Common Confidence Levels:

CL	Z-Score
99%	2.576
95%	1.96
90%	1.645

Standard Deviation (Std Dev): 50% *Remains Constant*

Margin of Error (MoE): 5% *Can Vary 1-10%*

Population Size: 2,500

Sample - Underlying Calculations:

$$\text{Sample Size} = \frac{[\text{Z-Score}^2 \times \text{Standard Deviation} \times (1 - \text{Standard Deviation}) / \text{Margin of Error}^2]}{[(\text{Z-Score2} \times \text{Standard Deviation} \times (1 - \text{Standard Deviation}) / \text{Margin of Error2} \times \text{Population Size})) + 1]}$$

$$\text{Sample Size} = [2.576^2 \times 0.5 \times (1 - 0.5) / 0.05^2] / [(2.576^2 \times 0.5 \times (1 - 0.5) / 0.05^2 \times 2500)) + 1]$$

$$\text{Sample Size} = 663.578 / 1.2654$$

Sample Size = $\boxed{524}$

<u>QA/QC Process Implementation</u>: Liberty employs both internal and external processes as part of its overall QA/QC strategy:

- *Internal*: A post work documentation review, or desktop review, is performed by Liberty to assess if all required information has been submitted by the vendor. This review is also used to determine if the invoices are accurate. This review is completed on 100% of submitted invoices. Liberty also conducts a post work validation review, or field review, to assess adherence to work specifications, industry standards, and regulatory requirements.
- *External*: QC inspections are performed by qualified vendors. These QC inspections include work that has been completed in the following categories:
  - Tree Pruning and Removal
  - Detailed Inspections
  - Hazard Tree Work
  - Pole Clearing

<u>Qualifications</u>: Contract employees shall hold a valid certificate from the International Society of Arboriculture ("ISA") as a Certified Arborist with a minimum of three years of experience in

utility arboriculture. Additional credentials such as ISA Certified Utility Specialist and Tree Risk Assessment Qualification are preferred.

<u>QA/QC Program Results, Documentation of Findings and How the Lessons Learned from Those Findings are Incorporated Into Trainings and/or Procedures</u>: Liberty conducts post work verification and reviews third-party QC inspection results as part of its Post Work Verification Procedure, VM-04. QC inspections are performed by the qualified vendor using a third-party data collection software (see Section 8.2.4: Vegetation Management Enterprise System). Errors identified during QA/QC review are communicated to the contractor as needed. Inadequate work is remediated and objective evidence to support remediation is provided to Liberty VM personnel.

Work found not performed to specifications are provided to Liberty Vegetation Management to determine if rework is required by the contractor. Once it has been reworked by the contractor, it should be verified by QC contractor as requested by Liberty. All exports and reports of QC findings, correspondence to contractors, and work verification are archived and retained in Liberty's internal server access database.

Liberty routinely conducts regular meetings with its vegetation contractors through the course of project implementation. Any identified work deficiencies are discussed or reviewed and plans to correct the findings are identified. If unsatisfactory work reported to VM contractors after review fails to yield satisfactory performance, additional controls may be added to correct performance deficiencies.

Liberty provides the results of its VM QA/QC Program in Table 8-30.

Table 8-30: Liberty VM QA/QC Program Results

Activity Being Reviewed	Sample Size	Category	Type of Review	Review (Pass %) Results 2022	Yearly Target Pass % Rate for 2023-2025
Detailed Inspections	77 Circuit Miles	Location Description	Field	99.45%	99%
		Species ID	Field	98.90%	98%
		Work Type	Field	99.78%	98%
		Clean-up Prescription	Field	99.83%	99%
		MCD Prescription	Field	99.06%	99%
Completed Tree Work (Includes	229 Circuit miles	MCD Achieved	Field	92.21%	98%
		Work Performed	Field	96.16%	99%
		18-Month Clearance Hold	Field	98.79%	99%

Activity Being Reviewed	Sample Size	Category	Type of Review	Review (Pass %) Results 2022	Yearly Target Pass % Rate for 2023-2025
Hazard Tree Work)		Potential Hazard	Field	99.75%	99%
		Site Clean-up	Field	96.13%	97%
		ANSI Standard	Field	99.00%	99%
		Other Trees Impacted	Field	99.64%	99%
		Site Conditions Post-Work	Field	99.72%	99%
Pole Brushing (Clearing)	585 Poles	Location Description	Field	91.17%	99%
		Non-Exempt Pole	Field	97.47%	98%
		Pole Tag Correct	Field	87.47%	97%
		10-Foot Radial Clearance	Field	72.43%	99%
		No Fuel Remains in Cylinder	Field	78.73%	99%
		0-8' Vertical Clearance	Field	85.31%	98%
		Above 8' Clearance	Field	98.63%	99%
		ANSI Standard	Field	98.26%	99%
		Site Clean-up	Field	92.26%	97%

Liberty completed 271.7 miles of QA/QC for its VM inspections out of its target of 221 miles in 2022.

Updates to Initiative: There are currently no anticipated updates to this initiative.

8.2.6 Open Work Orders

In this section, the electrical corporation must provide an overview of the procedures it uses to manage its open work orders resulting from vegetation management inspections that prescribe vegetation management activities. This overview must include a brief narrative that provides:

- Reference to procedures documenting the work order process.
- A description of how work orders are prioritized based on risk.
- A description of the plan for eliminating work order backlogs (*i.e.*, open work orders that have passed remediation deadlines), if applicable.
- A discussion of trends with respect to open work orders.

In addition, each electrical corporation must:

- Graph open work orders over time as reported in the QDRs (Table 2, metrics 7.a and 7.b).
- Provide an aging report for work orders past due.

Procedures documenting work order process: Liberty implements several plans and procedures that provide guidance for action thresholds for creation and completion of work orders for vegetation management work: VM-02 Vegetation Management Plan, VM-03 Hazard Tree Management Plan, VM-05 Vegetation Threats Procedure, and VM-07 Inspection Manual.

How work orders are prioritized based on risk: During inspections, trees and vegetation identified as requiring work for the current maintenance cycle are assigned a work order with a priority condition based on the observed field conditions at time of inspection. VM-05, Vegetation Threat Procedure, describes the criteria for assigned work order priority and mitigation timelines:

Potential Tree or Limb Failures

- *Priority 1 Conditions*: Any observed tree, or parts thereof, that is failing or expected to imminently fail and contact electric facilities or any observed tree, or parts thereof, where it appears that contact has occurred with electric facilities.
    - *P1 Mitigation*: Clear the threat within 24 hours.
- *Priority 2 Conditions*: Any observed tree, or parts thereof, that is not a Priority 1 condition but is likely to fail and impact electric facilities prior to issuing a planned maintenance work order (failure may be expected within 6 months).
    - *P2 Mitigation*: Clear the threat within 30 days.
- *Priority 3 Conditions*: Any observed tree, or parts thereof, that is not a Priority 1 or Priority 2 condition but there is a probability of failure and contact with electric facilities within two years.
    - *P3 Mitigation*: Add to the tree inventory for creating and scheduling a planned maintenance work order. The threat shall be re-assessed or mitigated within nine months.
- *Priority 4 Conditions*: Any observed tree, or parts thereof, that is not considered a Priority 1, Priority 2, or Priority 3 condition, is currently stable, may be in decline or defective, but is not expected to fail and contact electric facilities.

Potential Tree Growth Encroachments

- *Priority 1 Conditions*: Any observed vegetation condition, resulting from tree growth or tree sway, where it appears that contact has occurred with electrical facilities.
    - *P1 Mitigation*: Clear to the MCD within 24 hours.
- *Priority 2 Conditions*: Any observed vegetation condition, resulting from tree growth, that is not a Priority 1 but is within the Regulation Clearance Distance
    - *P2 Mitigation*: Clear to the MCD within 30 days.
- *Priority 3 Conditions*: Any observed vegetation condition, resulting from tree growth, that is not a Priority 1 or Priority 2 condition but requires work prior to the next inspection (12 to 18-months) to maintain the Regulation Clearance Distance
    - *P3 Mitigation*: Clear to the MCD no later than nine-months from initial inspection

Plan for eliminating work order backlogs: Liberty adheres to the mitigation timelines it has identified for completing vegetation work orders. Liberty develops an annual vegetation work plan and intends to complete all applicable work orders for the current maintenance cycle and work plan.

Throughout any given inspection and maintenance cycle there may be work requirements that are outside of the normal scope or standard operating procedures (outage requests, engineering requests, specialized equipment procurement, coordination with landowners, permitting, refusal resolution, emergency work, etc.) that are needed to be able to complete the work order. These are usually the cause of work orders remaining open past Liberty’s identified timeframes for completing the work.

Liberty attempts to identify all these work requirements beyond normal procedures as early as possible to begin coordination and scheduling of the vegetation work. Work orders requiring specialized work circumstances are review by internal Liberty VM employees to authorize or determine the necessary steps to complete the work order. In some circumstances Liberty may ‘no work’ the work order, defer maintenance or retain and monitor certain trees depending on their condition, site characteristics, and the special circumstances needed to complete the work order.

Although there are several reasons why the specific timeline for remediation cannot be met, under no circumstances will Liberty leave a hazardous vegetation condition unmanaged.

Trends of open work orders: The amount of open VM work orders is in constant flux as vegetation management activities take place through the calendar year. New work is constantly being identified as planned and unplanned inspections occur while the backlog of identified work is completed. Typically, there will be a higher volume of open work orders during the current maintenance plan year and quarter. This is due to ongoing inspections, notifications, and scheduling ahead of the maintenance work. In general, maintenance work is more time consuming, and it is commonplace to have a backlog of work orders in que for tree crews to maintain an efficient and steady work pace of maintenance cycle schedules.

As the maintenance schedule moves forward and work is completed there are fewer workorders from the previous quarter of the calendar year that are left in an open status. Simultaneously, new work is being identified and work orders created to be completed within the mitigation timelines.

Liberty provides a graph of its open work orders over time in Figure 8-10 and a table of its open work orders categorized by age Table 8-31.

Figure 8-10: Liberty Open Work Orders over Time

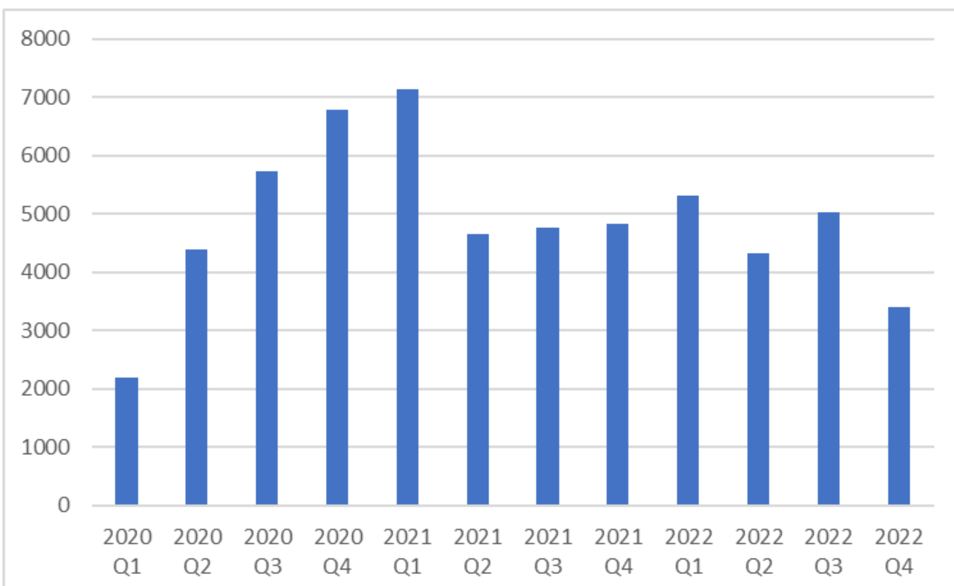


Table 8-31: VM Work Orders Beyond Liberty Mitigation Timelines, as of May 5, 2023

HTFD Area	0-30 Days	31-90 Days	91-180 Days	181+ Days
Non-HFTD	0	0	1	0
HFTD Tier 2	14	12	8	0
HFTD Tier 3	0	26	0	0

8.2.7 Workforce Planning

In this section, the electrical corporation must provide a brief overview of its recruiting practices for vegetation management personnel. It must also provide its worker qualifications and training practices for workers in the following target roles:

- Vegetation inspections
- Vegetation management projects

For each of the target roles listed above, the electrical corporation must:

- List all worker titles relevant to the target role.
- List and explain minimum qualifications for each worker title with an emphasis on qualifications relevant to vegetation management. Note if the job requirements include the following:
    - Special certification requirements, such as being an International Society of Arboriculture Certified Arborist with specialty certification as a Utility Specialist or a California-licensed Registered Professional Forester
    - Additional training on biological resources identification and protection (*e.g.*, plant and animal species and habitats); and cultural prehistoric and historic resources identification and protection
- Report the percentage of electrical corporation and contractor full-time equivalents (FTEs) in target roles with specific job titles
- Report plans to improve qualifications of workers relevant to vegetation management. The electrical corporation must explain how it is developing more robust outreach and onboarding training programs for new electric workers to identify hazards that could ignite wildfires

Overview: Liberty requires employees within the VM Department to hold professional credentials and to complete ongoing training necessary to maintain applicable certifications. Being a Certified Arborist by the International Society of Arboriculture ("ISA") with three years of relevant experience is the minimum requirement to be employed by Liberty as a System Arborist. Additional training and credentials beyond the minimum are encouraged to further the professional development of employees and to provide a well-trained, motivated workforce.

Liberty's internal vegetation management personnel provide monitoring, oversight, and evaluation of vegetation inspections and maintenance projects. Liberty VM staff operate in high-level program and project management roles to implement the vegetation management program. Liberty's VM employees are mentors and provide continued leadership to vegetation management contractors to bring alignment with the overall goals and objectives of the program.

Liberty has been proactive in acquiring and developing trained internal VM staff and has used historical data to assess the number of Liberty employees necessary to implement the VM program. Liberty increased internal VM staffing in 2022 based on the results of its workforce assessment in 2021. Liberty was successful in recruiting qualified personnel for the positions added to the department. Liberty employs a very qualified workforce with a high concentration of advanced credentials (Table 8-32).

Table 8-32: Liberty VM Credentials or Certifications

Applicable Credential or Certification	**Liberty Arborists with Credential**	
ISA Certified Arborist	6	100%
ISA Tree Risk Assessment Qualification	4	66%
ISA Certified Arborist Utility Specialist	3	50%
ISA Board Certified Master Arborist	1	16%
Registered Professional Forester	1	16%
Utility Vegetation Management Professional Certificate	1 *(2 employees currently in progress)*	16%

To help expand the available vegetation management professionals, Liberty supports the development of utility vegetation management training such as that offered by the University of Wisconsin, Stevens Point. This is a two-year UVM Professional Development Certificate Program aimed at increasing the personnel available to staff utility VM programs and perform vegetation management inspection work. Currently, Liberty employs one UVM Professional Certificate holder and two employees who are currently enrolled in the program. Liberty also supports the five-week tree worker training program at Butte College in Oroville, California, which is intended to develop and support individuals looking to make a transition to the utility tree worker industry.

Liberty's contract specifications describe minimum requirements for contract personnel. Liberty reviews contract personnel qualifications to remain in compliance with the stated requirements and works with vendors to assign personnel to appropriate tasks. This process is applied consistently throughout the Liberty service territory.

Liberty continually seeks opportunities to host field trainings, benchmarking, and tailboards on utility arboriculture topics among VM groups to align on industry practices and obtain continuing education units ("CEU") to keep professional certifications in good standing. Depending on the subject and learning objectives, training will be developed by a combination of Liberty's highly qualified utility arborists and consultants who are subject matter experts in specific fields within utility vegetation management. Specific opportunities include both standard and specialized learning opportunities including:

- Electrical hazard awareness training
- Internal and external peer-to-peer training and knowledge sharing
- Liberty-specific plant identification training for IVM program development
- Industry standards and best practices training for utility VM operations
- Communication training

<u>Vegetation inspections worker qualifications</u>: Minimum qualifications for worker titles listed in Table 8-20 establish personnel that are proficient in providing vegetation inspections on Liberty's system. Personnel performing vegetation inspections on Liberty's system must demonstrate the required level of competence, gained through technical training, work experience, and professional credentials, set in place by minimum qualifications for each worker title. Liberty's VM inspection contractors employ their own training programs to provide Liberty with a qualified workforce for its system. The specific skills, training and certificates exhibited by these workers include understanding of regulatory requirements, program policies and procedures, tree identification, knowledge of specific species characteristics and susceptibilities, hazard tree assessments, understanding various types of vegetation threats to

electrical equipment, electrical knowledge, fire safety procedures, industry standards and best management practices, and industry safety standards.

Vegetation Management projects worker qualifications: Minimum qualifications for worker titles listed in Table 8-33 verify that personnel are proficient in providing the work required for vegetation management projects along Liberty's system. Personnel performing tree work for vegetation management projects must demonstrate the required level of competence, gained through technical training and work experience, set in place by minimum qualifications for each worker title. Liberty's line-clearance tree contractors employ their own training programs to meet minimum qualifications of qualified workforce for Liberty's system. The specific skills, training and certificates exhibited by these workers include understanding of regulatory requirements, program policies and procedures, tree identification, knowledge of specific species characteristics and susceptibilities, hazard tree assessments, understanding various types of vegetation threats to electrical equipment, electrical knowledge, fire safety procedures, industry standards and best management practices, and industry safety standards.

Liberty provides its VM workforce qualifications and training in Table 8-33.

Table 8-33. Liberty Vegetation Management Workforce Qualifications and Training

Worker Title	Minimum Qualifications for Target Role	Special Certification Requirements	Electrical Corporation % FTE Min Quals	Electrical Corporation % Special Certifications	Contractor % FTE Min Quals	Contractor % Special Certifications	Reference to Electrical Corporation Training/Qualification Programs
System Arborist (Liberty)	Four years' experience in utility arboriculture	ISA Certified Arborist or Registered Professional Foresters (RPF) License	100%	100%	0%	0%	No formal training program required for this position
Supervisor, Utility Forester (Contractor)	Three years' experience in utility arboriculture	ISA Certified Arborist or Registered Professional Foresters License	0%	0%	100%	100%	No formal training program required for this position
Utility Forester I (Contractor)	Less than one year experience in utility arboriculture	None	0%	0%	100%	0%	No formal training program required for this position
Utility Forester II (Contractor)	One year experience in utility arboriculture	None	0%	0%	100%	0%	No formal training program required for this position
Utility Forester III (Contractor)	Two years' experience in utility arboricultural	ISA Certified Arborist or Registered Professional Foresters (RPF) License	0%	0%	100%	100%	No formal training program required for this position
Utility Forester IV (Contractor)	Three years' experience in utility arboriculture	ISA Certified Arborist or Registered Professional Foresters (RPF) License	0%	0%	100%	50%	No formal training program required for this position
Utility Forester V (Contractor)	Five years' experience in utility arboriculture	ISA Certified Arborist, ISA Certified Utility Specialist or Registered Professional Foresters (RPF) License	0%	0%	100%	100%	No formal training program required for this position

Worker Title	Minimum Qualifications for Target Role	Special Certification Requirements	Electrical Corporation % FTE Min Quals	Electrical Corporation % Special Certifications	Contractor % FTE Min Quals	Contractor % Special Certifications	Reference to Electrical Corporation Training/Qualification Programs
General Foreperson (Contractor)	Two years' experience as a Foreperson Two years' prior experience as Journeyman Tree Worker	None	0%	0%	100%	0%	No formal training program required for this position
Foreperson (Contractor)	One year experience as Journeyman Tree Worker	None	0%	0%	100%	0%	No formal training program required for this position
Journeyman Tree Worker (Contractor)	18 months of related training and on the job experience Successful completion of Company Line Clearance Tree Trimmer Certification Program	None	0%	0%	100%	0%	No formal training program required for this position
Tree Worker Trainee (Contractor)	Successful completion of Grounds Operation Specialist Test	None	0%	0%	100%	0%	No formal training program required for this position
Bucket Operator (Contractor)	Prior Experience as professional Tree Trimmer or Climber Meets Journeyman Tree Trimmer Requirements	None	0%	0%	100%	0%	No formal training program required for this position
Groundperson (Contractor)	GRA – 0 to 6 months GRF – 6 to 12 months	None	0%	0%	100%	0%	No formal training program required for this position

8.3 Situational Awareness and Forecasting

8.3.1 Overview

In this section, the electrical corporation must identify objectives for the next 3- and 10-year periods, targets, and performance metrics related to the following situational awareness and forecasting programmatic areas:

- Environmental monitoring systems
- Grid monitoring systems
- Ignition detection systems
- Weather forecasting
- Ignition likelihood calculation
- Ignition consequence calculation

Situational awareness and forecasting are utilized by Liberty's wildfire team and operations to monitor and assess daily wildfire risk and to adjust working conditions on elevated fire risk and PSPS risk days. Liberty has identified objectives for the next three to 10 years to assess the effectiveness of its current and future portfolio of mitigations to improve situational awareness and forecasting. Liberty's discussion of the following situational awareness and forecasting programmatic areas includes:

- Environmental monitoring systems
- Grid monitoring systems
- Ignition detection systems
- Weather forecasting
- Ignition likelihood calculation
- Ignition consequence calculation

Liberty's overhead lines within the greater Lake Tahoe region in California have similar terrain, topography, and environmental aspects of a mountainous community. This region is also impacted by extreme snowfall in the winter season (October to April) that strains assets and causes frequent repairs for failed equipment in service and has summers that are impacted by dry and extreme wind events (RFW days) and thunderstorms from late-May to September. Liberty's fire season is from June to September. However, fire risk is monitored until the ground has significant snowfall and fuel moisture levels are high.

8.3.1.1 Objectives

Each electrical corporation must summarize the objectives for its 3-year and 10-year plans for implementing and improving its situational awareness and forecasting.[81] These summaries must include the following:

- Identification of which initiative(s) in the WMP the electrical corporation is implementing to achieve the stated objective, including Utility Initiative Tracking IDs
- Reference(s) to applicable codes, standards, and best practices/guidelines and an indication of whether the electrical corporation exceeds an applicable code, standard, or regulation
- Method of verifying achievement of each objective
- A completion date for when the electrical corporation will achieve the objective
- Reference(s) to the WMP section(s) or appendix, including page numbers, where the details of the objective(s) are documented and substantiated

Liberty has identified the following objectives it plans to achieve over the next three years in Table 8-34. Liberty has also identified future planned improvements to its situational awareness objectives planned over the next 10 years in Table 8-35.

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81 Annual information included in this section must align with the QDR data.

Table 8-34. Liberty Situational Awareness Initiative Objectives (three-year plan)

Objectives for Three Years (2023–2025)	**Applicable Initiative(s), Tracking ID(s)**	**Applicable Regulations, Codes, Standards, and Best Practices**	**Method of Verification (*i.e.*, program)**	**Completion Date**	**Reference (section & page #)**
Determine weather station network capacity	WMP-SA-01	None	Weather station optimization tool results	2023	Section 8.3.2, pp. 262-266
Implement maintenance program for weather stations	WMP-SA-01	None	Invoices, work orders	2023	Section 8.3.2, pp. 262-266
Research emerging technologies for future fault detection pilot programs	WMP-SA-02	None	Annual WMP	Not known	None in 2023 WMP; in development
Work with AlertWildfire to own and operate cameras to track smoke and fires	WMP-SA-03	None	Service agreement	2023	Section 8.3.4, pp. 271-274

Table 8-35. Liberty Situational Awareness Initiative Objectives (10-year plan)

Objectives for Ten Years (2026–2032)	**Applicable Initiative(s), Tracking ID(s)**	**Applicable Regulations, Codes, Standards, and Best Practices (See Note)**	**Method of Verification (*i.e.*, program)**	**Completion Date**	**Reference (section & page #)**
Implement new technologies if available (*i.e.*, AI smoke detection) to identify ignitions more quickly	WMP-SA-03	None	Invoices, work orders, agreements	Not known	Section 8.3.4, pp. 271-274
Improve weather forecasting capabilities as models improve or additional data becomes available	WMP-SA-01	None	Program	Not known	Section 8.3.2, pp. 262-266

8.3.1.2 Targets

Initiative targets are forward-looking quantifiable measurements of activities identified by each electrical corporation in its WMP. Electrical corporations will show progress toward completing targets in subsequent reports, including QDRs and WMP Updates.

The electrical corporation must list all targets it will use to track progress on its situational awareness and forecasting for the three years of the Base WMP. Energy Safety's Compliance Assurance Division and third parties must be able to track and audit each target.[82] For each initiative target, the electrical corporation must provide the following:

- Utility Initiative Tracking IDs.
- Projected targets for each of the three years of the Base WMP and relevant units.
- The expected "x% risk impact" For each of the three years of the Base WMP. The expected x% risk impact is the expected percentage risk reduction per year, as described in Section 7.2.2.2.
- Method of verifying target completion.

The electrical corporation's targets must provide enough detail to effectively inform efforts to improve the performance (*i.e.*, reduction in ignition probability or wildfire consequence) of the electrical corporation's situational awareness and forecasting initiatives.

Liberty provides targets for its Situational Awareness WMP initiatives in Table 8-36.

[82] Annual information included in this section must align with Table 1 of the QDR.

Table 8-36. Liberty Situational Awareness Initiative Targets by Year

Initiative Activity	Tracking ID	2023 Target & Unit	x% Risk Impact 2023[83]	2024 Target & Unit	x% Risk Impact 2024	2025 Target & Unit	x% Risk Impact 2025	Method of Verification
Install Weather Stations	WMP-SA-01	4 weather station installations	See footnote	Unknown (based on station citing analysis)	See footnote	Unknown (based on station citing analysis)	See footnote	Field verification, Web application, QDR
Fault Indicators	WMP-SA-02	10 circuits	See footnote	10 circuits	See footnote	~~10~~7 circuits	See footnote	Work order, invoices
AlertWildfire Cameras	WMP-SA-03	8 camera installations	See footnote	Unknown	See footnote	Unknown	See footnote	Invoices, QDR

[83] Liberty does not currently have sufficient information to calculate; See Section 7.2.2 for Liberty's planned risk analysis

8.3.1.3 Performance Metrics Identified by the Electrical Corporation

Performance metrics indicate the extent to which an electrical corporation's Wildfire Mitigation Plan is driving performance outcomes. Each electrical corporation must:

- List the performance metrics the electrical corporation uses to evaluate the effectiveness of its situational awareness and forecasting in reducing wildfire and PSPS risk[84]

For each of these performance metrics listed, the electrical corporation must:

- Report the electrical corporation's performance since 2020 (if previously collected)
- Projected performance for 2023-2025
- List method of verification

The electrical corporation must ensure that each metric's name and values are the same in its WMP reporting as its QDR reporting (specifically, QDR Table 2 and QDR Table 3). Metrics listed in this section that are the same as performance metrics required by Energy Safety and reported in QDR Table 2 (Performance Metrics)[85] must match those reported in QDR Table 2. Metrics listed in this section that are not the same as any of the performance metrics identified by Energy Safety and reported in QDR Table 2 must match those reported in QDR Table 3.

The electrical corporation must:

- Summarize its self-identified performance metric(s) in tabular form
- Provide a brief narrative that explains trends in the metrics

Currently there are no performance metrics related to situational awareness in Table 2 of the QDR. In the future, Liberty may add newly identified performance metrics related to situational awareness to Table 3 of the QDR.

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[84] There may be overlap between the performance metrics the electrical corporation uses and performance metrics required by Energy Safety. The electrical corporation must list these overlapping metrics in this section in addition to any unique performance metrics it uses.

[85] The performance metrics identified by Energy Safety are included in Energy Safety's Data Guidelines.

8.3.2 Environmental Monitoring Systems

The electrical corporation must describe its systems and procedures for monitoring environmental conditions within its service territory. These observations should inform the electrical corporation's near-real-time risk assessment and weather forecast validation. The electrical corporation must document the following:

- Existing systems, technologies, and procedures
- How the need for additional systems is evaluated
- Implementation schedule for any planned additional systems
- How the efficacy of systems for reducing risk are monitored

Reference the Utility Initiative Tracking ID where appropriate.

Tracking ID: WMP-SA-01

8.3.2.1 Existing Systems, Technologies, and Procedures

The electrical corporation must report on the environmental monitoring systems and related technologies and procedures currently in use, highlighting any improvements made since the last WMP submission. At a minimum, the electrical corporation must discuss systems, technologies, and procedures related to the reporting of the following:

- Current weather conditions:
  - Air temperature
  - Relative humidity
  - Wind velocity (speed and direction)
- Fuel characteristics:
  - Seasonal trends in fuel moisture

Each system must be summarized in Table 8-37. The electrical corporation must provide the following additional information for each system in the accompanying narrative:

- Generalized location of the system/locations measured by the system (*e.g.*, HTFD, entire service territory).
- Integration with the broader electrical corporation's system.
- How measurements from the system are verified.
- Frequency of maintenance.

- For intermittent systems (*e.g.*, aerial imagery, line patrols), what triggers collection. This should include flow charts and equations as appropriate.
- For calculated quantities, how raw measurements are converted into calculated quantities. This should include flow charts and equations as appropriate.

Liberty's weather monitoring program provides information to operations and allows for the safe operation of the electric grid during extreme weather events. Certain weather events can cause damage to the electrical system, which leads to the possibility of an ignition event. Real-time weather monitoring data is an important tool to help Liberty plan for operating activities during such extreme events.

Liberty's weather station network currently consists of 35 stations that are distributed throughout the service territory and plans to add an additional four stations in 2023. In addition to Liberty's weather stations, there are dozens more RAWS and NWS weather stations within the service territory that are monitored through the MesoWest network.

Since Liberty began installing weather stations in 2019, maintenance and repairs have been performed on an as-needed basis. Due to the increase in weather stations and growing need to maintain and repair stations, Liberty plans to initiate an annual maintenance schedule to repair, calibrate, and perform software updates if needed prior to fire season.

Seasonal variations in fuel moisture conditions are tracked through a combination of analytical methods and field-based fuel moisture sampling. For the former, observed and forecasted Energy Release Component ("ERC") percentiles from the USFS Wildland Fire Assessment System ("WFAS") are used to monitor intermediate to long-term fuel dryness. The data is generated from Remote Automated Weather Station ("RAWS") observations and the National Weather Service ("NWS") National Digital Forecast Database ("NDFD"). WFAS data is supplemented with in-situ fuel moisture sampling. In 2022, fuel moisture sampling was conducted on a weekly basis and will continue during the 2023 fire season. Fuel moisture sampling is targeted at values that are most difficult to accurately calculate from weather observations, including 1,000-hour dead fuel moisture, live woody fuel moisture, and foliar moisture content. These readings serve as a check on the automated WFAS ERC percentiles and inform fire behavior calculations that are conducted when adverse weather conditions are forecast to occur.

Liberty provides information on its Environmental Monitoring Systems in Table 8-37.

Table 8-37. Liberty Environmental Monitoring Systems

System	Measurement/ Observation	Frequency	Purpose and Integration
Weather stations	• Temperature • Dew Point • Wind Speed • Wind Direction • Wind Gust • Wind Gust Direction	6 observations per hour	• Improve weather forecasts with observed weather station data • Configure alerts • Generate reports
Remote sensing fuel moistures	• Fuel Moisture %	6 observations per hour	• Calculate fuel moisture content
Remote sensing soil moisture	• Soil Moisture %	6 observations per hour	• Calculate soil moisture content
Fuel moisture field sampling	• Live woody % • 1,000 hour % • Live fuel moisture by predominant species	1 per week	• Calculate Energy Release Component • Fire behavior calculations

8.3.2.2 Evaluation and Selection of New Systems

The electrical corporation must describe how it evaluates the need for additional environmental monitoring systems. This description must include:

- How the electrical corporation evaluates the impact of new systems on reducing risk (*e.g.*, expected quantitative improvement in weather forecasting)
- How the electrical corporation evaluates the efficacy of new technologies

These descriptions should include flow charts as appropriate.

Liberty is not currently evaluating new systems for environmental monitoring.

8.3.2.3 Planned Improvements

The electrical corporation must describe its planned improvements for its environmental monitoring systems.[86] This must include any plans for the following:

- Expansion of existing systems
- Establishment of new systems

For each planned improvement, the electrical corporation must provide the following in Table 8-38:

- **Description:** A description of the planned initiative activity
- **Impact:** Reference to and description of the impact of the initiative activity on each risk and risk component
- **Prioritization:** A description of the x% risk impact (see Section 8.1.1.2 for explanation)
- **Schedule:** A description of the planned schedule for implementation

Liberty is planning to install additional weather stations to improve situational awareness. The number of additional stations and locations of such stations have not yet been determined and will be optimized by:

- Using the weather station optimization tool that has been developed by the Pyregence consortium with funding from the California Energy Commission; and
- Consulting with National Weather Service (“NWS”) Reno personnel

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[86] Annual information included in this section must align with Tables 7 and 8 of the QDR.

In this way, weather stations installations will be targeted at blind spots where existing situational awareness could be improved, and not targeted for areas where situational awareness is already high. Liberty provides information on planned improvements to its Environmental Monitoring System in Table 8-38.

Table 8-38. Liberty Planned Improvements to Environmental Monitoring Systems

System	Description	Impact	x% Risk Impact	Implementation Schedule
Weather Stations	Installation of additional weather stations	Unknown	Unknown	• Install 4 stations in 2023 remaining from 2022 target. • 2024 install additional stations if blind spots are identified.

8.3.2.4 Evaluating Mitigation Initiatives

The electrical corporation must describe its procedures for the ongoing evaluation of the efficacy of its environmental monitoring program.

Liberty relies on the subject matter expertise of Reax engineering to evaluate the efficacy of its environmental monitoring program.

8.3.3 Grid Monitoring Systems

The electrical corporation must describe its systems and procedures used to monitor the operational conditions of its equipment. These observations should inform the electrical corporation’s near-real-time risk assessment. The electrical corporation must document:

- Existing systems, technologies, and procedures
- Procedure used to evaluate the need for additional systems
- Implementation schedule for any planned additional systems
- How the efficacy of systems for reducing risk are monitored

Reference the Utility Initiative Tracking ID where appropriate.

Tracking ID: WMP-SA-02

8.3.3.1 Existing Systems, Technologies, and Procedures

The electrical corporation must report on the grid system monitoring systems and related technologies and procedures currently in use, highlighting any improvements made since the last WMP submission. At a minimum, the electrical corporation must discuss systems, technologies, and procedures related to the detection of:

- Faults (*e.g.*, fault anticipators, rapid earth fault current limiters, etc.)
- Failures
- Recloser operations

Each system must be summarized in Table 8-39 below. The electrical corporation must provide the following information for each system in the accompanying narrative:

- Location of the system/locations measured by the system
- Integration with the broader electrical corporation's system
- How measurements from the system are verified
- For intermittent systems (*e.g.*, aerial imagery, line patrols), what triggers collection. This should include flow charts and equations as appropriate
- For calculated quantities, how raw measurements are converted to calculated quantities. This should include flow charts and equations as appropriate.

Liberty is currently exploring multiple pilot projects for grid monitoring, including DFA, DA, and HIFD. These initiatives were installed in 2022, and in 2023, Liberty will be testing their effectiveness and risk reduction to forecast their use in future years. Reference Section 8.1.2.6 for more information on these initiatives.

In 2022, Liberty included the installation of fault indicators as part of its Fast Trip or SRP Program. This program has proven useful and will be expanded in future years. Fault indicators have been installed on the Topaz 1261 circuit and Meyers 3300 circuit, where SRP equipment and settings have been installed. Fault indicators expedite power restoration during an outage by helping line crews locate the fault. Two different types of fault indicators have been installed and are operational this year. One type includes remote communication, while the other has local indication via a light. The local indicators are installed on both circuits and have proved useful in expediting restoration times. The remote communication fault indicators are part of a pilot program for the Topaz 1261 circuit, and their effectiveness and value compared to the local indicators will be tested this year. Both types of fault indicators are set to trip at a predetermined value when a fault current is reached on that circuit. Thus far, Liberty has installed 45 fault indicators with 30 on the Meyers 3300 circuit and 15 on the Topaz 1261 circuit.

The majority of fault indicators have been installed on taps off the main line, which enables line crews to focus their restoration efforts by driving along the main line to see if fault indicators have lit up. This helps line crews avoid patrolling unnecessary sections of the line and makes restoration efforts more efficient when there is less sunlight. Liberty provides information on its Grid Monitoring System in Table 8-39 below.

Table 8-39. Liberty Grid Monitoring Systems

System	Measurement/ Observation	Frequency	Purpose and Integration
Fault indicators	Line tripped or Line not tripped	Varies based on trip events	Expedite response and location of tripped lines

8.3.3.2 Evaluation and Selection of New Systems

The electrical corporation must describe how it evaluates the need for additional grid operation monitoring systems. This description must include:

- How the electrical corporation evaluates the impact of new systems on reducing risk (*e.g.*, expected reduction in ignitions from failures, expected reduction in failures)
- How the electrical corporation evaluates the efficacy of new technologies

These descriptions should include flow charts as appropriate.

Liberty will be evaluating three pilot programs that were installed in 2022, including its DFA, DA and HIFD programs. Refer to Section 8.1.2.6 for more information on the evaluation of these initiatives.

Liberty has made significant progress with Distribution Fault Anticipation (“DFA”) technology. DFA is still in the implementation phase. Ten total DFA units have been installed at the Meyers, Stateline, and Northstar Substations to monitor ten circuits. These units will be online within the first half of 2023 once the communication path for data collection is established. Liberty anticipates that the units will collect data in the early part of this year. The data will be collected and analyzed by an algorithm developed by a specialized team at the Texas A&M Power System Automation Laboratory. DFA monitors that look at the current and voltage wave forms in high fidelity will generate reports sent out periodically with recommendations of which circuits to investigate for specific problems identified by the algorithmic report process. Liberty will evaluate the effectiveness of this technology for preventative maintenance and anticipation of fault events. Based on the results, Liberty will evaluate whether and how much to expand the program in future years.

Liberty also commissioned a study by University of Nevada, Reno (UNR) to examine the potential effectiveness of HIFD in its distribution system. UNR concluded that HIFD is not the best technology for Liberty to pursue and that technologies such as fast trip and sensitive earth relay settings have more potential to reduce wildfire risk and improve reliability. According to the study, HIFD has the potential to cause nuisance trips and would only provide coverage for about 70% of the faults on the line. Liberty did enable the Meyers 3400 circuit with capabilities to search for high impedance faults. However, based on the information collected by UNR, Liberty will only be using HIFD sparingly to check for high impedance faults on the Meyers 3400 circuit. Based on this information, Liberty will not move forward with HIFD technology at this time, but HIFD may still be a consideration for the future depending on technology advancements.

8.3.3.3 Planned Improvements

The electrical corporation must describe its planned improvements in its grid operation monitoring systems. This must include any plans for the following:

- Expansion of existing systems
- Establishment of new systems

For each planned improvement, the electrical corporation must provide the following in Table 8-40:

- Description: A description of the planned initiative activity
- Impact: Reference to and description of the impact of the initiative activity on each risk and risk component
- Prioritization: A description of the x% risk impact (see Section 8.1.1.2 for explanation)
- Schedule: A description of the planned schedule for implementation

Liberty plans to expand its use of SRP in 2023. To help with restoration times when the SRP program is activated, Liberty will be hanging fault indicators on all lines that have SRPs. The fault indicators are hung at the start of all laterals and key points along the main lines so that when the operations team is dispatched on a fault event, they can more quickly locate the fault and re-energize lines. In 2022, Liberty installed the SRP plus fault indicators on two lines and will be installing this on ten additional lines in 2023.

Liberty provides its planned improvements to its Grid Monitoring Systems in Table 8-40.

Table 8-40. Liberty Planned Improvements to Grid Operation Monitoring Systems

System	Description	Impact	x% Risk Impact	Implementation Schedule
Fault Indicators	Used to expedite response times to trips on fault events.	Expedited responses times to get customer's power back on	No risk associated with fault indicators.	Ten additional lines in 2023

8.3.3.4 Evaluating Mitigation Initiatives

The electrical corporation must describe its procedures for the ongoing evaluation of the efficacy of its grid operation monitoring program.

Liberty will be evaluating three Pilot Programs that were installed in 2022, including its DFA, DA and HIFD programs. Reference Section 8.1.2.6 more information on the evaluation of these initiatives

8.3.3.5 Enterprise System for Grid Monitoring

In this section, the electrical corporation must provide an overview of its enterprise system for grid monitoring. This overview must include discussion of:

- Any database(s) used for storage
- Describe the electrical corporation's internal documentation of its database(s)
- Integration with systems in other lines of business
- Describe any QA/QC or auditing of its system
- Describe internal processes for updating the enterprise system including database(s)
- Any changes to the initiative since the last WMP submission and a brief explanation as to why those changes were made. Include any planned improvements or updates to the initiative and the timeline for implementation

Liberty does not have an enterprise system for grid monitoring in 2023.

8.3.4 Ignition Detection Systems

The electrical corporation must describe its systems, technologies, and procedures used to detect ignitions within its service territory and gauge their size and growth rates.

The electrical corporation must document the following:

- Existing ignition detection sensors and systems
- Evaluation and selection of new ignition detection systems
- Planned integration of new ignition detection technologies
- Monitoring of mitigation improvements

Reference the Utility Initiative Tracking ID where appropriate.

Tracking ID: WMP-SA-03

8.3.4.1 Existing Ignition Detection Sensors and Systems

The electrical corporation must report on the sensors and systems, technologies, and procedures for ignition detection that are currently in use, highlighting any improvements made since the last WMP submission. At a minimum, the electrical corporation must document the deployment of each of the following:

- Early fire detection including, for example:
  - Satellite infrared imagery
  - High-definition video
  - Infrared cameras
- Fire growth potential software

The electrical corporation must summarize each system in a table. It must provide the following additional information for each system in an accompanying narrative:

- General location of detection sensors (*e.g.*, HFTD or entire service territory)
- Resiliency of sensor communication pathways
- Integration of sensor data into machine learning or AI software
- Role of sensor data in risk response
- False positives filtering
- Time between detection and confirmation

- Security measures for network-based sensors

Liberty has not yet deployed wildfire detection sensors or systems. Existing ALERTCalifornia and Alert Wildfire cameras in and surrounding the service territory are used to monitor incipient or developing fires. Liberty has not yet commissioned fire growth potential software but has previously used Pyrecast for forecasting the spread of active fires in or near its service territory, including the Caldor, Dixie, Tamarack, and Beckwourth Complex fires.

8.3.4.2 Evaluation and Selection of New Detection Systems

The electrical corporation must describe how it evaluates the need for additional ignition detection technologies. This description must include:

- How the electrical corporation evaluates the impact on new detection technologies on reducing and improving detection and response times
- How the electrical corporation evaluates the efficacy of new technologies
- The electrical corporation’s budgeting process for new detection system purchases

Liberty is not currently evaluating or selecting new detection systems

8.3.4.3 Planned Integration of New Ignition Detection Technologies

The electrical corporation must provide an implementation schedule for new ignition detection and alarm system technologies. This must include any plans for the following:

- Integration of new systems into existing physical infrastructure
- Integration of new systems into existing data analysis
- Increases in budgets and staffing to support new systems

For each new technology system, the electrical corporation must provide the following in Table 8-41:

- **Description:** A description of the technology’s capabilities
- **Impact:** A description of the impact the technology will have on each risk and risk component
- **Prioritization:** A description of the x% risk impact (see Section 8.1.1.2 for explanation)
- **Schedule:** A description of the planned schedule for implementation

Liberty is aware that larger utilities have begun deploying HD cameras with AI-based fire detection algorithms and may consider deploying similar technologies in the future.

Additionally, Liberty plans to sponsor conventional pan/tilt/zoom cameras on the ALERTCalifornia and/or Alert Wildfire networks. Liberty expects to support eight cameras within its service territory.

Liberty provides information regarding planned improvements to its Ignition Detection and Alarm Systems in Table 8-41.

Table 8-41. Liberty Planned Improvements to Fire Detection and Alarm Systems

System	Description	Impact	x% Risk Impact	Implementation Schedule
AlertWildfire Cameras	Sponsor 8 existing cameras in service territory	Unknown	Unknown	2023

8.3.4.4 Evaluating Mitigation Initiatives

The electrical corporation must describe its procedures for the ongoing evaluation of the efficacy of its fire detection systems.

Since Liberty has not yet deployed fire detection systems, it does not currently have procedures for evaluating efficacy of such systems.

8.3.4.5 Enterprise System for Ignition Detection

In this section, the electrical corporation must provide an overview of its enterprise system for ignition detection. This overview must include discussion of:

- Any database(s) used for storage.
- Describe the electrical corporation’s internal documentation of its database(s).
- Integration with systems in other lines of business.
- Describe any QA/QC or auditing of its system.
- Describe internal processes for updating the enterprise system including database(s).
- Any changes to the initiative since the last WMP submission and a brief explanation as to why those changes were made. Include any planned improvements or updates to the initiative and the timeline for implementation.

Since Liberty has not yet deployed fire detection systems, it does not currently have an enterprise system for ignition detection.

8.3.5 Weather Forecasting

The electrical corporation must describe its systems and procedures used to forecast weather within its service territory. These forecasts should inform the electrical corporation's near-real-time-risk assessment and PSPS decision-making processes. The electrical corporation must document the following:

- Its existing modeling approach
- The known limitations of its existing approach
- Implementation schedule for any planned changes to the system
- How the efficacy of systems for reducing risk are monitored

Reference the Utility Initiative Tracking ID where appropriate.

Tracking ID: WMP-SA-04

8.3.5.1 Existing Modeling Approach

At a minimum, the electrical corporation must discuss the following components of weather forecasting:

- **Data assimilation** from environmental monitoring systems within the electrical corporation service territory
- **Ensemble forecasting** with control forecast and perturbations
- **Model inputs** including, for example:
  - Land cover/land use type
  - Local topography
- **Model outputs** including, for example:
  - Air temperature
  - Barometric pressure
  - Relative humidity
  - Wind velocity (speed and direction)
  - Solar radiation
  - Rainfall duration and amount

- **Separate modules** (*e.g.*, local weather analysis and local vegetation analysis)
- **Subject matter expert (SME) assessment of forecasts**
- **Spatial granularity of forecasts** including:
    - Horizontal resolution
    - Vertical resolution
- **Time horizon** of the weather forecast throughout the service territory

The electrical corporation must highlight improvements made to the electrical corporation's weather forecasting since the last WMP submission.

The electrical corporation must also provide documentation of its modeling approach pertaining to its weather forecasting system in accordance with the requirements in Appendix B.

Liberty is not currently utilizing an internal weather model such as WRF, but rather using data from operational weather models developed by meteorological organizations. Because these operational models are run by national meteorological organizations and not Liberty, Liberty cannot provide a detailed discussion of these models. References are provided below for each model. Several models with a range of spatial resolution and forecast duration are currently in use. These models as used at Liberty include:

- High Resolution Rapid Refresh ("HRRR"):[87] 3 km spatial resolution, 48-hr forecast duration, four cycles per day.
- North American Mesoscale ("NAM") forecast system:[88] 12 km spatial resolution, 84-hr forecast duration, four cycles per day.
- NAM CONUS nest:[89] 3 km spatial resolution, 60-hr forecast duration, 4 cycles per day.
- Global Forecast System:[90] 0.125° (approximately 13 km) and 0.25° (approximately 26 km) spatial resolution, 16-day forecast duration, 4 cycles per day
- European Centre for Medium-Range Weather Forecasts ("ECMWF") HRES:[91] 0.1° (approximately 11 km) spatial resolution, 10-day forecast duration, 2 cycles per day

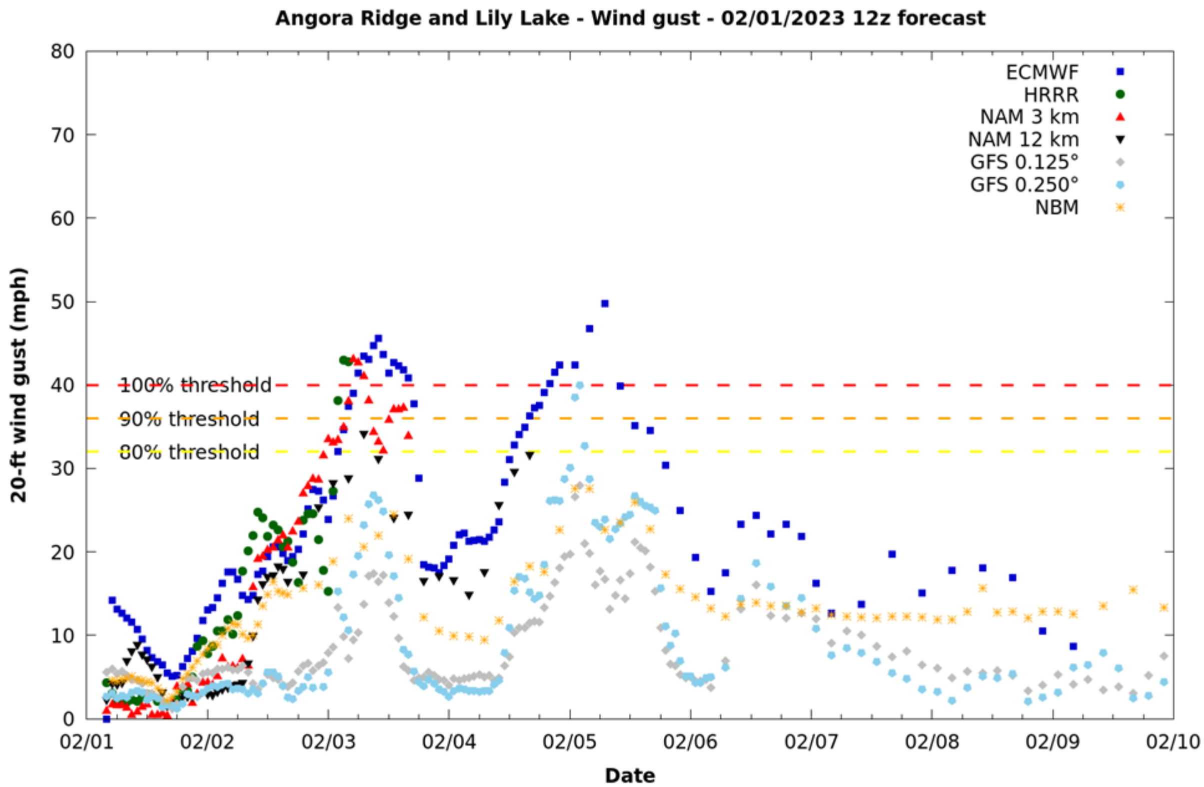
[87] https://rapidrefresh.noaa.gov/hrrr/
[88] https://www.ncei.noaa.gov/access/metadata/landing-page/bin/iso?id=gov.noaa.ncdc:C00630
[89] https://www.ncei.noaa.gov/access/metadata/landing-page/bin/iso?id=gov.noaa.ncdc:C00630
[90] https://www.ncei.noaa.gov/products/weather-climate-models/global-forecast
[91] https://www.ecmwf.int/en/forecasts/datasets/set-i

- National Blend of Models ("NBM"):[92] 2.5 km spatial resolution, 11-day forecast duration, 4 cycles per day

The primary outputs that are used for short term fire-weather forecasting include wind gust, sustained wind speed, relative humidity, and temperature. Derived quantities such as Fosberg Fire Weather Index, Hot Dry Windy index, and fuel bed ignition probability are also monitored. Key quantities are summarized as timeseries plots for each PSPS zone and updated 4 times daily. As an example, Figure 8-11 shows a wind gust forecast a PSPS zone from February 2023.

[92] https://blend.mdl.nws.noaa.gov/

Figure 8-11: Sample wind gust timeseries plot showing wind gust forecast from operational weather models used for fire weather forecasting



Since the last WMP submission, Liberty has added the NBM model to its forecast. To date, only limited subject matter expert assessment of forecast data has been conducted. However, Liberty has archived its weather forecast data since 2021 and, as described in Section 8.3.5.3, intends to use this data to develop bias correction procedures as part of a formalized forecast assessment.

8.3.5.2 Known Limitations of Existing Approach

The electrical corporation must describe any known limitations of its existing modeling approach resulting from assumptions, data availability, and computational resources. It must discuss the impact of these limitations on the modeling outputs.

The primary limitation of the existing approach is the accuracy of wind gust forecasts more than two days in the future. Of the three long-range models being used (GFS, ECMWF, and NBM), the ECMWF model generally provides more accurate wind gust forecasts than the GFS and NBM.

8.3.5.3 Planned Improvements

The electrical corporation must describe its planned improvements in its weather forecasting systems. This must include any plans for the following:

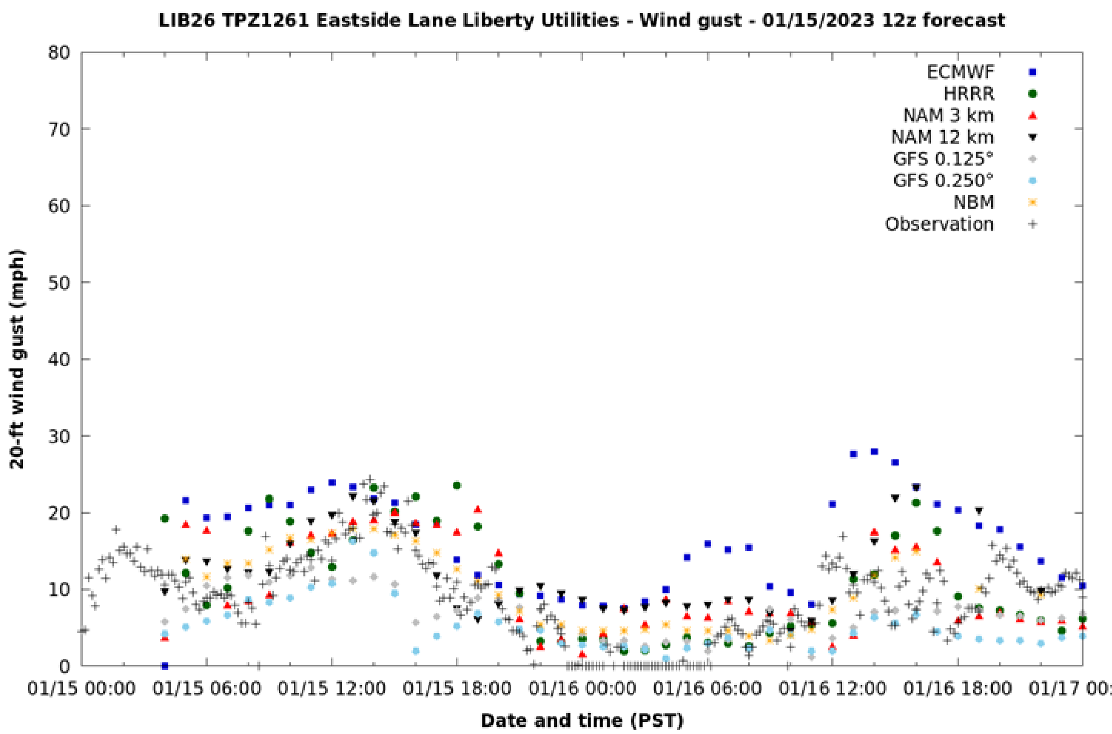
- Increase in model validation
- Increase in spatial granularity
- Decrease in limitations by removal of assumptions
- Increase in input data quality
- Increase in related frequency

For each planned improvement, the electrical corporation must provide the following:

- **Description:** A description of the planned initiative activity
- **Impact:** Reference to and description of the impact of the initiative activity on each risk and risk component
- **Prioritization:** A description of the x% risk impact (see Section 8.1.1.2 for explanation)
- **Schedule:** A description of the planned schedule for implementation

Liberty’s weather forecasting system compares weather station observations and weather forecast data in real time. An example of such comparisons is shown in Figure 8-12 below for a single weather station and forecast cycle. Liberty has archived approximately two years (Spring 2021 – current) of such comparisons at all stations in and immediately surrounding its service territory. To improve the accuracy of its weather forecasting, particularly for wind gust, Liberty intends to analyze this data archive and develop bias correction procedures to improve wind gust forecast accuracy. Liberty anticipates that this bias-correction work will be completed by mid-2023. The potential impact of this work is not known.

Figure 8-12: Sample comparison of forecast and observed wind gust



Because Liberty is an end-user of forecast products developed by national meteorological organizations, specific factors identified in the Technical Guidelines (model validation, increase in spatial granularity, decrease in limitations by removal of assumptions, increase in input data quality, and increase in related frequency) are not applicable as they are outside of Liberty's control.

8.3.5.4 Evaluating Mitigation Initiatives

The electrical corporation must describe its procedures for the ongoing evaluation of the efficacy of its weather forecasting program.

As described previously, only limited evaluation of the efficacy of Liberty's weather forecasting program has been conducted to date. Liberty intends to formalize these procedures in 2023 and will report on this progress during the next WMP cycle.

8.3.5.5 Enterprise System for Weather Forecasting

In this section, the electrical corporation must provide an overview of its enterprise system for weather forecasting. This overview must include discussion of:

- Any database(s) used for storage.
- Describe the electrical corporation's internal documentation of its database(s).
- Integration with systems in other lines of business.
- Describe any QA/QC or auditing of its system.
- Describe internal processes for updating the enterprise system including database(s).
- Any changes to the initiative since the last WMP submission and a brief explanation as to why those changes were made. Include any planned improvements or updates to the initiative and the timeline for implementation.

Liberty's weather forecasting system is operated by a vendor as follows:

- Native format (gridded binary) forecast data are pulled in real-time from the NOAA Operational Model Archive and Distribution System ("NOMADS"). ECMWF HRES data are pushed by ECMWF.
- Gridded binary data files are converted to GeoTiff and derived quantities (Fosberg Fire Weather Index, fuel bed ignition probability, etc.)
- Zonal statistics are calculated for each PSPS zone and summarized as timeseries plots for key quantities. Additionally, timeseries are extracted at weather station locations to facilitate direct comparison of forecast data to observations.
- Forecast data are summarized in a dashboard that provides forecasts for each zone, accessible by a web browser.
- Plots and underlying data (in .csv format) are archived for potential later use (*e.g.*, for bias correction studies).

New forecasts are generated every six hours. Since the forecast dissemination schedule is known a-priori, monitoring is in place to determine if a forecast is delayed (*e.g.*, due to a NOMADS outage). The forecast system runs on a primary and backup server to provide redundancy in case of a network outage or hardware failure on the primary server.

8.3.6 Fire Potential Index

The electrical corporation must describe its process for calculating its fire potential index ("FPI") or a similar a landscape scale index used as a proxy for assessing real-time risk of a wildfire under current and forecasted weather conditions. The electrical corporation must document the following:

- Its existing calculation approach and how its FPI is used in its operations
- The known limitations of its existing approach
- Implementation schedule for any planned changes to the system

Reference the Utility Initiative Tracking ID where appropriate.

Tracking ID: WMP-SA-05

Overview of Initiative: Liberty's FPI is an assessment tool designed to heighten awareness of daily forecast fire conditions to assist in operational decision-making. FPI converts environmental, statistical, and scientific data into an easily understood forecast of short-term fire threat for Liberty's service territory. FPI forecasts up to seven days of fire threat potential.

8.3.6.1 Existing Calculation Approach and Use

The electrical corporation must describe:

- How it calculates its own FPI or if uses an external source, such as the United States Geological Survey[93]
- How it uses its or an FPI in its operations

Additionally, if the electrical corporation calculates its own FPI, it must provide tabular information regarding the features of its FPI.

Use: Liberty uses FPI for fire threat awareness and operational decision-making. FPI provides a seven-day fire potential forecast for 11 geographic zones within the service territory using five adjective classes (Low, Moderate, High, Very High, and Extreme). These FPI ratings are used to determine and plan for daily operating procedures by zone. FPI forecasts are communicated to field staff daily to inform operational decisions when work restrictions are in place due to fire

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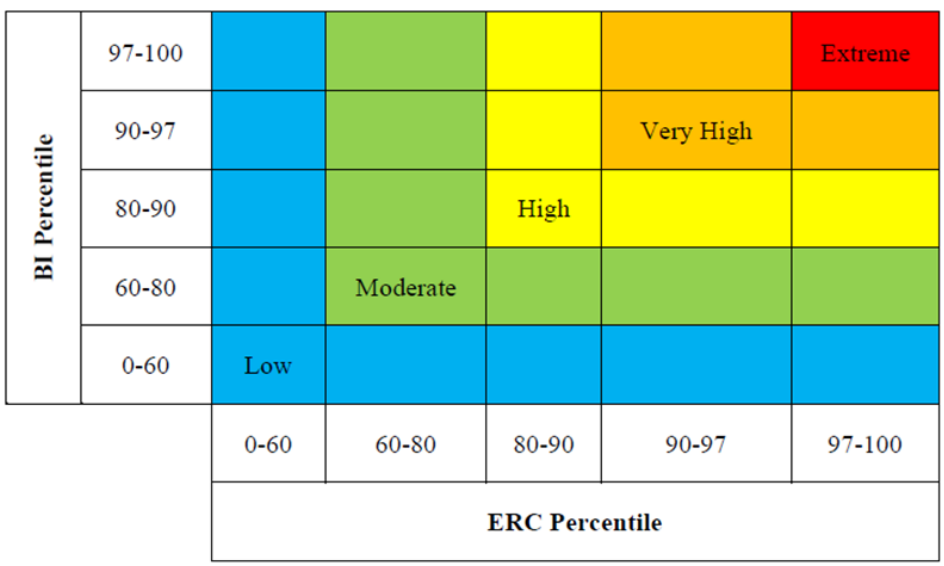
93 United States Geological Survey Fire Danger Map and Data Products Web Page (accessed Oct. 27, 2022): https://firedanger.cr.usgs.gov/viewer/index.html.

risk. Prior to the development of FPI, Liberty did not have any specialized fire risk prediction tools, which meant less overall awareness of day-to-day fire risk.

<u>Calculation approach</u>: Liberty's FPI is based on the Severe Fire Danger Index ("SFDI")[94] developed by the US Forest Service. SFDI combines two National Fire Danger Rating System ("NFDRS") indices into a single measure of fire potential. The first index, Energy Release Component ("ERC"), quantifies intermediate to long-term dryness and is strongly correlated with fire occurrence. The second index, Burning Index ("BI"), is proportional to flame length of a head fire and viewed as a measure of suppression difficulty. As shown in Figure 8-13, the combination of ERC and BI percentiles (the basis for SFDI) is strongly correlated with both the number and size of fires.

Liberty's FPI is implemented by obtaining gridded ERC and BI percentile forecast data from the US Forest Service Wildland Fire Assessment System ("WFAS").[95] These indices are converted to FPI using Figure 8-13.

Figure 8-13: Liberty FPI Ratings as a Function of ERC and BI Percentiles



Liberty provides more information regarding its Fire Potential Index in Appendix B.

94 Jolly, W.M, Freeborn, P.H., Page, W.G., and Butler, B.W., "Severe Fire Danger Index: A Forecastable Metric to Inform Firefighter and Community Wildfire Risk Management," Fire 2: 47 (2019).

95 http://wfas.net/

8.3.6.2 Known Limitations of Existing Approach

The electrical corporation must describe any known limitations of current FPI calculation.

Liberty's FPI currently provides daily ratings that are representative of peak fire potential on a given day. However, fire potential may vary significantly during the day due to diurnal variations in fire weather conditions (*e.g.*, Zephyr winds), disturbances moving into or out of the region, or precipitation.

An NFDRS fuel model is needed for calculating ERC and BI. Historically, Fuel Model G in the 78/88 NFDRS system or Fuel Model Y in the 2016 NFDRS system have been used when correlating fire occurrence with ERC/BI/SFDI. Fuel Model G/Y are timber fuel models with heavy fuel loadings in the 1000-hr size class and may not be representative of fire occurrence in shrub or grass/shrub fuel complexes where Fuel Model X (*e.g.*, shrub/brush) may be more appropriate.

8.3.6.3 Planned Improvements

The electrical corporation must describe its planned improvements for its FPI including a description of the improvement and the planned schedule for implementation.

In advance of the 2023 fire season, Liberty intends to address the limitations identified above by:

- Developing an internal FPI calculation from its weather modeling system that will make it possible to provide more temporally granular FPI ratings than is currently possible with daily ratings obtained from WFAS, and
- Assess the sensitivity of FPI to fuel model and determine whether a fuel model other than G or Y should be used in FPI zones where shrub/brush as opposed to timber litter is the predominant fuel type.

8.4 Emergency Preparedness

8.4.1 Overview

Each electrical corporation must develop and adopt an emergency preparedness[96] plan in compliance with the standards established by the CPUC pursuant to Public Utilities Code section 768.6(a). Wildfires and PSPS events introduce unique risk management challenges requiring the electrical corporation to evaluate, develop, and implement wildfire- and PSPS-specific emergency preparedness activities as part of a holistic emergency preparedness strategy.

In this section, the electrical corporation must identify objectives for the next 3- and 10-year periods, targets, and performance metrics related to the following emergency preparedness programmatic areas:

- Wildfire and PSPS emergency preparedness plan
- Collaboration and coordination with public safety partners
- Public notification and communication strategy
- Preparedness and planning for service restoration
- Customer support in wildfire and PSPS emergencies
- Learning after wildfire and PSPS events

8.4.1.1 Objectives

Each electrical corporation must summarize the objectives for its 3-year and 10-year plans for implementing and improving its emergency preparedness.[97] These summaries must include the following:

- Identification of which initiative(s) in the WMP the electrical corporation is implementing to achieve the stated objective, including Utility Initiative Tracking IDs
- Reference(s) to applicable codes, standards, and best practices/guidelines and an indication of whether the electrical corporation exceeds an applicable code, standard, or regulation
- Method of verifying achievement of each objective

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[96] "Emergency and Disaster Preparedness" from Public Utilities Code section 768.6 has been shortened here to Emergency Preparedness.

[97] Annual information included in this section must align with the QDR data.

- A completion date for when the electrical corporation will achieve the objective
- Reference(s) to the WMP section(s) or appendix, including page numbers, where the details of the objective(s) are documented and substantiated

The emergency preparedness and response plans descripted in Liberty's WMP comply with California Public Utilities Code §§ 768.6, 8386. Specifically, the WMP complies with the following mandates:

- Sharing elements of vested interest in the WMP and emergency response plan with relevant cities and counties to provide input and feedback.
- Direction to routinely update and improve the WMP.
- Accounting of responsibilities of persons responsible for executing the WMP.
- Appropriate and feasible procedures for notifying customers that may be impacted.
- Plans to prepare for and restore service, including workforce mobilization.
- Plans for community outreach and public awareness before, during, and after a wildfire.
- Emergency communications that include plans to provide messages in English, Spanish, German, French, and Chinese (Mandarin and Cantonese). Languages prevalent in Liberty's service area are English and Spanish, based on United States census data.
- Protocols for compliance with Commission reporting guidelines.

Liberty provides objectives for its Emergency Preparedness WMP initiatives in Table 8-42 for the three-year plan and Table 8-43 for the 10-year plan.

Table 8-42. Liberty Emergency Preparedness Initiative Objectives (three-year plan)

Objectives for Three Years (2023–2025)	**Applicable Initiative(s), Tracking ID(s)**	**Applicable Regulations, Codes, Standards, and Best Practices ~~(See Note)~~**	**Method of Verification (*i.e.*, program)**	**Completion Date**	**Reference (section & page #)**
~~Update workforce training on incident Command System ("ICS")~~	~~WMP-EP-01~~	~~G.O. 166~~	~~Updated emergency response training curriculum and training records in the Liberty Learning Management System ("LMS")~~	~~June 2023~~	~~Section 8.4.2.2, pp. 295-302~~
Ongoing Maintenance of Emergency Response Plans	WMP-EP-02	Corporate Emergency Response Plan ("CEMP")	Change Log in Corporate Emergency Management Plan	Annual (June 2024 and June 2025)	Section 8.4.2, pp. 291-310
Continued engagement with local stakeholders to prepare for and respond to fire-related events	WMP-EP-03	CEMP	Wildfire Community Advisory Board Meetings as recorded in the Liberty Community Outreach Recording Document	Annual (June 2024 and June 2025)	Section 8.4.2, pp. 291-310
Enhanced documentation and use of lessons learned to update plans	WMP-EP-04	CEMP	Change Log in Corporate Emergency Management Plan	Annual (June 2024 and June 2025)	Section 8.4.3, pp. 311-327

Table 8-43. Liberty Emergency Preparedness Initiative Objectives (10-year plan)

Objectives for Ten Years (2026–2032)	Applicable Initiative(s), Tracking ID(s)	Applicable Regulations, Codes, Standards, and Best Practices (See Note)	Method of Verification (*i.e.*, program)	Completion Date	Reference (section & page #)
Ongoing Maintenance of Emergency Response Plans	WMP-EP-02	Corporate Emergency Response Plan ("CEMP")	Change Log in Corporate Emergency Management Plan	Ongoing	Section 8.4.2, pp. 291-310
Continued engagement with local stakeholders to prepare for and respond to fire-related events	WMP-EP-03	CEMP	Wildfire Community Advisory Board Meetings as recorded in the Liberty Community Outreach Recording Document	Ongoing	Section 8.4.2, pp. 291-310
Enhanced documentation and use of lessons learned to update plans	WMP-EP-04	CEMP	Change Log in Corporate Emergency Management Plan	Ongoing	Section 8.4.3, pp. 311-327
~~Increase granularity and customization of response plans~~	~~WMP-EP-05~~	~~Corporate Emergency Response Plan ("CEMP")~~	~~Existence of emergency plans based on type of emergency~~	~~January 2030~~	~~Section 8.4.2, pp. 291-310~~

8.4.1.2 Targets

Initiative targets are forward-looking quantifiable measurements of activities identified by each electrical corporation in its WMP. Electrical corporations will show progress toward completing targets in subsequent reports, including QDRs and WMP Updates.

The electrical corporation must list all targets it will use to track progress on its emergency preparedness for the three years of the Base WMP. Energy Safety's Compliance Assurance Division and third parties must be able to track and audit each target.[98] For each initiative target, the electrical corporation must provide the following:

- Utility Initiative Tracking IDs.
- Projected targets for the three years of the Base WMP and relevant units.
- The expected "x% risk impact" for each of the three years of the Base WMP. The expected x% risk impact is the expected percentage risk reduction per year, as described in Section 7.2.2.2.
- Method of verifying target completion.

The electrical corporation's targets must provide enough detail to effectively inform efforts to improve the performance (*i.e.*, reduction in wildfire consequence) of the electrical corporation's emergency preparedness initiatives.

Liberty provides targets for its Emergency Management WMP initiatives in Table 8-44.

[98] Annual information included in this section must align with Tables 1 and 12 of the QDR.

Table 8-44. Liberty Emergency Preparedness Initiative Targets by Year

Initiative Activity	Tracking ID	2023 Target & Unit	x% Risk Impact 2023	2024 Target & Unit	x% Risk Impact 2024	2025 Target & Unit	x% Risk Impact 2025	Method of Verification
Collaboration and coordination with public safety partners	WMP-EP-02	Conduct emergency drills; continued engagement with local stakeholders and PSPs to prepare for and respond to fire-related event; meet with Community Advisory Boards	NA	Conduct emergency drills; continued engagement with local stakeholders and PSPs to prepare for and respond to fire-related event; meet with Community Advisory Boards	NA	Conduct emergency drills; continued engagement with local stakeholders and PSPs to prepare for and respond to fire-related event; meet with Community Advisory Boards	NA	QDR; After action reports
Customer support in wildfire and PSPS emergencies	WMP-EP-05	Conduct Incident Command Training for all identified IC members and hold a Virtual PSPS Tabletop exercise; continued implementation of Liberty's 2022 AFN Plan; continued maintenance of emergency response plans; enhanced documentation and use of lessons learned to update plans	NA	Conduct Incident Command Training for all identified IC members and hold a Virtual PSPS Tabletop exercise; continued implementation of Liberty's 2022 AFN Plan; continued maintenance of emergency response plans; enhanced documentation and use of lessons learned to update plans	NA	Conduct Incident Command Training for all identified IC members and hold a Virtual PSPS Tabletop exercise; continued implementation of Liberty's 2022 AFN Plan; continued maintenance of emergency response plans; enhanced documentation and use of lessons learned to update plans	NA	QDR; After action reports
Learning after wildfire and PSPS events	WMP-EP-06	After action reports for each event	NA	After action reports for each event	NA	After action reports for each event	NA	After action reports

8.4.1.3 Performance Metrics Identified by the Electrical Corporation

Performance metrics indicate the extent to which an electrical corporation's Wildfire Mitigation Plan is driving performance outcomes. Each electrical corporation must:

- List the performance metrics the electrical corporation uses to evaluate the effectiveness of its emergency preparedness in reducing wildfire and PSPS risk[99]

For each of these performance metrics listed, the electrical corporation must:

- Report the electrical corporation's performance since 2020 (if previously collected)
- Project performance for 2023-2025
- List method of verification

The electrical corporation must ensure that each metric's name and values are the same in its WMP reporting as its QDR reporting (specifically, QDR Table 2 and QDR Table 3). Metrics listed in this section that are the same as performance metrics required by Energy Safety and reported in QDR Table 2 (Performance Metrics)[100] must match those reported in QDR Table 2. Metrics listed in this section that are not the same as any of the performance metrics identified by Energy Safety and reported in QDR Table 2 must match those reported in QDR Table 3.

The electrical corporation must:

- Summarize its self-identified performance metric(s) in tabular form
- Provide a brief narrative that explains trends in the metrics

Liberty does not have performance metrics in its QDR Table 2 or Table 3 that it uses to evaluate the effectiveness of its Emergency Preparedness WMP initiatives. Liberty uses the number of emergency management drills performed as one metric to track its Emergency Preparedness WMP initiatives and will consider adding this metric to Table 3 of its QDR in 2023.

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[99] There may be overlap between the performance metrics the electrical corporation uses and performance metrics required by Energy Safety. The electrical corporation must list these overlapping metrics in this section in addition to any unique performance metrics it uses.

[100] The performance metrics identified by Energy Safety are included in Energy Safety's Data Guidelines.

Table 8-45. Liberty Emergency Preparedness Performance Metrics Results by Year

Performance Metrics	**2020**	**2021**	**2022**	**2023 Projected**	**2024 Projected**	**2025 Projected**	**Method of Verification (*e.g.*, third-party evaluation, QDR)**
None	None	None	None	None	None	None	None

8.4.2 Emergency Preparedness Plan

In this section, the electrical corporation must provide an overview of how it has evaluated, developed, and integrated wildfire- and PSPS-specific emergency preparedness strategies, practices, policies, and procedures into its overall emergency plan based on the minimum standards described in G.O. 166. The electrical corporation must provide the title of its latest emergency preparedness report, the date of the report, and an indication of whether the plan complies with CPUC R. 15-06-009, D. 21-05-019, and G.O. 166. The overview must be no more than two paragraphs.

In addition, the electrical corporation must provide a list of any other relevant electrical corporation documents that govern its wildfire and PSPS emergency preparedness planning for response and recovery efforts. This must be a bullet point list with document title, version (if applicable), and date. For example:

- Electrical Corporation's Emergency Response Plan (ECERP), Third Edition, dated January 1, 2021

Reference the Utility Initiative Tracking ID where appropriate.

Tracking ID: WMP-EP-01

Overview of Initiative: In compliance with CPUC R. 15-06-009, D. 21-05-019, and G.O. 166, Liberty has developed the sixth revision of its Corporate Emergency Management Plan ("CEMP"), dated April 27, 2022. The CEMP outlines the Company's general procedures for response to and recovery from emergencies at all levels. Under CEMP procedure, wildfire or PSPS-specific emergencies would warrant activation of Liberty's Incident Management Team under the Incident Command System ("ICS").

In anticipation of a wildfire or PSPS-specific emergency, Liberty's Incident Management Team and CEMP procedures are supplemented by the procedures outlined in its PSPS Playbook. Liberty's PSPS playbook describes the roles, responsibilities, and protocols for PSPS and wildfire response and communications.

The following is a list of additional documents that govern Liberty's wildfire and PSPS emergency preparedness planning:

- Liberty Utilities Wildland Fire Incident Response Guide, dated August 26, 2022.
- Liberty Utilities Public Safety Power Shutoff Playbook, dated June 13, 2022.

8.4.2.1 Overview of Wildfire and PSPS Emergency Preparedness

In this section of the WMP, the electrical corporation must provide an overview of its wildfire- and PSPS-specific emergency preparedness plan. At a minimum, the overview must describe the following:

- Purpose and scope of the plan.
- Overview of protocols, policies, and procedures for responding to and recovering from a wildfire or PSPS event (*e.g.*, means and methods for assessing conditions, decision-making framework, prioritizations). This must include:
    - An operational flow diagram illustrating key components of its wildfire- and PSPS-specific emergency response procedures from the moment of activation to response, recovery, and restoration of service.
    - Separate overviews and operational flow diagrams for wildfires and PSPS events.
- Key personnel, qualifications, and training.
- Resource planning and allocation (*e.g.*, staffing).
- Drills, simulations, and tabletop exercises.
- Coordination and collaboration with public safety partners (*e.g.*, emergency planning, interoperable communications).
- Notification of and communication to customers during and after a wildfire or PSPS event.
- Improvements/updates made since the last WMP submission.

The overview must be no more than six pages.

In addition, the electrical corporation must provide a table with a list of current gaps and limitations in evaluating, developing, and integrating wildfire- and PSPS-specific preparedness and planning features into its overall emergency preparedness plan(s). Where gaps or limitations exist, the electrical corporation must provide a remedial action plan and the timeline for resolving the gaps or limitations.

The purpose of Liberty's Wildfire and Emergency Preparedness Plans is to promote the safety, of staff, contractors, and the members of the communities it serves. Liberty is dedicated to preserving the safety and integrity of its infrastructure and the continuation of service when they are threatened by wildland fires. The scope of the plan includes service territory which is comprised of seven counties in Northern California.

PSPS Event Flow Diagram:

- Event Activation 72 Hours out (Stage 1), Activate EOC, execute Incident Management Team (IMT) Stage 1 Tasks in PSPS Playbook=>>>>
- PSPS Stage 2a (48 hours out), execute Stage 2a IMT Tasks in PSPS Playbook=>>>>
- PSPS Stage 2b (24 hours out), execute Stage 2b IMT Tasks in PSPS Playbook=>>>>
- PSPS Stage 3 (implemented PSPS), execute Stage 3 IMT Tasks in PSPS Playbook=>>>>
- PSPS Stage 4 (restoration initiated), execute Stage 4 IMT Tasks in PSPS Playbook=>>>>
- PSPS Stage 5 (event concluded), execute Stage 5 IMT Tasks in PSPS playbook=>>>>Conduct event hotwash and After Action Review.

Wildfire Event Flow Diagram:

- Event Activation (Immediate Response), Activate EOC and execute IMT Immediate Response Tasks (0-2 hours) in Wildfire Incident Response Guide=>>>>
- Intermediate Response, execute IMT Intermediate Response Tasks (2-12 hours) in Wildfire Incident Response Guide=>>>>
- Extended Response, execute IMT Extended Response Tasks (greater than 12 hours) in Wildfire Incident Response Guide=>>>>
- Demobilization/System Recovery, execute IMT Demobilization/System Recovery Tasks in the Wildfire incident Response Guide=>>>> Conduct event hotwash and After Action Review.

Additionally, the following are provided in the relevant tables and sections listed:

- Key personnel and qualifications are provided in Table 8-47;
- Personnel and contractor training is detailed in Table 8-48 and Table 8-49;
- Internal and external drills, simulations, and tabletop exercises are provided in Table 8-50 and Table 8-51;
- Wildfire specific updates to the plan are described in Table 8-52;
- Coordination and collaboration with public safety partners is detailed in Table 8-53 and Table 8-55; and
- Liberty's Public Emergency Communications Strategy is provided in Section 8.4.4.

Current gaps and limitations in evaluating, developing, and integrating wildfire- and PSPS-specific preparedness and planning features into its Liberty's overall emergency preparedness plan(s) are provided in Table 8-46. Remedial action plans and timelines are provided for gaps or limitations.

Table 8-46. Liberty Gaps and Limitations in Integrating Wildfire- and PSPS-Specific Strategies into Emergency Plan

Gap or Limitation Subject	Remedial Brief Description	Remedial Action Plan
Training for Public Safety Partners on the Liberty Public Safety Partner Portal.	Liberty has developed an excellent public safety partner ("PSP") portal to provide its PSPs with situational awareness regarding circuits and critical infrastructure impacted during a PSPS or wildfire. Liberty needs more PSPs registered to use the portal in advance and training for them on how to use it. If we wait for an event to sign them up there could be bottlenecks in the sign-up process.	• Strategy: Confirm that PSPs are aware of the portal, signed up to use the portal in advance, and trained on the use of the portal. The Liberty Wildfire Safety Community Advisory Board can be used as a means of accomplishing this. • Target timeline: Include PSP training as an agenda item in the March and August Wildfire Safety Community Advisory Board meetings. Discuss features of the site, how to sign up for the site and how to use the site.

8.4.2.2 Key Personnel, Qualifications, and Training

In this section, the electrical corporation must provide an overview of the key personnel constituting its emergency planning, preparedness, response, and recovery team(s) for wildfire and PSPS events. This includes identifying key roles and responsibilities, personnel resource planning (internal and external staffing needs), personnel qualifications, and required training programs.

Personnel Qualifications

The electrical corporation must report on the various roles, responsibilities, and qualifications of electrical corporation and contract personnel tasked with wildfire emergency preparedness planning, preparedness, response, and recovery, and those tasked for PSPS-related events. This may include representatives from administration, information technology (IT), human resources, communications, electrical operations, facilities, and any other mission-critical units in the electrical corporation. As part of this section, the electrical corporation must provide a brief narrative describing its process for planning to meet its internal and external staffing needs for emergency preparedness planning, preparedness, response, and recovery related to wildfire and PSPS. The narrative must be no more than two to four pages.

Liberty utilizes the National Incident Management System ("NIMS") Incident Command System ("ICS") structure company-wide in its activations for incidents of any type taking place in North America. In accordance with the ICS principals of adaptability and scalability, only required ICS positions are activated initially, and additional positions are added as an incident progresses. Following an all hazards approach, Liberty has specific response plans for the most probable incident responses to include PSPS, wildfire, and winter storms. The response plans for these incidents provide the most likely base ICS structure for these scenarios and checklists with responsibilities for the ICS positions activated in each scenario.

Due to the relatively small geographic area that Liberty covers, it is very unlikely that multiple IMTs or separate Area Commands would be activated under a Unified Command structure. However, Liberty does have this capability if needed. In larger incidents involving Liberty, coordination takes place with city, county, and/or CAL FIRE Emergency Operations Centers by providing EOC liaisons.

Liberty's incident management structure complies with SEMS, NIMS and ICS. A Liberty IMT is made up of trained staff from multiple Liberty organizational units who may be called on to lead a response to an incident. Multiple staff are trained for each IMT position to achieve resiliency in IMT staffing. The IMT may operate in person, via VTC, or through a hybrid structure using the two options. A Liberty IMT is activated in “serious impact events” where 10,000 to 19,000 customers are impacted, and estimated full restoration will be greater than 24 hours. In addition, an IMT is activated in any PSPS event.

- The PSPS IMT activates when conditions are projected to meet Liberty’s thresholds for the fuels Energy Release Component, Fosberg Fire Weather Index, and wind gusts. The ultimate de-energization decision is made by a Liberty Executive Steering Committee, which includes executive leadership, weather consultants, and Operations. Any de-energization would be implemented by the Incident Commander and IMT. PSPS IMT actions are outlined in the Liberty PSPS Playbook, which prescribes PSPS IMT baseline positions and checklist items for each position to accomplish during each phase of the response. A dedicated PSPS Playbook and IMT support consistent decision-making, deeper PSPS-specific experience, and greater ability to support continuous improvements during non-event periods. The Playbook includes pre-scripted messaging for each stage of a PSPS. It also prescribes separate liaisons for regulatory affairs, public safety partners, community-based organizations, and AFN customers.
- Additional staffing support required by the IMT is provided from a company “manpower pool” of personnel who do not have pre-designated IMT positions. Members of the manpower pool include metering operations personnel and customer service personnel when customer service functions are transferred to remote locations.
- Subject Matter Experts (“SMEs”) from across the company can support the IMT in an advisory capacity as needed. SMEs can include legal, human resources, information technology, etc. employees.

<u>Initial Qualification</u>: IMT members are required to complete ICS training through the company Learning Management System (LMS). This training was developed from and incudes the principles from the FEMA Emergency Management Institute (EMI) IS 100.c and IS 200.c courses. In addition, the Emergency Manager, Fire Prevention Managers, and Incident Commander are required to have completed the IS 100.c, IS 200.c, IS 700.b and IS 800.d courses.

<u>Requalification</u>: Training on ICS principals is assigned and tracked through the LMS system and is required to be completed yearly along with the practical application of training in both tabletop and functional exercises. Training has been conducted for customer service supervisors and staff with responsibilities for working in customer resource centers (“CRCs”) in the event of a PSPS. CRC staff training is provided and required each year prior to fire season

Liberty provides information on its Emergency Preparedness key personnel, qualifications and training in Table 8-47.

Table 8-47. Liberty Emergency Preparedness Staffing and Qualifications

Role	Incident Type	Responsibilities	Qualifications	No. of Dedicated Staff Required	No. of Dedicated Staff Provided	No. of Contract Workers Required	No. of Contract Workers Provided
Program Director	Wildfires	• Lead, oversee, and coordinate emergency preparedness department • Oversee all functions related to preventing, mitigating, responding to, and recovering from emergencies due to all relevant hazards for the electrical corporation • Develop, maintain, and update the electrical corporation emergency preparedness plan with associated policies, practices, and procedures • Direct and manage emergency program managers and supervisors • Evaluate resources, equipment, and personnel available to respond to emergencies • Monitor program performance; recommend and implement modifications to systems and procedures • Develop and oversee the electrical corporation's emergency operations center; evaluate regular and emergency communication systems; make recommendations as appropriate	• Incident Command Certifications: ICS 100, 200, 300, 700, 800 • Master's in Disaster Risk Management • Minimum 15 years' experience in disaster risk management and/or emergency preparedness and planning	1	1	None	None
Grid Operations Manager	Wildfires, PSPS	• Maintain facilities used during emergency operations	None established	3	3	None	None
Public Information Officer	Wildfires, PSPS	• Plan and host press conferences to announce major news or address crises • Prepare press releases, speeches, articles, social media posts, and other materials for public consumption • Develop strategies and procedures for working effectively with the media • Maintain good working relationships with media organizations • Collaborate with executive management and marketing team to ensure a cohesive public image • Work with various teams to organize and host public events and promotions • Speak directly to the public or media to address questions and represent the organization	• Bachelor's degree in communications, public relations, journalism, or related field • Prior experience in a public relations role • Exceptional written and verbal communication skills • Strong understanding of the media, including social media	1	1	None	None

Role	Incident Type	Responsibilities	Qualifications	No. of Dedicated Staff Required	No. of Dedicated Staff Provided	No. of Contract Workers Required	No. of Contract Workers Provided
			• Organized and detail-oriented work ethic • Ability to travel on short notice • Great public speaking and interpersonal skills				
Utility Incident Commander	Wildfires, PSPS	• Leads emergency operations center • Serve as point of contact for all wildfire-related emergencies/disasters in conjunction with the Program Director • Command all emergency response functions at the field response level	None established	1	1	None	None
Public Safety Partner Liaison	Wildfires, PSPS	• Develop relations with outside organizations, including local, state, and federal fire suppression organizations, the state Office of Emergency Services, the county sheriff's department, the Red Cross, school districts, etc.; maintain close working relationships to ensure rapid and coherent response in emergency situations • Coordinate with relevant public safety partners in electrical corporation's service territory (*e.g.*, fire, law enforcement, OES, CPUC, Energy Safety, Emergency Management Systems, public health departments, public works) to coordinate emergency preparedness, response and recovery plans, roles and responsibilities, etc. • Meet with public safety officials, private companies, and the general public to get recommendations regarding emergency response plans • Coordinate with local public safety partners to assess damage to communities • Coordinate getting assistance and supplies into impacted community • Oversee and direct a variety of emergency-related community education programs, including disaster preparedness programs and AM radio classes	None established	3	3	None	None
Trainer Officer	Wildfires, PSPS	• Run training courses and disaster exercises for staff, volunteers, and local agencies to ensure an effective and coordinated response to an emergency	None established	None	None	None	None

Personnel Training

The electrical corporation must report on its internal personnel training program(s) for wildfire and PSPS emergency events. This training must include, at a minimum, training on relevant policies, practices, and procedures before, during, and after a wildfire or PSPS event. The reporting must include, at a minimum:

- The name of each training program
- A brief narrative on the purpose and scope of each program
- The type of training method
- The schedule and frequency of training programs
- The percentage of staff who have completed the most current training program
- How the electrical corporation tracks who has completed the training programs

Liberty provides information on its Emergency Management personnel training in Table 8-48.

External Contractor Training

The electrical corporation must report on its external contractor training program(s) for wildfire and PSPS emergency events. This training must include, at a minimum, training on relevant policies, practices, and procedures before, during, and after a wildfire or PSPS event. The reporting must include, at a minimum:

- The name of each training program
- A brief narrative on the purpose and scope of each program
- The type of training method
- The schedule and frequency of training programs
- The percentage of contractors who have completed the most current training program
- How the electrical corporation tracks who has completed the training programs

Liberty provides information on its Emergency Management external contractor training in Table 8-49.

Table 8-48. Liberty Emergency Management Personnel Training Program

Training Topic	Purpose and Scope	Training Method	Training Frequency	Position or Title of Personnel Required to Take Training	# Personnel Requiring Training	# Personnel Provided with Training	Form of Verification or Reference
Community Resource Center Response	• Train internal employees in both Community Resource Center Lead and Community Resource Center Representative positions. Training for the process of setting up and supporting Community Resource Center locations in the event of PSPS	Virtual or In-Person	Annual	Community Resource Center Lead, Community Resource Center Representative, applicable department management	12 Leads; 23 Representatives	12 Leads; 23 Representatives; materials and training recording provided to those unable to attend	Training logs
Introduction to the electrical corporation's emergency preparedness plan	• The contents of emergency response plans, in particular those for wildfire- and PSPS-specific incidents • The electrical corporation's overall safety practices and those specific to wildfire and PSPS incidents • The organizational structure of how the electrical corporation responds to, manages, and recovers from incidents • The electrical corporation's and public safety partners' roles and responsibilities before, during, and after a wildfire or PSPS incident • The electrical corporation's notification and activation protocols for wildfires and PSPS incidents	Online course, workshop, or in-person training	Annually	All staff	4,100	3,800	Training materials and training logs
Emergency response procedures during a wildfire	• Incident Management Team Assignments during a wildfire scenario • Wildfire response procedures during incident	Workshop, or in-person training	Annually prior to Fire Season	Incident Management Team	25	25	Training logs

Training Topic	Purpose and Scope	Training Method	Training Frequency	Position or Title of Personnel Required to Take Training	# Personnel Requiring Training	# Personnel Provided with Training	Form of Verification or Reference
	• Immediate Response, 0-2 hours • Intermediate Response, 2-12 hours • Extended Response, Greater than 12 hours • Demobilization/System Recovery						
Practices, policies, and procedures for emergency response and service restoration for PSPS events	• Incident Management Team actions for PSPS stages 1, 2a, 2b, 3, 4, and 5 as outlined in the PSPS Playbook	TTX and FSX	Annually	Incident Management Team	25	25	Training Logs

Table 8-49. Liberty Emergency Management Contractor Training Program

Training Topic	Purpose and Scope	Training Method	Training Frequency	Position or Title of Personnel Required to Take Training	# Contractors Requiring Training	# Contractors Completed Training	Form of Verification or Reference

Introduction to the electrical corporation's mutual aid agreement with aid partner	• Familiarize aid partners with the concepts and actions in the mutual aid operations plan prior to implementation
	• Allow responding resources the opportunity to practice their procedures and responsibilities
	• Scope items include:
	  ○ Contents of mutual aid operations plan, in particular those on wildfire- and PSPS-specific incidents
	  ○ The electrical corporation's overall safety practices and those specific to wildfire and PSPS incidents
	  ○ The organizational structure and interoperability of how the mutual aid partners and resources collaborate and coordinate
	  ○ The electrical corporation's and public safety partners' roles and responsibilities before, during, and after a wildfire or PSPS incident
	  ○ The electrical corporation's notification and activation protocols for wildfires and PSPS events
		Online course, workshop, or in-person training	Annually	All potential mutual aid resources	150	135	Training materials and training logs

8.4.2.3 Drills, Simulations, and Tabletop Exercises

Discussion-based and operational-based exercises enhance knowledge of plans, allow personnel to improve their own performance, and identify opportunities to improve capabilities to respond to real wildfire emergency events and PSPS events. Exercises also provide a method to evaluate an electrical corporation's emergency preparedness plan and identify planning and/or procedural deficiencies.

Internal Exercises

The electrical corporation must report on its program(s) for conducting internal discussion-based and operations-based exercises for both wildfire and PSPS emergency events. This must include, at a minimum:

- The types of discussion-based exercises (*e.g.*, seminars, workshops, tabletop exercises, games) and operations-based exercises (*e.g.*, drills, functional exercises, full-scale exercises)
- The purpose of the exercises
- The schedule and frequency of exercise programs
- The percentage of staff who have completed/participated in exercises
- How the electrical corporation tracks who has completed the exercises

Liberty conducts internal exercises to provide expedient and efficient operations of its Incident Management Team in response to the most prevalent threats in its service area. In 2022 this included:

- An internal PSPS Table-Top exercise took place on May 25, 2022.
- An internal Wildfire Table-Top exercise took place on August 4, 2022.
- An internal Winter Storm Table-Top exercise scheduled for Nov 8, 2022, was precluded by an actual winter storm event.

The purpose of the exercises is to exercise Liberty's emergency response plans, log items for improvement, and continually improve the quality of our plan and emergency response efforts. Table-Top exercises are conducted three times per year. If a real-world event precludes the exercise being held the real-world event will satisfy the requirement for an exercise. Approximately 90 percent of staff assigned to the organization Incident Management Team and organization leadership have participated in internal Table-Top exercises. Exercise participation is logged on sign-in rosters.

Liberty provides information on its Emergency Management drills, simulations and tabletop exercises in Table 8-50.

External Exercises

The electrical corporation must report on its program(s) for conducting external discussion-based and operations-based exercises for both wildfire and PSPS emergency events. This must include, at a minimum:

- The types of discussion-based exercises (*e.g.*, seminars, workshops, tabletop exercises, games) and operations-based exercises (*e.g.*, drills, functional exercises, full-scale exercises)
- The schedule and frequency of exercise programs
- The percentage of public safety partners who have participated in these exercises
- How the electrical corporation tracks who has completed the exercises

Liberty provides information on its Emergency Management external exercises in Table 8-51.

Table 8-50. Liberty Emergency Management Internal Drill, Simulation, and Tabletop Exercise Program

Category	Exercise Title and Type	Purpose	Exercise Frequency	Position or Title of Personnel Required to Participate	# Personnel Participation Required	# Personnel Participation Completed	Form of Verification or Reference
Discussion-based	PSPS event tabletop exercise	• Provide electrical corporation a way to determine its readiness to respond to a PSPS event • Identify gaps or problems with existing policies and plans • Help administration and staff understand their roles during a PSPS event. • Serve as an Incident Command training tool • Serve as a tool for modifying and improving existing PSPS plans based on lessons learned during the exercise • Service restoration exercised as a component of the exercise	Annually	• Senior Director of Operations • Emergency Services Coordinator • Senior Manager Communications • Coordinator Regional Comms • Sr. Manager Wildfire Prevention • Mgr. Regulatory Affairs • Sr Mgr. Customer Solutions • Manager Customer Care II • Safety Manager • Director of Operations • Customer Service Manager • Specialist II, GIS • Manager Electric Control	13	15	Exercise scoping materials and After Action Report (“AAR”)
Discussion-based	Wildfire tabletop exercise	• Provide electrical corporation a way to determine its readiness to respond to a Wildfire event • Identify gaps or problems with existing policies and plans • Help administration and staff understand their roles during a Wildfire event • Serve as an Incident Command training tool • Serve as a tool for modifying and improving existing Wildfire response plans based on lessons learned during the exercise • Service restoration exercised as a component of the exercise	Annually	• Senior Director of Operations • Senior Manager Wildfire Prevention • Senior Manager Communications • Safety Manager • Emergency Services Coordinator • Customer Service Manager • Specialist II, GIS • Manager Operations NLT • Manager Operations SLT	13	15	Exercise scoping materials and After Action Report (“AAR”)

Category	Exercise Title and Type	Purpose	Exercise Frequency	Position or Title of Personnel Required to Participate	# Personnel Participation Required	# Personnel Participation Completed	Form of Verification or Reference
				• Manager Electric Control • Warehouse Supervisor • Director Procurement • Buyer III, Finance • Accountant III • Manager, Human Resources			
Operations-based	Winter Storm emergency drill	• Provide electrical corporation a way to determine its readiness to respond to a winter storm • Identify gaps or problems with existing policies and plans • Help personnel understand roles during a winter storm emergency • Serve as a training tool • Service restoration exercised as a component of the exercise	Annually (before December 1)	• Senior Director of Operations • Emergency Services Coordinator • Senior Manager Communications • Sr. Manager Wildfire Prevention • Safety Manager • Director of Operations • Customer Service Manager • Specialist II, GIS • Manager Operations NLT • Manager Operations SLT • Manager Electric Control • Manager Vegetation Management • Manager Field Services • Warehouse Supervisor • Director Procurement • Buyer III, Finance	16	19	Exercise scoping materials and AAR

Table 8-51. Liberty Emergency Management External Drill, Simulation, and Tabletop Exercise Program

Category	Exercise Title and Type	Purpose	Exercise Frequency	Position or Title of Personnel Required to Participate	# Personnel Participation Required	# Personnel Participation Completed	Form of Verification or Reference
Discussion-based	PSPS event tabletop exercise	• Provide electrical corporation and public safety partners a way to determine their readiness to respond to and recover from a PSPS event • Clarify gaps or problems with existing mutual aid agreements (MAAs) and memorandums of agreement (MOAs), policies, and plans • Help electrical corporation and public safety partners understand their roles during a PSPS event • Serve as an Incident Command training tool • Help identify needs for other resources • Serve as a tool for modifying and improving existing PSPS coordination and emergency response plans based on the lessons learned during the exercise • Service restoration exercised as a component of the exercise	Annually	• Senior Director of Operations • Emergency Services Coordinator • Senior Manager Communications • Coordinator Regional Comms • Sr. Manager Wildfire Prevention • Mgr. Regulatory Affairs • Sr Mgr. Customer Solutions • Manager Customer Care II • Safety Manager • Director of Operations • Customer Service Manager • Specialist II, GIS • Manager Electric Control	13	15	Exercise scoping materials and AAR
Discussion-based	PSPS Functional Exercise	• Provide electrical corporation and public safety partners a way to determine their readiness to respond to and recover from a PSPS event in a functional environment • Clarify gaps or problems with existing mutual aid agreements (MAAs) and memorandums of agreement (MOAs), policies, and plans • Help electrical corporation and public safety partners understand their roles during a PSPS event • Serve as an Incident Command training tool • Help identify needs for other resources • Serve as a tool for modifying and improving existing PSPS coordination and emergency response plans based on the lessons learned during the exercise	Annually (before September 1)	• Senior Director of Operations • Emergency Services Coordinator • Senior Manager Communications • Coordinator Regional Comms • Sr. Manager Wildfire Prevention • Mgr. Regulatory Affairs • Sr Mgr. Customer Solutions • Manager Customer Care II • Safety Manager • Director of Operations • Customer Service Manager	13	15	Exercise scoping materials and completion logs

Category	Exercise Title and Type	Purpose	Exercise Frequency	Position or Title of Personnel Required to Participate	# Personnel Participation Required	# Personnel Participation Completed	Form of Verification or Reference
		• Service restoration exercised as a component of the exercise		• Specialist II, GIS • Manager Electric Control			

8.4.2.4 Schedule for Updating and Revising Plan

The electrical corporation must provide a log of the updates to its emergency preparedness plan since 2019 and the date of its next planned update.

Updates should occur every two years, per R. 15-06-009 and D. 21-05-019. For each update, the electrical corporation must provide the following:

- Year of updated plan
- Revision type (*e.g.*, addition, modification, elimination)
- Component modified (*e.g.*, communications, training, drills/exercises, protocols/procedures, MOAs)
- A brief description of the lesson learned that informed the revision
- A brief description of the specific addition, modification, or elimination

Liberty provides wildfire-specific updates to its Emergency Preparedness Plan in Table 8-52.

Table 8-52. Liberty Wildfire-Specific Updates to the Emergency Preparedness Plan

ID #	Year of Updated Plan	Revision Type	Lesson Learned	Revision Description	Reference Section
1	2021	Addition	Liberty has electrical companies across the U.S. Liberty uses the National Incident Management System ("NIMS") as its Incident Command System ("ICS").	Updated plan to specify that Liberty will use the ICS based on NIMS in the implementation of Incident Command.	Section 3.0
2	2021	Modification	The name of the Squaw Valley area that Liberty serves has been renamed to Palisades Tahoe.	Changed Squaw Valley to Palisades Tahoe.	Section 3.1
3	2021	Addition	Incident Management Team positions not specified in the plan.	The Incident Management Team may consist of the Incident Commander and any or all of the following positions: Public Information Officer, Safety and Security Officer, Emergency Response Liaison, and Emergency Services Coordinator.	Section 3.3
4	2021	Modification	Additional Liaisons were added to the Incident Management Team to manage all PSPS Liaison requirements.	Four Liaisons designated: Public Safety Partner/Critical Infrastructure Liaison, Community Based Organizations Liaison, Regulatory Liaison, and AFN Liaison.	Section 3.3.; d.iv
5	2021	Addition	Use of the Incident Action Planning Process spelled out in detail at the request of the CPUC.	Liberty employs the Incident Action Planning process. Responsibilities of the Incident Commander, Plans Chief, and Safety Officer in Incident Action Plan (IAP) development are described. Forms for IAP documentation and procedures for dissemination are spelled out.	Section 3.5
6.	2021	Addition	Points of contact for coordination with PG&E needed.	Points of contact and phone numbers added for coordination with PG&E. One for Eldorado County, another for Placer/Nevada Counties.	Section 8.3

8.4.3 External Collaboration and Coordination

8.4.3.1 Emergency Planning

In this section, the electrical corporation must provide a high-level description of its wildfire and PSPS emergency preparedness coordination with relevant public safety partners at state, county, city, and tribal levels within its service territory. The electrical corporation must indicate if its coordination efforts follow California's SEMS or, where relevant for multi-jurisdictional electrical corporations (*e.g.*, PacifiCorp), the Federal Emergency Management Agency (FEMA) National Incident Management Systems (NIMS), as permitted by G.O. 166. The description must be no more than a page.

In addition, the electrical corporation must provide the following information in tabular form, with no more than one page of information in the main body of the WMP and a full table, if needed, in an appendix:

- List of relevant state, city, county, and tribal agencies within the electrical corporation's service territory and key point(s) of contact, with associated contact information. Where necessary, contact information can be redacted for the public version of the WMP.
- For each agency, whether the agency has provided consultation and/or verbal or written comments in preparation of the most current wildfire- and PSPS-specific emergency preparedness plan. If so, the electrical corporation should provide the date, time, and location of the meeting at which the agency's feedback was received.
- For each agency, whether it has an MOA with the electrical corporation on wildfire and/or PSPS emergency preparedness, response, and recovery activities. The electrical corporation must provide a brief summary of the MOA, including the agreed role(s) and responsibilities of the external agency before, during, and after a wildfire or PSPS emergency.
- In a separate table, a list of current gaps and limitations in the electrical corporation's existing collaboration efforts with relevant state, county, city, and tribal agencies within its territory. Where gaps or limitations exist, the electrical corporation must indicate the remedial action plan and the timeline for resolving the gaps or limitations.
- For all requested information, a form of verification that can be provided upon request for compliance assurance.

The electrical corporation must reference the Utility Initiative Tracking ID where appropriate.

Tracking ID: WMP-EP-02

Liberty provides information on its Emergency Planning collaboration and coordination in Table 8-53 and Table 8-54.

Table 8-53. Liberty Emergency Management State and Local Agency Collaboration(s)

Name of State or Local Agency	Point of Contact and Information	Emergency Preparedness Plan Collaboration – Last Version of Plan Agency Collaborated	Emergency Preparedness Plan Collaboration – Collaborative Role	Memorandum of Agreement (MOA)?	Brief Description of MOA
Alpine County	JT Chevallier, Economic Development Director jchevallier@alpinecountyca.gov	Community Resource Center (CRC) Discussion 2/1/2022	Discussed use of the Turtle Rock Community Center as a CRC	No	No MOA to describe
Liberty Wildfire Safety Community Advisory Board	Wildfire Safety Community Advisory Board Members	Briefing to Board members 3/31/2022	Briefed PSPS program for 2022, answered questions on the program.	No	No MOA to describe
Alpine County Board of Supervisors	JT Chevallier, Economic Development Director jchevallier@alpinecountyca.gov	Briefing to Alpine County Board of Supervisors Meeting 4/6/2022	Briefed on PSPS procedures and the CRC program.	No	No MOA to describe
Placer County	Dave Atkinson, Assistant Director, Placer County OES DAtkinso@placer.ca.gov	Briefing to PSPs in the Placer County Operational area. 5/2/2022	Briefed the Wildfire Management plan, PSPS preparedness, Community Resource Program	No	No MOA to describe
CPUC, CAL FIRE, IOUs	Dru Dunton Drucilla.Dunton@CPUC.ca.gov	CPUC, CAL FIRE, IOUs briefed on 5/26/2022.	Briefed Planning and Execution of PSPS exercises in 2022	No	No MOA to describe
NV Energy, Placer and Nevada County PSPs, Tahoe Donner Public Utility District	Steven Poncelet Stevenponcelet@tdpud.org	Briefing to NV Energy, Placer County, and Nevada County Local Agency spring kick-off meeting to discuss communication during a PSOM 8/3/2022.	Briefed the Wildfire Management Plan and performed PSPS outreach	No	No MOA to describe

Name of State or Local Agency	Point of Contact and Information	Emergency Preparedness Plan Collaboration – Last Version of Plan Agency Collaborated	Emergency Preparedness Plan Collaboration – Collaborative Role	Memorandum of Agreement (MOA)?	Brief Description of MOA
Town of Truckee	Bob Womack rwomack@townoftruckee.com	Coordination with PSPs in Placer and Nevada Counties and the Town of Truckee.	TTX to develop and exercise the Town of Truckee evacuation plan	No	No MOA to describe
City of Portola Health and Human Resources Loyalton Senior Center	Dakota Davis DMDavis@pcbh.services Carolyn Widman Carolyniscsc@outlook.com	Community Presentations 7/22/2022	Presented on PSPS	No	No MOA to describe
South Lake Tahoe Fire Dept South Tahoe Refuse	Chjowells@southtahoerefuse.com	South Lake Tahoe Fire Fest 10/1/2022	Presented on downed line procedures to the general public.	No	No MOA to describe
Liberty Wildfire Safety Community Advisory Board	Wildfire Safety Community Advisory Board Members	Training for Board members 9/9/2022	Conducted Training on the Public Safety Partner Portal	No	No MOA to describe
South Lake Tahoe Fire South Lake Tahoe Community Recreation Center	Sara Letton sletton@Cityofslt.us	Community Resource Center (CRC) Discussion	Discussed the use of the South Lake Tahoe City Rec Center as a CRC.	No	No MOA to describe

Table 8-54. Liberty Gaps and Limitations in Collaboration Activities with State and Local Agencies

Gap or Limitation Subject	Remedial Brief Description	Remedial Action Plan
Additional coordination needed with Region 9 Department of Homeland Security ("DHS").	Liberty requires additional guidance on mitigation of the threats from a cyber-attack, and/or vehicle born IED.	Include DHS in planning and exercising the Liberty CEMP in response to cyber security and vehicle born IED threats. DHS will be included in the planning and execution of the PSPS TTX and PSPS FXS to assist with injects to respond to cyber security and Vehicle born IEDs threats.

8.4.3.2 Communication Strategy with Public Safety Partners

The electrical corporation must describe at a high level its communication strategy to inform external public safety partners and other interconnected electrical corporation partners of wildfire, PSPS, and re-energization events as required by G.O. 166 and Public Utilities Code section 768.6. This must include a brief description of the policies, practices, and procedures the electrical corporation adopts to establish appropriate communication protocols with public safety partners for both wildfire- and PSPS-specific incidents to ensure timely, accurate, and complete communications. The electrical corporation must refer to its emergency preparedness plan as needed to provide more detail. The narrative must be no more than two pages.

As each public safety partner will have its own unique communication protocols, procedures, and systems, the electrical corporation must coordinate with each entity individually. The electrical corporation must summarize the following information in tabulated format:

- All relevant public safety partner groups (*e.g.*, fire, law enforcement, OES, municipal governments, Energy Safety, CPUC, other electrical corporations) at every level of administration (state, county, city, or tribe) as needed.
- The names of individual public safety entities.
- For each entity, the point of contact for emergency communications coordination, and the contact information. Information may be redacted as needed.
- Key protocols for ensuring the necessary level of voice and data communications (*e.g.*, interoperability channels, methods for information exchange, format for each data typology, communication capabilities, data management systems, backup systems, common alerting protocols, messaging), and associated references in the emergency plan for more details.
- Frequency of prearranged communication review and updates.
- Date of last discussion-based or operations-based exercise(s) on public safety partner communication.

In a separate table, the electrical corporation must list the current gaps and limitations in its public safety partner communication strategy coordination. Where gaps or limitations exist, the electrical corporation must indicate the remedial action plan and the timeline for resolving the gaps or limitations. For all requested information, the electrical corporation must indicate a form of verification that can be provided upon request for compliance assurance.

Liberty has established a communication strategy to inform external public safety partners and other interconnected electrical corporation partners of wildfire, PSPS, and re-energization events as required by G.O. 166 and Public Utilities Code Section 768.6.

Notifications: During a major outage or emergency that affects a significant number of customers, an email is sent to personnel, agencies, and media to provide information, detail, and status of the outage. As the outage or emergency continues, status update emails and/or phone calls will be made to keep the agencies and media informed. Once the outage has concluded and the system is back to normal, a final email will be sent to close out the communication of the incident.

A contact list of local governmental agencies, municipalities, and media outlets within Liberty's service territory has been developed (see Table 8-46). Liberty's public safety partner and critical facilities contact list is formatted for compatibility with the Everbridge mass communication platform. Each entity is listed within the county for which they provide service. Entities such as CALFIRE, which need to be notified regardless of which counties a PSPS may impact, are given a designation in Everbridge.

Governmental and Regulatory Communications: During emergency events, Liberty works directly with local law enforcement, medical agencies, and fire agencies. In larger emergencies, city and county emergency management representatives provide coordinating responsibilities in responding to the event. In escalating emergency events, additional coordinating resources, such as an Emergency Response Liaison and/or a Government Liaison, can be activated by the Incident Commander.

During emergency events, Liberty will provide a liaison to the highest level of city or county Emergency Operations Center activated. This will be accomplished through the Emergency Response Liaison or Government Liaison, who are both members of the Emergency Management Team. If an emergency event is large enough to initiate the activation of a State level Emergency Operations Center or Regional Emergency Operations Center, the Emergency Response Liaison will communicate with the State Emergency Operations Center ("EOC"). The California state coordination will be through the California Utilities Emergency Association ("CUEA") Emergency Operations Center. As a member of the CUEA, Liberty Utilities is party to its Mutual Assistance Agreement and is represented in the Utility Operations Center ("UOC"), which is in the State Operations Center ("SOC"). All mutual assistance activities will be communicated to the State EOC and the Utilities Operations Center ("UOC")/Office of Emergency Services ("OES") during an emergency.

City/county, OES offices, critical infrastructure, CPUC, and agency partners will receive the earliest notifications of a “significant” planned or potentially planned outage, up to eight days in advance, when possible. Liberty will continue to provide updates to these contacts as the outage event nears or whenever conditions or details change. Communications will be executed by text, email, and phone calls. City/county, OES offices, critical infrastructure, CPUC, and agency partners will also receive updates at the 48-hour mark. Local website, radio, newspapers, and TV media will be notified and requested to broadcast the PSA. Updates will be directly communicated 24 hours in advance and right before the outage commences, as appropriate.

During the outage, updates will be sent directly to city/county, OES offices, critical infrastructure, CPUC, agency partners, and media, as well as posted to social media accounts and the Liberty website as updates are available or situations change. In addition, during a PSPS outage, additional outage information to include critical infrastructure impacted and more detailed information on lines/customers impacted will be provided to Public Safety Partners via the Liberty Public Safety Partner Portal. Once the outage has concluded, a final update will be sent directly to city/county, OES offices, critical infrastructure, CPUC, agency partners, and media, as well as posted to social media accounts and the Liberty website with a request that any remaining power outages or issues be communicated with Liberty .

For all unplanned outages, Liberty will post outage information on social media accounts and website. Media, city/county, OES offices, critical infrastructure, CPUC, and agency partners will be notified if the severity of the outage warrants. City/county, OES offices, critical infrastructure, CPUC, and agency partners will receive direct text, email, and/or voice message updates via the Everbridge system and again when the outage has concluded. Once power has been restored, Liberty will request that any remaining power outages or issues be communicated with Liberty Communication Channels.

Communications with Transmission Owner (“TO”): NV Energy is the TO for Liberty. During emergencies, the Emergency Management Team is (“EMT”) Emergency Response Liaison is responsible for coordinating and communicating all anticipated major system impacts to Liberty’s System Control Center in New Hampshire. The System Control Center is responsible for providing information to the NV Energy Distribution Desk or Transmission Desk, as appropriate. A specific plan for communicating with NV Energy including the information to be provided is included in the Liberty CEMP on page 14, paragraphs A and B.

Liberty provides information on its communications strategies with PSPs in Table 8-55 and Table 8-56.

Table 8-55. Liberty High-Level Communication Protocols, Procedures, and Systems with Public Safety Partners

Public Safety Partner Group	Name of Entity	Point of Contact and Information	Email Address	Phone Number	Key Protocols	Frequency of Prearranged Communication Review and Update	Communication Exercise(s): Date of Last Completed	Communication Exercise(s): Date of Planned Next
El Dorado County	El Dorado Co Emergency Prep	Kristine Guth	Redacted	Redacted	Communication Capabilities, Common Protocols	Annually (April)	Table-Top Exercise, 06/23/2022 at 0830 PST	Workshop, 03/23/2023 at 2 pm PST
El Dorado County	El Dorado Co Sheriff	Moke Auwae	Redacted	Redacted	Communication Capabilities, Common Protocols	Annually (April)	Table-Top Exercise, 06/23/2022 at 0830 PST	Workshop, 03/23/2023 at 2 pm PST
El Dorado County	El Dorado Co Supervisor	Sue Novasel			Communication Capabilities, Common Protocols	Annually (April)	Table-Top Exercise, 06/23/2022 at 0830 PST	Workshop, 03/23/2023 at 2 pm PST
El Dorado County	South Tahoe PUD	Jeff Lee			Communication Capabilities, Common Protocols	Annually (April)	Table-Top Exercise, 06/23/2022 at 0830 PST	Workshop, 03/23/2023 at 2 pm PST
El Dorado County	South Tahoe PUD	Chris Stanley	Redacted	Redacted	Communication Capabilities, Common Protocols	Annually (April)	Table-Top Exercise, 06/23/2022 at 0830 PST	Workshop, 03/23/2023 at 2 pm PST
El Dorado County	El Dorado Co OES	Greg Almos	Redacted	Redacted	Communication Capabilities, Common Protocols	Annually (April)	Table-Top Exercise, 06/23/2022 at 0830 PST	Workshop, 03/23/2023 at 2 pm PST
El Dorado County	Lukin Water Company	Danny Lukins	Redacted	Redacted	Communication Capabilities, Common Protocols	Annually (April)	Table-Top Exercise, 06/23/2022 at 0830 PST	Workshop, 03/23/2023 at 2 pm PST
El Dorado County	SLT City Manager	Joe Irvin	Redacted	Redacted	Communication Capabilities, Common Protocols	Annually (April)	Table-Top Exercise, 06/23/2022 at 0830 PST	Workshop, 03/23/2023 at 2 pm PST
El Dorado County	LTCC VP Admin Services	Russi Egan	Redacted	Redacted	Communication Capabilities, Common Protocols	Annually (April)	Table-Top Exercise, 06/23/2022 at 0830 PST	Workshop, 03/23/2023 at 2 pm PST
El Dorado County	USFS	Harold Flory	Redacted	Redacted	Communication Capabilities, Common Protocols	Annually (April)	Table-Top Exercise, 06/23/2022 at 0830 PST	Workshop, 03/23/2023 at 2 pm PST
El Dorado County	South Tahoe PUD	Jeremy Rutherdale	Redacted	Redacted	Communication Capabilities, Common Protocols	Annually (April)	Table-Top Exercise, 06/23/2022 at 0830 PST	Workshop, 03/23/2023 at 2 pm PST
El Dorado County	City of SLT Fire Chief	Jim Drennan	Redacted	Redacted	Communication Capabilities, Common Protocols	Annually (April)	Table-Top Exercise, 06/23/2022 at 0830 PST	Workshop, 03/23/2023 at 2 pm PST

Public Safety Partner Group	Name of Entity	Point of Contact and Information	Email Address	Phone Number	Key Protocols	Frequency of Prearranged Communication Review and Update	Communication Exercise(s): Date of Last Completed	Communication Exercise(s): Date of Planned Next
El Dorado County	Fallen Leaf Fire Chief/CSD	Gary Gerren	Redacted	Redacted	Communication Capabilities, Common Protocols	Annually (April)	Table-Top Exercise, 06/23/2022 at 0830 PST	Workshop, 03/23/2023 at 2 pm PST
El Dorado County	Lake Valley Fire Chief	Chad Stephen	Redacted	Redacted	Communication Capabilities, Common Protocols	Annually (April)	Table-Top Exercise, 06/23/2022 at 0830 PST	Workshop, 03/23/2023 at 2 pm PST
El Dorado County	SLT Airport Mgr	Anush Nejad	Redacted	Redacted	Communication Capabilities, Common Protocols	Annually (April)	Table-Top Exercise, 06/23/2022 at 0830 PST	Workshop, 03/23/2023 at 2 pm PST
El Dorado County	Glenridge Park Water Co.	Steven Glazer	Redacted	Redacted	Communication Capabilities, Common Protocols	Annually (April)	Table-Top Exercise, 06/23/2022 at 0830 PST	Workshop, 03/23/2023 at 2 pm PST
El Dorado County	Barton Hosp Safety and Security Mngr	April Boyde	Redacted	Redacted	Communication Capabilities, Common Protocols	Annually (April)	Table-Top Exercise, 06/23/2022 at 0830 PST	Workshop, 03/23/2023 at 2 pm PST
Placer/Nevada County	Truckee EMS Coordinator	Robert Womack	Redacted	Redacted	Communication Capabilities, Common Protocols	Annually (April)	Table-Top Exercise, 06/23/2022 at 0830 PST	Workshop, 03/23/2023 at 2 pm PST
Placer/Nevada County	Truckee Dir Public Works	Dan Wilkins	Redacted	Redacted	Communication Capabilities, Common Protocols	Annually (April)	Table-Top Exercise, 06/23/2022 at 0830 PST	Workshop, 03/23/2023 at 2 pm PST
Placer/Nevada County	Truckee Fire Chief	Kevin McKechnie	Redacted	Redacted	Communication Capabilities, Common Protocols	Annually (April)	Table-Top Exercise, 06/23/2022 at 0830 PST	Workshop, 03/23/2023 at 2 pm PST
Placer/Nevada County	Nevada Co OES Program Manager	Paul Cummings	Redacted	Redacted	Communication Capabilities, Common Protocols	Annually (April)	Table-Top Exercise, 06/23/2022 at 0830 PST	Workshop, 03/23/2023 at 2 pm PST
Placer/Nevada County	TFH Director of Facilities	Dylan Crosby	Redacted	Redacted	Communication Capabilities, Common Protocols	Annually (April)	Table-Top Exercise, 06/23/2022 at 0830 PST	Workshop, 03/23/2023 at 2 pm PST
Placer/Nevada County	TFH EOC Coordinator	Myeara Tanner	Redacted	Redacted	Communication Capabilities, Common Protocols	Annually (April)	Table-Top Exercise, 06/23/2022 at 0830 PST	Workshop, 03/23/2023 at 2 pm PST
Placer/Nevada County	Truckee PUD Water Sup	Brian Wright	Redacted	Redacted	Communication Capabilities, Common Protocols	Annually (April)	Table-Top Exercise, 06/23/2022 at 0830 PST	Workshop, 03/23/2023 at 2 pm PST
Placer/Nevada County	Truckee PUD Elec Utility PIO	Steven Poncelet	Redacted	Redacted	Communication Capabilities, Common Protocols	Annually (April)	Table-Top Exercise, 06/23/2022 at 0830 PST	Workshop, 03/23/2023 at 2 pm PST

Public Safety Partner Group	Name of Entity	Point of Contact and Information	Email Address	Phone Number	Key Protocols	Frequency of Prearranged Communication Review and Update	Communication Exercise(s): Date of Last Completed	Communication Exercise(s): Date of Planned Next
Placer/Nevada County	TTUSD Superintendent	Carmen Ghysels	Redacted	Redacted	Communication Capabilities, Common Protocols	Annually (April)	Table-Top Exercise, 06/23/2022 at 0830 PST	Workshop, 03/23/2023 at 2 pm PST
Placer/Nevada County	TTUSD CBO	Todd Rivera	Redacted	Redacted	Communication Capabilities, Common Protocols	Annually (April)	Table-Top Exercise, 06/23/2022 at 0830 PST	Workshop, 03/23/2023 at 2 pm PST
Placer/Nevada County	Placer County Sheriff LT	Paul Long			Communication Capabilities, Common Protocols	Annually (April)	Table-Top Exercise, 06/23/2022 at 0830 PST	Workshop, 03/23/2023 at 2 pm PST
Placer/Nevada County	North Tahoe Business Assn	Kerry Andras			Communication Capabilities, Common Protocols	Annually (April)	Table-Top Exercise, 06/23/2022 at 0830 PST	Workshop, 03/23/2023 at 2 pm PST
Placer/Nevada County	Placer County Sheriff Captain	Darrell Steinhauer	Redacted	Redacted	Communication Capabilities, Common Protocols	Annually (April)	Table-Top Exercise, 06/23/2022 at 0830 PST	Workshop, 03/23/2023 at 2 pm PST
Placer/Nevada County	Northstar Fire Chief	J Gibeaut	Redacted	Redacted	Communication Capabilities, Common Protocols	Annually (April)	Table-Top Exercise, 06/23/2022 at 0830 PST	Workshop, 03/23/2023 at 2 pm PST
Placer/Nevada County	North Tahoe Fire PIO	Erin Holland	Redacted	Redacted	Communication Capabilities, Common Protocols	Annually (April)	Table-Top Exercise, 06/23/2022 at 0830 PST	Workshop, 03/23/2023 at 2 pm PST
Placer/Nevada County	Squaw Valley Fire Chief	Allen Riley	Redacted	Redacted	Communication Capabilities, Common Protocols	Annually (April)	Table-Top Exercise, 06/23/2022 at 0830 PST	Workshop, 03/23/2023 at 2 pm PST
Placer/Nevada County	Tahoe City PUD Dir Util	Tony Laliotis	Redacted	Redacted	Communication Capabilities, Common Protocols	Annually (April)	Table-Top Exercise, 06/23/2022 at 0830 PST	Workshop, 03/23/2023 at 2 pm PST
Placer/Nevada County	Tahoe Swiss Water Co	Steven Glazer	Redacted	Redacted	Communication Capabilities, Common Protocols	Annually (April)	Table-Top Exercise, 06/23/2022 at 0830 PST	Workshop, 03/23/2023 at 2 pm PST
Placer/Nevada County	USFS - LTBMU	Tod Flowers	Redacted	Redacted	Communication Capabilities, Common Protocols	Annually (April)	Table-Top Exercise, 06/23/2022 at 0830 PST	Workshop, 03/23/2023 at 2 pm PST
Placer/Nevada County	Placer County Telecomm	Dieter Wittenberg	Redacted	Redacted	Communication Capabilities, Common Protocols	Annually (April)	Table-Top Exercise, 06/23/2022 at 0830 PST	Workshop, 03/23/2023 at 2 pm PST
Placer/Nevada County	Nevada Co OES	Bob Jakobs	Redacted	Redacted	Communication Capabilities, Common Protocols	Annually (April)	Table-Top Exercise, 06/23/2022 at 0830 PST	Workshop, 03/23/2023 at 2 pm PST

Public Safety Partner Group	Name of Entity	Point of Contact and Information	Email Address	Phone Number	Key Protocols	Frequency of Prearranged Communication Review and Update	Communication Exercise(s): Date of Last Completed	Communication Exercise(s): Date of Planned Next
Placer/Nevada County	North Tahoe PUD	Will Stelter			Communication Capabilities, Common Protocols	Annually (April)	Table-Top Exercise, 06/23/2022 at 0830 PST	Workshop, 03/23/2023 at 2 pm PST
Placer/Nevada County	Squaw Valley PSD	Josh Wilson	Redacted	Redacted	Communication Capabilities, Common Protocols	Annually (April)	Table-Top Exercise, 06/23/2022 at 0830 PST	Workshop, 03/23/2023 at 2 pm PST
Placer/Nevada County	Fulton Water	Taylor Dolph	Redacted	Redacted	Communication Capabilities, Common Protocols	Annually (April)	Table-Top Exercise, 06/23/2022 at 0830 PST	Workshop, 03/23/2023 at 2 pm PST
Placer/Nevada County	Placer County Public Health	Michelle Romero	Redacted	Redacted	Communication Capabilities, Common Protocols	Annually (April)	Table-Top Exercise, 06/23/2022 at 0830 PST	Workshop, 03/23/2023 at 2 pm PST
Placer/Nevada County	Nevada County	Hardy Bullock	Redacted	Redacted	Communication Capabilities, Common Protocols	Annually (April)	Table-Top Exercise, 06/23/2022 at 0830 PST	Workshop, 03/23/2023 at 2 pm PST
Placer/Nevada County	Placer County Public Health	Chris Hazen	Redacted	Redacted	Communication Capabilities, Common Protocols	Annually (April)	Table-Top Exercise, 06/23/2022 at 0830 PST	Workshop, 03/23/2023 at 2 pm PST
Plumas/Sierra County	Plumas Co Sheriff	Todd Johns	Redacted	Redacted	Communication Capabilities, Common Protocols	Annually (April)	Table-Top Exercise, 06/23/2022 at 0830 PST	Workshop, 03/23/2023 at 2 pm PST
Plumas/Sierra County	Portola City Code Compliance	Kevin Sankey	Redacted	Redacted	Communication Capabilities, Common Protocols	Annually (April)	Table-Top Exercise, 06/23/2022 at 0830 PST	Workshop, 03/23/2023 at 2 pm PST
Plumas/Sierra County	Eastern Plumas /Health Care	Darrelyn Clark	Redacted	Redacted	Communication Capabilities, Common Protocols	Annually (April)	Table-Top Exercise, 06/23/2022 at 0830 PST	Workshop, 03/23/2023 at 2 pm PST
Plumas/Sierra County	EP Health Care	Michelle Romero	Redacted	Redacted	Communication Capabilities, Common Protocols	Annually (April)	Table-Top Exercise, 06/23/2022 at 0830 PST	Workshop, 03/23/2023 at 2 pm PST
Plumas/Sierra County	Portola Dir Pub Works	Todd Roberts	Redacted	Redacted	Communication Capabilities, Common Protocols	Annually (April)	Table-Top Exercise, 06/23/2022 at 0830 PST	Workshop, 03/23/2023 at 2 pm PST
Plumas/Sierra County	Plumas Co Fire Chief	Robert Frank	Redacted	Redacted	Communication Capabilities, Common Protocols	Annually (April)	Table-Top Exercise, 06/23/2022 at 0830 PST	Workshop, 03/23/2023 at 2 pm PST
Plumas/Sierra County	Beckwourth Fire	Brett Russell	Redacted	Redacted	Communication Capabilities, Common Protocols	Annually (April)	Table-Top Exercise, 06/23/2022 at 0830 PST	Workshop, 03/23/2023 at 2 pm PST

Public Safety Partner Group	Name of Entity	Point of Contact and Information	Email Address	Phone Number	Key Protocols	Frequency of Prearranged Communication Review and Update	Communication Exercise(s): Date of Last Completed	Communication Exercise(s): Date of Planned Next
Plumas/Sierra County	Portola Mayor	Phil Oels	Redacted	Redacted	Communication Capabilities, Common Protocols	Annually (April)	Table-Top Exercise, 06/23/2022 at 0830 PST	Workshop, 03/23/2023 at 2 pm PST
Plumas/Sierra County	Portola City Manager	Lauren Knox			Communication Capabilities, Common Protocols	Annually (April)	Table-Top Exercise, 06/23/2022 at 0830 PST	Workshop, 03/23/2023 at 2 pm PST
Plumas/Sierra County	AT&T	Paul Magoolaghan	Redacted	Redacted	Communication Capabilities, Common Protocols	Annually (April)	Table-Top Exercise, 06/23/2022 at 0830 PST	Workshop, 03/23/2023 at 2 pm PST
Plumas/Sierra County	Sierra Co Emerg Mgmt	Lee Brown	Redacted	Redacted	Communication Capabilities, Common Protocols	Annually (April)	Table-Top Exercise, 06/23/2022 at 0830 PST	Workshop, 03/23/2023 at 2 pm PST
Plumas/Sierra County	Sierra Co OES Dir	Tim Beals	Redacted	Redacted	Communication Capabilities, Common Protocols	Annually (April)	Table-Top Exercise, 06/23/2022 at 0830 PST	Workshop, 03/23/2023 at 2 pm PST
Plumas/Sierra County	Sierra Co Fire Chief	Bryan Davey	Redacted	Redacted	Communication Capabilities, Common Protocols	Annually (April)	Table-Top Exercise, 06/23/2022 at 0830 PST	Workshop, 03/23/2023 at 2 pm PST
Plumas/Sierra County	Sierra Co Sheriff	Mike Fisher	Redacted	Redacted	Communication Capabilities, Common Protocols	Annually (April)	Table-Top Exercise, 06/23/2022 at 0830 PST	Workshop, 03/23/2023 at 2 pm PST
Plumas/Sierra County	Sierra Co Pub Health	LeTina Vanetti	Redacted	Redacted	Communication Capabilities, Common Protocols	Annually (April)	Table-Top Exercise, 06/23/2022 at 0830 PST	Workshop, 03/23/2023 at 2 pm PST
Plumas/Sierra County	City of Loyalton	Sarah Jackson	Redacted	Redacted	Communication Capabilities, Common Protocols	Annually (April)	Table-Top Exercise, 06/23/2022 at 0830 PST	Workshop, 03/23/2023 at 2 pm PST
Plumas/Sierra County	Loyalton Fire Chief	John Evans	Redacted	Redacted	Communication Capabilities, Common Protocols	Annually (April)	Table-Top Exercise, 06/23/2022 at 0830 PST	Workshop, 03/23/2023 at 2 pm PST
Alpine/Monoe County	Mono Co Sheriff	Seth Clark	Redacted	Redacted	Communication Capabilities, Common Protocols	Annually (April)	Table-Top Exercise, 06/23/2022 at 0830 PST	Workshop, 03/23/2023 at 2 pm PST
Alpine/Monoe County	Mono County Emergency Manager	Chris Mokracek	Redacted	Redacted	Communication Capabilities, Common Protocols	Annually (April)	Table-Top Exercise, 06/23/2022 at 0830 PST	Workshop, 03/23/2023 at 2 pm PST
Alpine/Monoe County	Mono Co Fire Chief	Mike Curti	Redacted	Redacted	Communication Capabilities, Common Protocols	Annually (April)	Table-Top Exercise, 06/23/2022 at 0830 PST	Workshop, 03/23/2023 at 2 pm PST

Public Safety Partner Group	Name of Entity	Point of Contact and Information	Email Address	Phone Number	Key Protocols	Frequency of Prearranged Communication Review and Update	Communication Exercise(s): Date of Last Completed	Communication Exercise(s): Date of Planned Next
Alpine/Monoe County	Mono Co MCMWTC	Andrew Oddo	Redacted	Redacted	Communication Capabilities, Common Protocols	Annually (April)	Table-Top Exercise, 06/23/2022 at 0830 PST	Workshop, 03/23/2023 at 2 pm PST
Alpine/Monoe County	Mono County Supervisor	John Peters	Redacted	Redacted	Communication Capabilities, Common Protocols	Annually (April)	Table-Top Exercise, 06/23/2022 at 0830 PST	Workshop, 03/23/2023 at 2 pm PST
Alpine/Monoe County	Mono Co Emergency Services	Mark Hanson	Redacted	Redacted	Communication Capabilities, Common Protocols	Annually (April)	Table-Top Exercise, 06/23/2022 at 0830 PST	Workshop, 03/23/2023 at 2 pm PST
Alpine/Monoe County	Mono Co Social Services	Kathy Peterson	Redacted	Redacted	Communication Capabilities, Common Protocols	Annually (April)	Table-Top Exercise, 06/23/2022 at 0830 PST	Workshop, 03/23/2023 at 2 pm PST
Alpine/Monoe County	Mono Co Social Services	Cathy Young	Redacted	Redacted	Communication Capabilities, Common Protocols	Annually (April)	Table-Top Exercise, 06/23/2022 at 0830 PST	Workshop, 03/23/2023 at 2 pm PST
Alpine/Monoe County	Mono Co Social Services	Pat Espinosa	Redacted	Redacted	Communication Capabilities, Common Protocols	Annually (April)	Table-Top Exercise, 06/23/2022 at 0830 PST	Workshop, 03/23/2023 at 2 pm PST
Alpine/Monoe County	Mono Co Social Services	Kyla Closson	Redacted	Redacted	Communication Capabilities, Common Protocols	Annually (April)	Table-Top Exercise, 06/23/2022 at 0830 PST	Workshop, 03/23/2023 at 2 pm PST
Alpine/Monoe County	AT&T	Paul Magoolaghan	Redacted	Redacted	Communication Capabilities, Common Protocols	Annually (April)	Table-Top Exercise, 06/23/2022 at 0830 PST	Workshop, 03/23/2023 at 2 pm PST
Alpine/Monoe County	Antelope Valley CERT	Bruce Woodworth	Redacted	Redacted	Communication Capabilities, Common Protocols	Annually (April)	Table-Top Exercise, 06/23/2022 at 0830 PST	Workshop, 03/23/2023 at 2 pm PST
Alpine/Monoe County	Alpine Co HHS Dir	Nichole Williamson	Redacted	Redacted	Communication Capabilities, Common Protocols	Annually (April)	Table-Top Exercise, 06/23/2022 at 0830 PST	Workshop, 03/23/2023 at 2 pm PST
Alpine/Monoe County	Alpine Co Pub Health Officer	Richard Johnson	Redacted	Redacted	Communication Capabilities, Common Protocols	Annually (April)	Table-Top Exercise, 06/23/2022 at 0830 PST	Workshop, 03/23/2023 at 2 pm PST
Alpine/Monoe County	Alpine Co Fire Chief	Terry Hughes	Redacted	Redacted	Communication Capabilities, Common Protocols	Annually (April)	Table-Top Exercise, 06/23/2022 at 0830 PST	Workshop, 03/23/2023 at 2 pm PST
Alpine/Monoe County	Alpine Co Emerg Prep	Tim Streeper	Redacted	Redacted	Communication Capabilities, Common Protocols	Annually (April)	Table-Top Exercise, 06/23/2022 at 0830 PST	Workshop, 03/23/2023 at 2 pm PST

Public Safety Partner Group	Name of Entity	Point of Contact and Information	Email Address	Phone Number	Key Protocols	Frequency of Prearranged Communication Review and Update	Communication Exercise(s): Date of Last Completed	Communication Exercise(s): Date of Planned Next
Alpine/Monoe County	Washoe Tribe	Ken Quiner	Redacted	Redacted	Communication Capabilities, Common Protocols	Annually (April)	Table-Top Exercise, 06/23/2022 at 0830 PST	Workshop, 03/23/2023 at 2 pm PST
Alpine/Monoe County	Washoe Tribe	Elizabeth Fuller	Redacted	Redacted	Communication Capabilities, Common Protocols	Annually (April)	Table-Top Exercise, 06/23/2022 at 0830 PST	Workshop, 03/23/2023 at 2 pm PST

Table 8-56. Liberty Gaps and Limitations in Communication Coordination with Public Safety Partners

Gap or Limitation Subject	Remedial Brief Description	Remedial Action Plan
Need additional contacts within the Washoe Tribe	Liberty currently only has one contact listed for the Washoe Tribe, the Emergency Manager. It would be helpful to have additional contacts to allow for more direct communication.	**Strategy**: Coordinate with Liberty Community outreach for additional contact information and attend a tribal meeting to achieve face to face contact. **Target timeline**: Complete by November 30, 2023.

8.4.3.3 Mutual Aid Agreements

In this section, the electrical corporation must provide a brief overview of the Mutual Aid Agreements (MAA) it has entered into regarding wildfire emergencies and/or disasters, as well as PSPS events. The overview narrative must be no more than one page.

In addition, the electrical corporation must provide the following wildfire emergency information in tabulated format:

- List of entities with which the electrical corporation has entered into an MAA
- Scope of the MAA
- Resources available from the MAA partner

Having an adequate and trained workforce is part of Liberty's normal operating procedures. Liberty employs a staff of qualified journeymen linemen to handle day-to-day activities as well as respond to emergencies. If needed, Liberty can add entities in major emergencies through mutual aid agreements. Mutual assistance entities include NV Energy, Western Region Mutual Assistance Agreement ("WRMMA") and the California Utilities Emergency Association ("CUEA").

Liberty provides information on its Mutual Aid Agreements in Table 8-57.

Table 8-57. Liberty High-Level Mutual Aid Agreement for Resources During a Wildfire or De-Energization Incident

Mutual Aid Partner	**Scope of Mutual Aid Agreement**	**Available Resources from Mutual Aid Partner**
NV Energy	Liberty Utilities and NV Energy as members of the Western Region Mutual Assistance Agreement ("WRMMA") can coordinate mutual aid through the WRMMA. Alternatively, because the utilities share a mutual border mutual aid is frequently arranged between the utilities directly.	Supplies, and Vegetation Management and line crews where practical and available.
Western Region Mutual Assistance Agreement ("WRMAA")	This agreement is designed as a tool for all gas and electric utilities throughout the Western United States and Canada.	Supplies, and Vegetation Management and line crews where practical and available.
The California Utilities Emergency Association ("CUEA")	The CUEA serves as a point-of-contact for critical infrastructure utilities and the California Office of Emergency Services and other governmental agencies before, during and after an event to facilitate communications and cooperation between member utilities, public agencies, and non-member utilities to provide emergency response support. As a member of CUEA, Liberty Utilities is party to its Mutual Assistance Agreement and is represented in the Utility Operations Center ("UOC"), located in the State Operations Center ("SOC"). All mutual assistance activities are communicated to the State EOC and the UOC/Office of Emergency Services ("OES") during an emergency.	Supplies, and Vegetation Management and line crews where practical and available.
PG&E	Fire response and resource protection.	During the 2021 Caldor Fire in Liberty's service territory, PG&E provided Liberty with seven Structure and Infrastructure Protection Teams ("SIPT").

8.4.4 Public Emergency Communication Strategy

The electrical corporation must describe at a high level its comprehensive communication strategy to inform essential customers and other stakeholder groups of wildfires, outages due to wildfires, and PSPS and service restoration, as required by Public Utilities Code section 768.6. This should include a discussion of the policies, practices, and procedures the electrical corporation adopts to establish appropriate communication protocols to ensure timely, accurate, and complete communications. The electrical corporation may refer to its Public Utilities Code section 768.6 emergency preparedness plan to provide more detail. The narrative must be no more than one page.

In the following sections, the electrical corporation must provide an overview of the following components of an effective and comprehensive communication strategy:

- Protocols for emergency communications
- Messaging
- Current gaps and limitations

Reference the Utility Initiative Tracking ID where appropriate.

Tracking ID: WMP-EP-03

Liberty executes a robust, year-round communications and outreach effort to increase community resiliency to wildfires and educate customers and the public about PSPS and how to prepare for potential de-energization events. The goal of this effort is to increase awareness and community resiliency to wildfires and PSPS.

Liberty conducts PSPS and wildfire-specific communications in three phases: before, during, and following an emergency event. Efforts before focus on immediate actions customers and the public can employ to remain safe, resilient, and updated during the emergency. During the event, Liberty focuses on providing real-time awareness and updates about the event and how to remain safe. Following the event, Liberty focuses on transparency, from educating customers and the public on the impact of the event to soliciting customer feedback to improve communication efforts for any future event. Specific details are provided in Section 8.4.4.2.

Public education and communication efforts target Liberty’s service territory with a particular focus on the areas that are most at risk of PSPS or wildfire (High Fire Threat District). Liberty also focuses on areas with an elevated percentage of at-risk customers, such as MBL and AFN customers.

Liberty's wildfire mitigation communications and public education initiative consists of direct and indirect engagement through community outreach materials and engagement campaigns. Materials produced over the course of the year are tailored to match Liberty's respective audience and phase. Additionally, communications and outreach efforts will be enhanced and adjusted to reflect feedback received and emerging best practices.

8.4.4.1 Protocols for Emergency Communications

The electrical corporation must identify the relevant stakeholder groups in its service territory and describe the protocols, practices, and procedures used to provide notification of wildfires, outages due to wildfires and PSPS, and service restoration before, during, and after each incident type. Stakeholder groups include, but are not limited to, the general public, priority essential services, AFN populations, populations with limited English proficiency, tribes, and people in remote areas. The narrative must include a brief discussion of the decision-making process and use of best practices to ensure timely, accurate, and complete communications. The narrative must be no more than one page.

The electrical corporation must also provide, in tabular form, details of the following:

- Communication methods
- Message receipt verification mechanisms

Liberty has identified the relevant stakeholder groups in its service territory. These groups include the following: the General Public, Priority Essential Services, AFN populations to include Medical Baseline customers, the Spanish-speaking population with limited English proficiency, and members of the Washoe Tribe. The protocols, practices, and procedures, used to provide notification of wildfires, outages due to wildfires, PSPS, and service restoration before, during, and after each incident type are described in Table 8-49. Liberty's communications decision-making process is detailed in its Communication Strategy provided in Section 8.4.4. Liberty communications messaging protocols at the operational and tactical levels to include communication efforts prior to a potential threat, during an event, and following an event are provided in Section 8.4.4.2.

Liberty provides its protocols for emergency communications in Table 8-58.

Table 8-58: Liberty Protocols for Emergency Communication to Stakeholder Groups

Stakeholder Group	Event Type	Method(s) for Communicating	Means to Verify Message Receipt
General public	Wildfire	Wildfire-specific communications are conducted in three phases: before, during, and following an emergency event. Efforts before focus on immediate actions customers and the public can employ to remain safe, resilient, and updated during the emergency. This applies to all Liberty constituents to include the General Public, Priority Services, AFN populations, populations with limited English-speaking ability, and tribal populations.	Community Outreach; Public Workshops; Yearly surveys
General public	Wildfire-related outage	Liberty will employ standard communication channels to communicate wildfire-related outages including, but not limited to social media channels, broadcast and print media, and the Liberty website. As part of its expanded outreach, Liberty will coordinate roadside changeable message signs with Caltrans throughout affected communities to keep impacted residents informed. These signs will be critically important to educate tourists in Liberty's service territory. Liberty Customers are notified via the Everbridge Communication system.	Everbridge acknowledgement receipt
General public	PSPS-related outage	Liberty will employ standard communication channels to promote emergency service resources including, but not limited to social media channels, broadcast and print media, and the Liberty website. As part of its expanded outreach, Liberty will coordinate roadside changeable message signs with Caltrans throughout affected communities to keep impacted residents informed. These signs will be critically important to educate tourists in Liberty's service territory. Liberty has a PSPS Playbook with pre-scripted messages to deliver during all five stages of a PSPS. Liberty Customers are notified via the Everbridge Communication system.	Everbridge acknowledgement receipt
General public	Restoration of service	Following the event, Liberty focuses on transparency in educating customers and the public on the impact of the event and soliciting customer feedback to improve communication efforts for any future event. Liberty Customers are notified via the Everbridge Communication system.	Everbridge acknowledgement receipt; After Action Briefings and Reports
Priority essential services	Wildfire	Wildfire-specific communications are conducted in three phases: before, during, and following an emergency event. Efforts before focus on immediate actions customers and priority essential services can employ to remain safe, resilient and updated during the emergency.	Community Outreach; Public Workshops; Yearly surveys
Priority essential services	Wildfire-related outage	During a major outage or emergency that affects a significant number of customers, an email is sent to personnel, agencies, and media to provide information, detail, and status of the outage. As the outage or emergency continues, status update emails and/or phone calls will be made to keep the agencies and media informed. Liberty will also disseminate detailed information on the wildfire including a list and maps of impacted communities, critical facilities, and estimated number of impacted customers and share it with local public safety partners and elected officials via our Public Safety Partner Portal. Public Safety Partners are notified via the Everbridge Communication system.	Notification receipt via Everbridge

Stakeholder Group	Event Type	Method(s) for Communicating	Means to Verify Message Receipt
Priority essential services	PSPS-related outage	Liberty will disseminate detailed information on the PSPS event, including a list and maps of impacted communities, critical facilities, and estimated number of impacted customers and share it with local public safety partners and elected officials via our Public Safety Partner Portal. Liberty facilitated daily workshops for both Public Safety Partners and commercial customers during its potential PSPS event in September 2021 and intends on employing this practice in 2023. Public Safety Partners are notified via the Everbridge Communication system.	Notification receipt via Everbridge; Feedback from public workshops
Priority essential services	Restoration of service	Once the outage has concluded and the system is back to normal, a final email will be sent to close out the communication of the incident, and Public Safety Partners are notified via the Everbridge Communication system.	Notification receipt via Everbridge
AFN populations	Wildfire related outage	Medical Baseline or Green Cross customers who will be affected by the outage will receive a direct phone call from Liberty CalPeco staff notifying them of outage details, including but not limited to time, duration, and reason. Liberty's goal, whenever possible, is to notify the medical baseline customer group 72 hours in advance of a planned outage.	Notification receipt via Everbridge
AFN populations	PSPS related outage	Medical Baseline or Green Cross customers who will be affected by the outage will receive a direct phone call from Liberty CalPeco staff notifying them of outage details, including but not limited to time, duration, and reason. Liberty's goal, whenever possible, is to notify the medical baseline customer group 72 hours in advance of a planned outage. If the customer can't be contacted via Everbridge a Liberty staff member will knock on the customer's door and leave a door hanger.	Notification receipt via Everbridge; In person door knock if not Everbridge receipt notification; Door hanger if door not answered.
AFN populations	Restoration of Service	Once the outage has concluded, a final update will be sent directly to customers and media, as well as posted to social media accounts and the Liberty website with a request that any customers still without power notify the Company. Liberty Customers are notified via the Everbridge Communication system.	Notification receipt via Everbridge
Spanish Population with limited English proficiency	Wildfire related outage	Wildfire-specific communications are conducted in three phases: before, during, and following an emergency event. Efforts before focus on immediate actions customers and the public can employ to remain safe, resilient, and updated during the emergency. English and Spanish have been identified as the most prevalent languages used in the Liberty service territory. Customers are notified via the Everbridge Communication system which has the ability to notify in English and Spanish. Liberty Customer Service has staff members and Community Outreach Coordinators available who are fluent in Spanish.	Customer Service in person communication; Notification receipt via Everbridge
Spanish Population with limited English proficiency	PSPS related outage	Liberty will employ standard communication channels to promote emergency service resources including, but not limited to social media channels, broadcast and print media, and the Liberty website. Customers are notified via the Everbridge Communication system which has the ability to notify in English and Spanish. Liberty Customer Service has staff members and Community Outreach Coordinators available who are fluent in Spanish.	Everbridge acknowledgement receipt; Customer Service in person communication

Stakeholder Group	**Event Type**	**Method(s) for Communicating**	**Means to Verify Message Receipt**
Spanish Population with limited English proficiency	Restoration of Service	Once the outage has concluded, a final update will be sent directly to customers and media, as well as posted to social media accounts and the Liberty website with a request that any customers still without power notify the Company. Customers are notified via the Everbridge Communication system which has the ability to notify in English and Spanish. Liberty Customer Service has staff members and Community Outreach Coordinators available who are fluent in Spanish.	Everbridge acknowledgement receipt; Customer Service in person communication
Washoe Tribe	Wildfire related outage	Wildfire-specific communications are conducted in three phases: before, during, and following an emergency event. Efforts before focus on immediate actions customers and the public can employ to remain safe, resilient, and updated during the emergency. Liberty has conducted in person briefings on emergency management at Tribal meetings.	Community Outreach; Public Workshops; Yearly surveys
Washoe Tribe	PSPS related outage	Liberty will employ standard communication channels to promote emergency service resources including, but not limited to social media channels, broadcast and print media, and the Liberty website. As part of its expanded outreach, Liberty will coordinate roadside changeable message signs with Caltrans throughout affected communities to keep impacted residents informed. Liberty has a PSPS Playbook with pre-scripted messages to deliver during all five stages of a PSPS. Liberty Customers are notified via the Everbridge Communication system.	Everbridge acknowledgement receipt
Washoe Tribe	Restoration of Service	Once the outage has concluded, a final update will be sent directly to customers and media, as well as posted to social media accounts and the Liberty website with a request that any customers still without power notify the Company. Customers are notified via the Everbridge Communication system.	Everbridge acknowledgement receipt; After Action Briefings and Reports
People in remote areas	Wildfire related outage	Wildfire-specific communications are conducted in three phases: before, during, and following an emergency event. Efforts before focus on immediate actions customers and the public can employ to remain safe, resilient, and updated during the emergency. Liberty has made extensive efforts to present on emergency management briefings in the towns of Portola and Loyalton in the north part of the service territory and in Alpine and Mono Counties in the southern portion of the service territory.	Community Outreach; Public Workshops; Yearly surveys
People in remote areas	PSPS related outage	Liberty will employ standard communication channels to promote emergency service resources including, but not limited to social media channels, broadcast and print media, and the Liberty website. As part of its expanded outreach, Liberty will coordinate roadside changeable message signs with Caltrans throughout affected communities to keep impacted residents informed. Liberty has a PSPS Playbook with pre-scripted messages to deliver during all five stages of a PSPS. Liberty Customers are notified via the Everbridge Communication system.	Everbridge acknowledgement receipt
People in remote areas	Restoration of Service	Once the outage has concluded, a final update will be sent directly to customers and media, as well as posted to social media accounts and the Liberty website with a request that any customers still without power notify the Company. Customers are notified via the Everbridge Communication system.	Everbridge acknowledgement receipt; After Action Briefings and Reports

8.4.4.2 Messaging

In this section, the electrical corporation must describe its procedures for developing effective messaging to reach the largest percentage of stakeholders in its service territory before, during, and after a wildfire, an outage due to wildfire, or a PSPS event.

In addition, the electrical corporation must provide an overview of the development of the following aspects of its communication messaging strategy:

- Features to maximize accessibility of the messaging (*e.g.*, font size, color contrast analyzer)
- Alert and notification schedules
- Translation of notifications
- Messaging tone and language
- Key components and order of messaging content (*e.g.*, hazard, location, time)

In 2022, Liberty undertook a visual refresh of its public website to comply with new brand standards. As part of this project, the original site design was assessed to determine where Liberty was not meeting WCAG Level AA compliance targets. The following accessibility concerns were addressed through changes to style sheets and html content tags:

- Color contrast: Updated color palette and typography of Liberty public website to meet WCAG AA standards for contrast.
- Landmarks: Updated Liberty public website templates to utilize content landmark tags such as <header>, <main>, and <footer>, assisting screen readers with basic fragmentation of page content.
- Bypass repeating blocks: Implemented a link element at the top of each web page, visible only to the screen reader, which enables skipping down to the main page content.
- HTML presentational attributes, inline styles, <font> tags, etc.: The updated Liberty public website templates do not use locally-styles content. This reduces the likelihood of interference with assistive technologies that may need to alter the content for its own purposes.
- Page Headings: To assist in organizing page content hierarchically, Liberty public website templates have been updated to better establish a top-down order of page headings, with only a single <h1> tag declaring the page purpose, and encouraging the use of descending tags <h2>, <h3>, etc.

Liberty website content for California locations is available in Spanish. Liberty has used a third-party vendor for content translation since Q4 of 2022.

In addition to website postings, Liberty uses Everbridge for emergency alerts sent directly to customers with accurate contact information. Everbridge utilizes a tiered approach so Liberty can reach as many people as possible. Everbridge will send a text, phone call, and email. Everbridge captures the data on who has received and opened the message.

Liberty will utilize its social media platforms on Facebook and Twitter to reach not only customers, but the community as a whole. Lastly, Liberty will send messages to CBOs, PSPs, and media contacts. Liberty takes into account the tone of messaging and will craft messages to be urgent but not fear-inducing, action-oriented, helpful, and educational. Liberty has a robust communications procedure with multi- department coordination and review so that different stakeholders receive necessary messages crafted efficiently.

<u>Prior to a potential event</u>: In 2022, Liberty expanded its public education and outreach efforts associated with its wildfire mitigation plan. Safety and resiliency communications were part of a territory-wide public education campaign. These communications focused on personal preparedness and community resiliency, including:

- Online town halls: Community-based virtual town halls were held to provide information about Liberty's local wildfire mitigation efforts, PSPS, and how to prepare and remain resilient through the events. Virtual town halls were advertised on Liberty's social media platforms and promoted via email communications. Liberty anticipates the continued need for similar events; therefore, planning for future events will focus on garnering more participation in these community events through both virtual and in person offerings.
- Community newsletter outreach: Liberty continually looks for new ways to reach its customers. In 2021, Liberty continued its public education campaign through community-based newsletters and magazines. The purpose of the campaign was to promote personal preparedness during an emergency, wildfire, or PSPS. Liberty also provided PSPS messaging, including educational material on the factors that determine a PSPS and how Liberty would communicate to customers and community partners during a de-energization event.
- Digital communications: In 2022, Liberty employed a digital ad campaign specific to Wildfire Mitigation and PSPS preparation and awareness. Topics included defensible space, emergency preparedness, medical baseline program information, general PSPS information and preparation tips, communication of PSPS public workshops, and the importance of updating contact information in Liberty systems to enable PSPS and

emergency notifications. Liberty anticipates the continued need for digital communications in 2023 and beyond.

- CBO Outreach: Liberty engaged regional CBOs to help disseminate critical preparedness information. CBOs were provided with a digital toolkit, which included information about assistance programs, the MBL program, etc.

During an event: Liberty will execute standard communication protocols, such as customer notifications, media updates and situational awareness postings across social media channels. In addition, Liberty will activate a series of additional tactics to inform customers and the public about the latest developments during emergency, wildfire, and PSPS events

Liberty will assign dedicated liaisons who are responsible for conveying real-time updates and outreach material to our public safety partners, elected officials, critical facilities, and CBOs. Liberty will also employ standard communication channels to promote emergency service resources including, but not limited to social media channels, broadcast and print media, and the Liberty website. As part of its expanded outreach, Liberty will coordinate roadside changeable message signs with Caltrans throughout affected communities to keep impacted residents informed. These signs will be critically important to educate tourists in Liberty's service territory. Liberty will disseminate detailed information on the emergency, wildfire, or PSPS event, including a list and maps of impacted communities, critical facilities, and estimated number of impacted customers and share it with local public safety partners and elected officials. Liberty facilitated daily workshops for both Public Safety Partners and customers during its potential PSPS event in September 2021 and intends on continuing this practice in 2022. To expand its digital outreach, Liberty will distribute public service announcements ("PSAs") to read live on the airwaves and coordinate with CalOES to distribute wireless emergency alerts to impacted regions. The templates allow for the addition of real-time awareness details and provide referral to Liberty's social media platforms for additional safety information and updates.

Following an event: Communication with customers and the public early and often is essential to the region's wildfire preparedness. Liberty engages in discussions and solicits feedback from its communities and stakeholders regarding proactive safety preparations, mitigation measures and community support strategies to reduce infrastructure-related ignitions and mitigate impacts of a wildfire or PSPS. In 2022, Liberty reached out to customers through formal surveys to determine the level of awareness of wildfire mitigation and PSPS-related messaging and communications at the beginning of wildfire season. Liberty uses the gathered feedback to evaluate, refine and improve customer and public education efforts for 2022 and follow a similar process in the coming years.

8.4.4.3 Current Gaps and Limitations

In tabulated format, the electrical corporation must provide a list of current gaps and limitations in its public communication strategy. Where gaps or limitations exist, the electrical corporation must indicate the remedial action plan and the timeline for resolving the gaps or limitations. For all requested information, the electrical corporation should indicate a form of verification that can be provided upon request for compliance assurance.

Liberty provides gaps and limitations in its public emergency communication strategy in Table 8-59.

Table 8-59. Liberty Gaps and Limitations in Public Emergency Communication Strategy

Gap or Limitation Subject	Remedial Brief Description	Remedial Action Plan
Liberty will need to expand its MBL and AFN population data to better communicate with at-risk populations	Survey results in 2022 indicated that Liberty's AFN population may be larger than the AFN population that has been documented to date.	Strategy: Liberty will expand its AFN database through communication and coordination with social service agencies in our service territory. Target Timeline: Liberty will begin the campaign early in 2023 and conclude the campaign in August 2023. Success of efforts will be gauged by responses to the yearly survey.

8.4.5 Preparedness and Planning for Service Restoration

8.4.5.1 Overview of Service Restoration Plan

In this section of the WMP, the electrical corporation must provide an overview of its plan to restore service after an outage due to a wildfire or PSPS event. At a minimum, the overview must include a brief description of the following:

- Purpose and scope of the restoration plan.
- Overview of protocols, policies, and procedures for service restoration (*e.g.*, means and methods for assessing conditions, decision-making framework, prioritizations, degree of customization). This must include:
  - An operational flow diagram illustrating key components of the service restoration procedures from the moment of the incident to response, recovery, and restoration of service.
- Resource planning and allocation (*e.g.*, staffing, equipment).
- Drills, simulations, and tabletop exercises.
- Coordination and collaboration with public safety partners (*e.g.*, interoperable communications).
- Notification of and communication to customers during and after a wildfire- or PSPS-related outage.

The electrical corporation may refer to its Public Utilities Code section 768.6 emergency preparedness plan to provide more detail. Where the electrical corporation has already reported the requested information in another section of the WMP, it must provide a cross-reference with a hyperlink to that section. The overview must be no more than one page.

Reference the Utility Initiative Tracking ID where appropriate.

Tracking ID: WMP-EP-04

Purpose and scope: The purpose of the Liberty restoration plan is to minimize the risks inherent in a long service interruption to a variety of customer types, including medical baseline customers. Service restoration is considered a priority throughout Liberty's entire service territory. Service restoration is unique for each emergency event and restoration prioritization is influenced by multiple factors that include safety, accessibility, availability of repair parts, availability of personnel, etc. The Liberty CEMP identifies general restoration prioritization guidelines, but allows for the Incident Commander, or designee, to alter priorities according to the circumstances of the emergency and in coordination with essential load customer and government agencies.

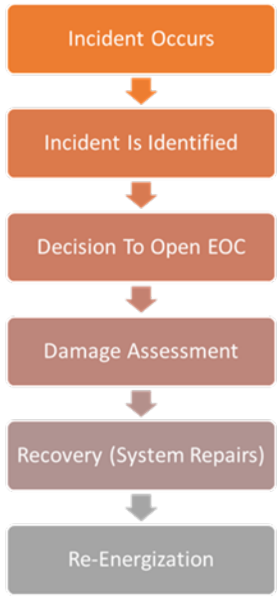
Protocols, policies, and procedures:

- Damage Assessment: The designated Incident Commander is responsible for determining how damage assessment will be best achieved for the specific emergency. The Incident Commander may delegate the responsibility, or a portion of the responsibility, to the manager(s) or other qualified individual(s) or retain this responsibility. Detailed procedures are provided in the Liberty CEMP pages 18-19, paragraph 6 subparagraphs a through g.
- Service restoration: All critical infrastructure in the Liberty Service Territory is prioritized for restoration in our mapping system. In general, restoration will proceed in this order:
    i. Radial transmission and substations.
    ii. Distribution circuits with essential customers, such as health care facilities, utilities, public safety, governmental facilities, and lifeline customers.
    iii. Circuits with the greatest number of customers.
    iv. Primary taps, followed by secondary lines.
    v. Individual services that are accessible and serviceable can be addressed

Below is the priority list of Liberty's essential customers. Priority assumes circuits, equipment, and services are accessible and repairable.

- Health Care Facilities
    i. Primary care hospitals
- Utility Services/Districts
    i. Public utility districts
    ii. Telecommunications
    iii. Water and water treatment facilities
    iv. Pipeline
- Public Safety Agencies
    i. Public safety dispatch centers
    ii. Law enforcement facilities/holding facilities
    iii. Fire operations facilities
    iv. Transportation equipment and facilities
- Government facilities
    i. Green Cross and Lifeline customers

Figure 8-14: Liberty Operational Flow Diagram for Service Restoration



8.4.5.2 Planning and Allocation of Resources

The electrical corporation must briefly describe its methods for planning appropriate resources (*e.g.*, equipment, specialized workers), and allocating those resources to assure the safety of the public during service restoration.

In addition, the electrical corporation must provide an overview of its plans for contingency measures regarding the resources required to respond to an increased number of reports concerning unsafe conditions and expedite a response to a wildfire- or PSPS-related power outage.

This must include a brief narrative on how the electrical corporation:

- Uses weather reports to pre-position manpower and equipment before anticipated severe weather that could result in an outage
- Sets priorities
- Facilitates internal and external communications
- Restores service

The narrative for this section must be no more than two pages.

Liberty monitors forecast and real-time weather conditions by utilizing weather station data and fire weather prediction tools. FPI and PSPS zones, which receive individualized forecasts, help to determine the specific circuits that are predicted to experience elevated fire risk conditions. This knowledge allows for patrol resources to be more accurately and efficiently deployed.

In areas with elevated fire weather condition forecasts, Liberty will activate proactive patrols along power lines. Operations personnel will be deployed to observe conditions along the electrical system (vegetation issues, equipment condition, wire sag and sway, and any potential system damage related to the weather event) that may pose a threat to public safety. This added situational awareness provides the ability to identify imminent safety risks in order to resolve them immediately.

Liberty's FPP describes work restrictions for certain at-risk activities based on FPI conditions. Depending on the FPI fire risk rating, some activities will require the designation of a Fire Safety Monitor or a Fire Safety Leader.

- Fire Safety Monitor: Designated field supervisor or crew member responsible for fire safety requirement oversight during Elevated Fire Risk working conditions.
- Fire Safety Leader: Designated field supervisor or crew member who has a dedicated role for fire safety requirement oversight during Extreme Fire Risk working conditions

Liberty's field crews are equipped with fire prevention and suppression tools throughout all areas of the service territory. In 2020, Liberty hired a Fire Protection Specialist to assist with fire prevention training and operational compliance with Liberty's protocols. In some instances, the Fire Protection Specialist will assist crews when a fire safety leader must be designated.

When Liberty anticipates forecasted conditions may result in power outages and damage to the electrical system that cannot be resolved under normal operations, the Incident Management Team (IMT) will convene, and the Incident Commander may choose to activate the EOC. The CEMP as discussed in section 8.4.2, outlines the Company's general procedures for response to and recovery from emergencies at all levels. The IMT will discuss potential impacts of the event, determine existing resource availability, current warehouse inventories, and the Incident Commander will decide if additional resources and materials are needed prior to the event. At the discretion of the Incident Commander, resources may be pre-positioned and ready to respond as necessary for the given event.

Liberty describes it's plan for communication during emergencies in Section 8.4.4.1.

Liberty's plan to restore customers during emergencies is detailed in Section 8.4.5.1.

8.4.5.3 Drills, Simulations, and Tabletop Exercises

Discussion-based and operational-based exercises enhance knowledge of plans, allow personnel to improve their own performance, and identify opportunities to improve capabilities to respond to wildfire- and PSPS-related service outages. Exercises also provide a method to evaluate an electrical corporation's emergency preparedness plan and identify planning and/or procedural deficiencies.

Internal Exercises

The electrical corporation must report on its program(s) for conducting internal discussion-based and operations-based exercises for service restoration. This must include, at a minimum:

- The types of discussion-based exercises (*e.g.*, seminars, workshops, tabletop exercises, games) and operations-based exercises (*e.g.*, drills, functional exercises, full-scale exercises)
- The purpose of the exercises
- The schedule and frequency of exercise programs
- The percentage of staff who have completed/participated in exercises
- How the electrical corporation tracks who has completed the exercises

Liberty includes service restoration as a component of its discussion-based and operational-based wildfire and PSPS exercises. Refer to Table 8-50.

External Exercises

The electrical corporation must report on its program(s) for conducting external discussion-based and operations-based exercises for service restoration due to wildfire. This must include, at a minimum:

- The types of discussion-based exercises (*e.g.*, seminars, workshops, tabletop exercises, games) and operations-based exercises (*e.g.*, drills, functional exercises, full-scale exercises)
- The schedule and frequency of exercise programs
- The percentage of public safety partners who have participated in these exercises
- How the electrical corporation tracks who has completed the exercises

Liberty includes service restoration as a component of its discussion-based and operational-based wildfire and PSPS exercises. Refer to Table 8-51.

8.4.6 Customer Support in Wildfire and PSPS Emergencies

In this section of the WMP, the electrical corporation must provide an overview of its programs, systems, and protocols to support residential and non-residential customers in wildfire emergencies and PSPS events. The overview for each emergency service must be no more than one page. At a minimum, the overview must cover the following customer emergency services, per Public Utilities Code section 8386(c)(21):

- Outage reporting
- Support for low-income customers
- Billing adjustments
- Deposit waivers
- Extended payment plans
- Suspension of disconnection and nonpayment fees
- Repair processing and timing
- List and description of community assistance locations and services
- Medical Baseline support services
- Access to electrical corporation representatives

Reference the Utility Initiative Tracking ID where appropriate.

Tracking ID: WMP-EP-05

Outage Reporting: Liberty utilizes a multi-channel approach for real-time situational awareness. After extreme weather conditions are forecasted and the National Weather Service issues a Red Flag Warning, Liberty begins to coordinate with local government agencies, community-based organizations, and public safety partners approximately 72 hours prior to the event. Communications are then initiated with customers via Everbridge, broadcast media, and social media channels. These communications drive traffic to Liberty's social media and/or dedicated PSPS landing page for more information and real-time situation updates. As the event progresses, these notifications become more specific and targeted to customers as the situation warrants. Along with outage updates, the channels listed above provide information related to wildfire safety, emergency preparedness, PSPS, and community resource centers.

Support for Low-Income Customers: Refer to Appendix G: Liberty's Plan to Support Populations with Access and Functional Needs During PSPS for specific measures that Liberty has developed to support AFN customers during emergencies, including PSPS events. Additionally, low-income/CARE and MBL customers may be offered special payment arrangements resulting from fire-related outages, as necessary.

Billing Adjustments: Liberty may suspend billing until power is restored to impacted customers.

Deposit Waivers: Liberty may waive deposit requirements for business customers who are seeking to re-establish service at either the same location or a new location.

Extended Payment Plans: Special consideration may be granted for payment extension when customers experience tremendous loss (*i.e.*, property loss).

Suspension of Disconnection and Nonpayment Fees: For customers impacted by wildfires, Liberty may suspend disconnection for non-payment and associated fees, waive the deposit and late fee requirements for affected customers who pay their utility bills late, and not report late payments by customers who are eligible for these protections to credit reporting agencies or to other such services.

Repair Processing and Timing: Timing for repair procedures will be determined on the severity of the wildfire. As feasible, Liberty will accelerate the repair process.

Community Assistance Locations and Services: In coordination with the communities that it serves, Liberty has established a network of Community Resource Centers ("CRCs") to assist communities in real time during extreme weather events. Planning factors for meeting the safety needs for access and functional needs and vulnerable populations have included local demographic data, as well as the company database of medical baseline customers. The establishment of CRCs was informed by presentations and discussions in seven Town Hall Meetings held in each of seven communities in Liberty's service territory. Plan creation included consultation with regional local government, advisory boards, public safety partners, representatives of people/communities with access and functional needs, tribal representatives, senior citizen groups, business owners, community resource organizations, and public health and healthcare providers.

<u>Locations</u>: If Liberty anticipates that the power will be off for an extended period, Liberty will open CRCs in the affected areas. The CRC locations selected by Liberty were identified through a rigorous process, which included input from fire and meteorological experts, as well as those areas most prone to extreme weather, as indicated by historical data. CRC locations identified to date include Walker, Markleeville, South Lake Tahoe, Truckee Tahoe Airport, Loyalton, and Portola.

<u>Accommodations</u>: All CRCs are in fixed facility locations known to the public. CRCs will have backup power or are in areas that are contiguous to PSPS zones that would not be shut off in

the event of a PSPS. They are ADA-compliant, and CRC site planning includes consideration of customers with access and functional needs. FEMA June 2020 Mass Care Emergency Assistance Pandemic Planning Considerations were used to provide for adequate space for estimated occupancy and comply with social distancing and public health protocols.

Services provided: Each CRC site meets fire codes and has at least two egress routes. Once activated, CRCs will operate in 14-hour shifts from 8:00 AM to 10:00 PM daily, until power to the affected community has been restored. The CRCs can provide device charging stations, cellular network services, chairs, and restrooms. Volunteer organizations will provide bottled water and snacks to impacted area residents. Preidentified Liberty SMEs will collaborate with volunteer staff at activated CRCs to communicate real-time PSPS updates directly to impacted community members.

Liberty provides additional information on its programs to support customers in wildfire emergencies and PSPS events in Appendix G – Liberty's 2023 AFN Plan.

Additionally, on February 11, 2022, Liberty filed an application for its Customer Resiliency Program ("CRP") with the CPUC. The proposed CRP includes a behind-the-meter ("BTM") battery storage program that will be offered to Liberty's critical needs customers, including MBL, critical facilities, and large commercial ("A3") customers. The BTM program will be structured as a resiliency-as-a-service ("RaaS") in which customers pay a monthly fee to participate in the program. For MBL customers, Liberty will provide this service at a significantly lower rate ($10/month), and for MBL customers who also qualify for Liberty's low-income CARE rate, the RaaS will be free.

Medical Baseline Support Services: Liberty will provide live agent outbound calls to medical baseline customers who did not confirm contact through automated notifications (*i.e.*, e-mails, phone calls).

Access to Liberty Representatives: If Liberty's offices are not impacted by the wildfire event, operations will resume, and customer service representatives will be available to provide support. If offices are impacted, nearby offices and corporate communications will be available to customers.

8.5 Community Outreach and Engagement

8.5.1 Overview

In accordance with California Public Utilities Code section 8386(c)(19)(B) each electrical corporation must provide its plans for community outreach and engagement before, during, and after a wildfire. The electrical corporation must also provide its plans for outreach and engagement related to PSPS, outages from protective equipment and device settings, and vegetation management.

In this section, the electrical corporation must identify objectives for the next 3- and 10-year periods, targets, and performance metrics related to the following community outreach and engagement mitigation initiatives:

- Public outreach and education awareness for wildfires, PSPS, outages from protective equipment and device settings, and vegetation management
- Public engagement in the WMP decision-making process
- Engagement with AFN populations, local governments, and tribal communities
- Collaboration on local wildfire mitigation and planning
- Best practice sharing with other electrical corporations from within and outside of California

8.5.1.1 Objectives

Each electrical corporation must summarize the objectives for its 3-year and 10-year plans for implementing and improving its community outreach and engagement.[101] These summaries must include the following:

- Identification of which initiative(s) in the WMP the electrical corporation is implementing to achieve the stated objective, including Utility Initiative Tracking IDs
- Reference(s) to applicable codes, standards, and best practices/guidelines and an indication of whether the electrical corporation exceeds an applicable code, standard, or regulation
- Method of verifying achievement of each objective
- A completion date for when the electrical corporation will achieve the objective
- Reference(s) to the WMP section(s) or appendix, including page numbers, where the details of the objective(s) are documented and substantiated

Liberty provides objectives for its Community Outreach and Engagement WMP initiatives in Table 8-60 for the three-year plan and Table 8-61 for the 10-year plan.

[101] Annual information included in this section must align with Tables 1 and 12 of the QDR.

Table 8-60. Liberty Community Outreach and Engagement Initiative Objectives (three-year plan)

Objectives for Three Years (2023–2025)	**Applicable Initiative(s), Tracking ID(s)**	**Applicable Regulations, Codes, Standards, and Best Practices**	**Method of Verification (*i.e.*, program)**	**Completion Date**	**Reference (section & page #)**
Implement planned communication channels and technologies with customers, community, and stakeholders.	WMP-CO-03	Liberty PSPS Playbook; AFN Plan	Records of open and closed customer tickets including dates	May 2024	Section 8.5.2, pp. 355-360
Engage Community Based Organizations and expand network of contacts in each area of Liberty service territory, including South Lake Tahoe, North Lake Tahoe, Coleville/Walker, and Loyalton/Portola communities.	WMP-CO-03	Liberty PSPS Playbook; AFN Plan	Documentation of instances of information sharing and in-person or virtual meetings with Community Based Organizations	Ongoing	Section 8.5.2, pp. 355-360
Work collaboratively with CBO networks to support, educate, notify, and prepare AFN communities.	WMP-CO-03	Liberty PSPS Playbook; AFN Plan	Documentation of outreach efforts and collaborative events; documentation of CBO information sharing regarding upcoming events or program information updates	Ongoing	Section 8.5.3, pp. 361-364
Work collaboratively with Public Safety Partners to support, educate, notify, and prepare AFN communities.	WMP-CO-03	Liberty PSPS Playbook; AFN Plan	AFN Plan	Ongoing	Section 8.5.3, pp. 361-364
Support bilingual outreach through the utilization of bilingual Outreach Coordinator.	WMP-CO-03	Liberty PSPS Playbook; AFN Plan	Documentation of outreach including bilingual support	Ongoing	Section 8.5.3, pp. 361-364
Identify improvements to overall accessibility of information available to AFN customers.	WMP-CO-03	Liberty PSPS Playbook; AFN Plan	Documentation of accessibility improvements as applicable	Ongoing	Section 8.5.3, pp. 361-364
Encourage self-identification of AFN customers through targeted outreach and communications.	WMP-CO-03	Liberty PSPS Playbook; AFN Plan	Assessment of identified AFN customer counts each quarter; Documentation of AFN Self-Id Tool content inclusion in communications	Ongoing	Section 8.5.3, pp. 361-364

Objectives for Three Years (2023–2025)	**Applicable Initiative(s), Tracking ID(s)**	**Applicable Regulations, Codes, Standards, and Best Practices**	**Method of Verification (*i.e.*, program)**	**Completion Date**	**Reference (section & page #)**
Regular PSPS coordination meetings with Tahoe Donner Public Utility District and NV Energy.	WMP-CO-03	Liberty PSPS Playbook; AFN Plan	Meeting notes	Ongoing	Section 8.5.4, pp. 364-367

Table 8-61. Liberty Community Outreach and Engagement Initiative Objectives (10-year plan)

Objectives for Ten Years (2026–2032)	**Applicable Initiative(s), Tracking ID(s)**	**Applicable Regulations, Codes, Standards, and Best Practices**	**Method of Verification (*i.e.*, program)**	**Completion Date**	**Reference (section & page #)**
Effective stakeholder communication through tailored approaches for outreach, engagement and information exchange with customers, communities and stakeholders based on various groups' unique needs. Identify emerging channels and technologies to better communicate with customers, community, and stakeholders.	WPM-CO-01; Best practice sharing	Guidance document for sharing data and information externally	Documented instances of collaboration between the electrical corporation and outside entities, including agendas, meeting minutes, and participant lists	June 2026	Section 8.5.2, pp. 355-360
Engage CBOs and further expand network of contacts in each area of Liberty service territory, including South Lake Tahoe, North Lake Tahoe, Coleville/Walker, and Loyalton/Portola communities.	WMP-CO-03	Liberty PSPS Playbook; AFN Plan	Documentation of instances of information sharing and in-person or virtual meetings with Community Based Organizations	Ongoing	Section 8.5.3, pp. 361-364
Continue to work collaboratively with CBO networks to support, educate, notify, and prepare AFN communities.	WMP-CO-03	Liberty PSPS Playbook; AFN Plan	Documentation of outreach efforts and collaborative events; documentation of CBO information sharing regarding upcoming events or program information updates	Ongoing	Section 8.5.3, pp. 361-364
Continue to work collaboratively with Public Safety Partners to support, educate, notify, and prepare AFN communities.	WMP-CO-03	Liberty PSPS Playbook; AFN Plan	AFN Plan	Ongoing	Section 8.5.3, pp. 361-364

Objectives for Ten Years (2026–2032)	**Applicable Initiative(s), Tracking ID(s)**	**Applicable Regulations, Codes, Standards, and Best Practices**	**Method of Verification (*i.e.*, program)**	**Completion Date**	**Reference (section & page #)**
Continue to support bilingual outreach efforts.	WMP-CO-03	Liberty PSPS Playbook; AFN Plan	Documentation of outreach including bilingual support	Ongoing	Section 8.5.3, pp. 361-364
Identify improvements to overall accessibility of information available to AFN. customers	WMP-CO-03	Liberty PSPS Playbook; AFN Plan	Documentation of customer survey feedback; Documentation of accessibility improvements as applicable	Ongoing	Section 8.5.3, pp. 361-364
Continue to encourage self-identification of AFN status through targeted outreach efforts and communications.	WMP-CO-03	Liberty PSPS Playbook; AFN Plan	Assessment of identified AFN customer counts each quarter; Documentation of AFN Self-Id Tool content inclusion in communications	Ongoing	Section 8.5.3, pp. 361-364
Ongoing PSPS coordination meetings with Tahoe Donner Public Utility District and NV Energy.	WMP-CO-03	Liberty PSPS Playbook; AFN Plan	Meeting notes	Ongoing	Section 8.5.4, pp. 364-367

8.5.1.2 Targets

Initiative targets are forward-looking quantifiable measurements of activities identified by each electrical corporation in its WMP. Electrical corporations will show progress toward completing targets in subsequent reports, including QDRs and WMP Updates.

The electrical corporation must list all targets it will use to track progress on its community outreach and engagement for the three years of its Base WMP. Energy Safety's Compliance Assurance Division and third parties must be able to track and audit each target.[102] For each initiative target, the electrical corporation must provide the following:

- Utility Initiative Tracking IDs.
- Projected targets for each of the three years of the Base WMP and relevant units.
- Quarterly, rolling targets for 2023 and 2024 (PSPS outreach only).
- The expected "x% risk impact" for each of the three years of the Base WMP. The expected x% risk impact is the expected percentage risk reduction per year, as described in Section 7.2.2.2.
- Method of verifying target completion.

The electrical corporation's targets must provide enough detail to effectively inform efforts to improve the performance (*i.e.*, reduction in ignition probability or wildfire consequence) of the electrical corporation's community outreach and engagement initiatives.

Liberty provides targets for its Community Outreach and Engagement WMP initiatives in Table 8-62 and Table 8-63.

[102] Annual information included in this section must align with Tables 1 and 12 of the QDR.

Table 8-62. Liberty Wildfire and PSPS Community Outreach and Engagement Initiative Targets by Year

Initiative Activity	Tracking ID	2023 Target & Unit	x% Risk Impact 2023[103]	2024 Target & Unit	x% Risk Impact 2024	2025 Target & Unit	x% Risk Impact 2025	Method of Verification
Public outreach and education awareness for wildfires, PSPS, outages from protective equipment and device settings, and vegetation management	WMP-CO-01	Two wildfire and PSPS outreach surveys	See footnote	Two wildfire and PSPS outreach surveys	See footnote	Two wildfire and PSPS outreach surveys	See footnote	Survey results; CPUC Post-Season PSPS Report
Engagement with AFN populations, local governments, and tribal communities	WMP-CO-03	9 Events	See footnote	Target not yet set	See footnote	Target not yet set	See footnote	Outreach and event documentation including town halls, outreach events, preparedness workshops, community presentations, and meetings with community partner contacts
Best practice sharing with other electrical corporations	WMP-CO-05	Participation in working groups and Joint IOU Councils	See footnote	Participation in working groups and Joint IOU Councils	See footnote	Participation in working groups and Joint IOU Councils	See footnote	Document attendance at Joint IOU Statewide AFN Council meetings
Hire additional customer support	PO-02	2 additional supervisors hired	See footnote	4 additional agents hired	See footnote	3 additional agents hired	See footnote	Hiring records and number of positions in workforce tracking platform showing before and after results

[103] Liberty does not currently have sufficient information to calculate

Table 8-63. Liberty PSPS Outreach and Engagement Initiative Targets by Year

Initiative Activity	Tracking ID	Target End of Q2 2023 & Unit	Target End of Q3 2023 & Unit	End of Year Target 2023 & Unit	x% Risk Impact 2023	Target End of Q2 2024 & Unit	Target End of Q3 2024 & Unit	End of Year Target 2024 & Unit	x% Risk Impact 2024	Target 2025 & Unit	x% Risk Impact 2025	Method of Verification
Public outreach and education awareness for wildfires, PSPS, outages from protective equipment and device settings, and vegetation management	WMP-CO-01	None	None	Two wildfire and PSPS outreach surveys	See footnote 87	None	None	Two wildfire and PSPS outreach surveys	See footnote 87	Two wildfire and PSPS outreach surveys	See footnote 87	Survey results; AFN Report; PSPS Post Season Report
Hold public meetings in high PSPS risk areas	PO-03	1 meeting	10 meetings	12 meetings	See footnote 87	3 meetings	15 meetings	20 meetings	See footnote 87	20 meetings	See footnote 87	Meeting agendas, meeting materials and attendance records

8.5.1.3 Performance Metrics Identified by the Electrical Corporation

Performance metrics indicate the extent to which an electrical corporation's Wildfire Mitigation Plan is driving performance outcomes. Each electrical corporation must:

- List the performance metrics the electrical corporation uses to evaluate the effectiveness of its community outreach and engagement in reducing wildfire and PSPS risk[104]

For each of those performance metrics listed, the electrical corporation must:

- Report the electrical corporation's performance since 2020 (if previously collected)
- Project performance for 2023-2025
- List method of verification

The electrical corporation must ensure that each metric's name and values are the same in its WMP reporting as its QDR reporting (specifically, QDR Table 2 and QDR Table 3). Metrics listed in this section that are the same as performance metrics required by Energy Safety and reported in QDR Table 2 (Performance Metrics)[105] must match those reported in QDR Table 2. Metrics listed in this section that are not the same as any of the performance metrics identified by Energy Safety and reported in QDR Table 2 must match those reported in QDR Table 3.

The electrical corporation must:

- Summarize its self-identified performance metric(s) in tabular form
- Provide a brief narrative that explains trends in the metrics

Liberty provides the performance metrics it uses to evaluate the effectiveness of its community outreach and engagement in reducing wildfire and PSPS risk in Table 8-64. Because Liberty has not had any PSPS events to date, the trends identified in this section show that no customers have been impacted.

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[104] There may be overlap between the performance metrics the electrical corporation uses and performance metrics required by Energy Safety. The electrical corporation must list these overlapping metrics in this section in addition to any unique performance metrics it uses.

[105] The performance metrics identified by Energy Safety are included in Energy Safety's Data Guidelines.

Table 8-64. Liberty Community Outreach and Engagement Performance Metrics Results by Year

Performance Metrics	2020	2021	2022	2023 Projected	2024 Projected	2025 Projected	Method of Verification (*e.g.*, third-party evaluation, QDR)
Number of customers impacted by PSPS	0	0	0	0	0	0	QDR; GIS
Number of medical baseline customers impacted by PSPS	0	0	0	0	0	0	QDR; GIS
Number of customers notified prior to initiation of PSPS event	0	0	0	0	0	0	QDR; GIS
Number of medical baseline customers notified prior to initiation of PSPS event	0	0	0	0	0	0	QDR; GIS
Number of customers notified prior to a PSPS event impacting them	0	0	0	0	0	0	QDR; GIS
Number of medical baseline customers notified prior to a PSPS event impacting them	0	0	0	0	0	0	QDR; GIS

8.5.2 Public Outreach and Education Awareness Program

The electrical corporation must provide a high-level overview of its public outreach and education awareness program(s) for wildfires; outages due to wildfires, PSPS events, and protective equipment and device settings; service restoration before, during, and after the incidents (as required by Public Utilities Code section 8386[c][19][B]); and vegetation management. This includes outreach efforts in English, Spanish, Chinese (including Cantonese, Mandarin, and other Chinese languages), Tagalog, and Vietnamese, as well as Korean and Russian where those languages are prevalent within the service territory.

At a minimum, the overview must include the following:

- A description of the purpose and scope of the program(s).
- References to the Utility Initiative Tracking ID where appropriate.
- A brief narrative followed by a tabulated list of all the different target communities it is trying to reach across the electrical corporation’s service territory. The target communities list must include AFN and other vulnerable or marginalized populations, but they may also include other target populations, such as communities in different geographic locations (*e.g.*, urban areas, rural areas), age groups, language and ethnic groups, transient populations, or Medical Baseline customers. In addition, the electrical corporation must summarize the interests or concerns each community may have before, during, or after a wildfire or PSPS event to help inform outreach and education awareness needs. Table 8-65 provides an example of the minimum acceptable level of information.
- A tabulated list of community partners the electrical corporation is working with or intends to work with to support its community outreach and education programs. Table 8-66 provides an example of the minimum acceptable level of information.
- A table of the various outreach and education awareness programs (*i.e.*, campaigns, informal education, grant programs, participatory learning) that the electrical corporation implements before, during, and after wildfire, vegetation management, and PSPS events, including efforts to engage with partners in developing and exercising these programs. In addition, the electrical corporation must describe how it implements its overall program, including staff and volunteer needs, other resource needs, method for implementation (*e.g.*, industry best practice, latest research in methods for risk communication, social marketing), long-term monitoring and evaluation of each program’s success, need for improvement, etc. The narrative for this section is limited

to two to three pages. The electrical corporation must also provide the information on its outreach and education awareness programs a in tabulated format. Table 8-65 provides an example of the minimum acceptable level of information.

Tracking ID: WMP-CO-01

Liberty's community outreach efforts focus on providing a presence in communities within all seven counties served by the utility. Liberty participates in a variety of outreach efforts including, but not limited to, general community events, health fairs, smaller presentations to community groups, presentations to senior centers, and collaborative events hosted by local organizations. The goal of Liberty's outreach efforts is to spread awareness of PSPS preparedness, Liberty's notification system, customer assistance program benefits, the importance of maintaining updated contact information, and AFN self-identification. CBO collaboration supports Liberty in reaching AFN communities through established community networks, and AFN categories are considered in planning collaborative efforts.

Liberty provides information on its WMP and PSPS public outreach and education awareness program in Table 8-65, Table 8-66 and Table 8-67.

Table 8-65. Liberty List of Target Communities

Target Community	Interests or Concerns Before, During, and After Wildfire and PSPS events
Identified Access and Functional Needs individuals	Liberty understands customers with access and functional needs may require earlier communication to plan for needs before, during, and after PSPS events and require communication regarding available resources. Liberty values targeted outreach to Access and Functional Needs populations with a focus on PSPS preparedness measures, education around Liberty's notification system, and importance of updated contact information.
Individuals enrolled in Medical Baseline Allowance program	Liberty understands customers with medical needs may require earlier communication to plan for medical needs before, during, and after PSPS events and require communication regarding available resources.

Target Community	Interests or Concerns Before, During, and After Wildfire and PSPS events
Community Based Organizations	Liberty understands Community Based Organizations ("CBOs") require communication regarding PSPS events in order to effectively communicate with and support their communities before, during, and after PSPS events.

Table 8-66. Liberty List of Community Partners

Community Partners	County	City
Sierra Community House	Placer	Kings Beach, CA
Boys and Girls Club of North Lake Tahoe	Placer	Kings Beach, CA
Placer County Health & Human Services	Placer	Truckee, CA
Sierra Senior Services	Nevada	Truckee, CA
Nevada County Health & Human Services	Nevada	Truckee, CA
Portola Family Resource Center	Plumas	Portola, CA
Plumas County Mental Health	Plumas	Portola, CA
Loyalton Senior Citizens of Sierra Co.	Sierra	Loyalton, CA
Sierra County Health and Human Services	Sierra	Loyalton, CA
Loyalton Family Resource Center	Sierra	Loyalton, CA
Boys and Girls Club of Lake Tahoe	El Dorado	South Lake Tahoe, CA
Live Violence Free	El Dorado	South Lake Tahoe, CA

Community Partners	**County**	**City**
Tahoe Coalition for the Homeless	El Dorado	South Lake Tahoe, CA
El Dorado Health and Human Services	El Dorado	Placerville, CA
First 5/Community Hub El Dorado	El Dorado	Placerville, CA
South Lake Tahoe Family Resource Center	El Dorado	South Lake Tahoe, CA
Tahoe Youth and Family Services	El Dorado	South Lake Tahoe, CA
Mono County Health and Human Services	Mono	Coleville, CA
Mono County Public Health	Mono	Mammoth Lakes, CA
Alpine County Health and Human Services	Alpine	Markleeville, CA
Washoe Tribe	Alpine	Markleeville, CA

Table 8-67. Liberty Community Outreach and Education Programs

Core Activity	Event Type	Period of Application (Before, During, After Incident)	Name of Outreach or Education Program	Description of Program	Target Audience	Reference/ Link
PSPS and Wildfire Mitigation community workshops before fire season	Virtual	Before	Pre-Season Community Workshops	Perform general PSPS and Wildfire Mitigation outreach ahead of fire season	All customers	None
Digital, print, and radio advertising	Campaign	All	PSPS and Wildfire Mitigation Awareness Advertising	Campaign occurs from April-October of each year, covering PSPS and Wildfire Mitigation awareness topics	All customers, medical baseline customers	None
Advertising in HOA publications and customer emails	Email, social media	Before	None	Perform general PSPS and Wildfire Mitigation outreach ahead of fire season	All Customers	None
Manage outreach/awareness webpage	Virtual	All	Liberty PSPS and Wildfire Mitigation awareness webpage	Social media posts, bill inserts, and customer emails help drive traffic to webpage that covers PSPS and wildfire mitigation awareness topics	All Customers	None
Community Outreach Events	In-Person	Before	None	Liberty attendance at community outreach events to spread PSPS awareness and preparedness education, update contact information, and provide education on available customer programs and Liberty notification system	All customers	None
Community Based Organization Meetings	In-Person, Virtual	Before	None	Liberty staff meetings with local Community Based Organizations to share PSPS awareness and available materials, preparedness education, customer program updates, and	Community Based Organizations, AFN Customers	None

Core Activity	Event Type	Period of Application (Before, During, After Incident)	Name of Outreach or Education Program	Description of Program	Target Audience	Reference/ Link
				to gather CBO contact information for inclusion in applicable exercises		
Collaborative Community Outreach with Community Based Organizations	In-Person	Before	None	Liberty involvement in collaborative outreach events to spread PSPS awareness and preparedness education, update contact information, and provide education on available customer programs and Liberty notification system. This form of outreach leverages CBO relationships within the community to access local communities and supports targeted outreach efforts to reach AFN populations.	All Customers, AFN Customers, Community Based Organizations	None

8.5.3 Engagement with Access and Functional Needs Populations

In this section, the electrical corporation must provide an overview of its process for understanding, evaluating, designing, and implementing wildfire and PSPS risk mitigation strategies, policies, and procedures specific to AFN customers across its territory. The electrical corporation must also report, at a minimum, on the following:

- Summary of key AFN demographics, distribution, and percentage of total customer base.
- Evaluation of the specific challenges and needs during a wildfire or PSPS event of the electrical corporation's AFN customer base.
- Plans to address specific needs of the AFN customer base throughout the service territory specific to the unique threats that wildfires and PSPS events may pose for those populations before, during, and after the incidents. This should include high-level strategies, policies, programs, and procedures for outreach, engagement in the development and implementation of the AFN-specific risk mitigation strategies, and ongoing feedback practices.

Reference the Utility Initiative Tracking ID where appropriate.

Tracking ID: WMP-CO-03

Overview of Initiative:

Identification of AFN Populations: Liberty identifies electricity dependent individuals above and beyond those enrolled in the Medical Baseline Allowance Program, through direct outreach to customers in Liberty's service area and collaborative opportunities with local partners.

Liberty has established the ability to track AFN customer categories beyond MBL in its CIS, including the following categories:

- Customers enrolled in low-income programs
- Customers with a physical, intellectual, or developmental disability
- Customers with a chronic condition or injury
- Customers identified as having limited English proficiency
- Customers in households with older adults/children
- Homeless/transportation-disadvantaged customers

Table 8-68. Liberty's Total Identified Medical Baseline and AFN Customers

	MBL Individuals	Individuals Identified as AFN (Beyond MBL)	Approximate Percentage of Individuals Identified as AFN based of Total Residential Customer Base
Liberty	Total: 185	Total: 6,103	14%

Liberty performs customer outreach to share information about customer programs (CARE, ESA, MBL) and PSPS awareness through a variety of methods, including community events, website resources, social media, bill inserts, targeted outreach to multi-family dwellings and mobile home parks, radio ads, digital ads, print ads, and call center staff.

Liberty has made progress in identifying AFN individuals through collaborative outreach with local CBOs, focusing on program enrollment, and promoting self-identification. Liberty identifies the following customer groups as AFN:

- Customers enrolled in the following programs:
  - California Alternate Rates for Energy ("CARE")
  - Medical baseline ("MBL"), including life-support
- Older adults
- Customers who self-identify with AFN categories listed above

<u>2022 Challenges and Needs for AFN Engagement</u>: In 2022, the Joint IOU Statewide AFN Advisory Council and AFN Core Planning Team developed guidance that included a bowtie analysis of the primary risk drivers, outcomes, and consequences for a PSPS event affecting individuals with AFN. Liberty identified the following challenges and needs in 2022 that aligned with the risk drivers outlined by that analysis:

- *Lack of Identification:* While Liberty has made overall progress in identifying Individuals with AFN in its service territory, Liberty continues to seek increased participation in its AFN self-identification tool. 2022 results from wildfire and PSPS awareness surveys conducted by MDC research indicate that only 2% of AFN customers reported awareness of AFN self-identification in November 2022 compared to 4% in June 2022. In 2022, Liberty developed paper versions of its self-identification web forms and shared AFN self-identification information through bill inserts and emails. Through assessment of identified AFN customer counts each quarter and documentation of self-identification communications, Liberty will monitor the success of future targeted outreach regarding AFN status.

- *Lack of Preparation*: One of the key performance indicators Liberty has developed to gauge PSPS preparedness is identification of individuals with AFN who are aware of what support and resources are available to them during a PSPS. Liberty has identified enhanced awareness of these resources as a need for increased PSPS preparedness. Continued monitoring of enrollment in available customer programs and resources will provide insight into the level of overall AFN engagement.
- *Lack of Communication*: Another notable finding from Liberty's PSPS and wildfire awareness survey efforts indicated that 41% of Liberty's customers with AFN reported being aware of additional PSPS notices for those with medical need. Another survey result indicated that communication was one of the largest concerns or perceived challenges for customers in the event of an extended power outage.

<u>2023 Key Objectives and Goals for AFN Engagement</u>: Liberty's goal is to mitigate the impacts of a PSPS on AFN customers through improved customer outreach, education, assistance programs and services. Key objectives for 2023 include:

- Identifying individuals who identify as Access and Functional Needs
- Executing a communication plan that considers survey feedback on successes and areas of opportunity
- Identifying accessibility improvements in resources, tools, and communications
- Cultivating new community partnerships and expanding existing partnerships
- Investigation of resources utilized by state and community entities to minimize duplication of efforts
- Collaboration to support the needs of individuals with AFN, before, during, and after potential PSPS

Liberty has identified the following goals to meet key AFN objectives for 2023:

<u>Communications</u>:

- Increase the volume of wildfire preparedness-specific communication to critical customers and AFN groups
- Increase information sharing around available customer programs and resources, directly correlating the benefit of program enrollment in terms of PSPS communication and AFN identification.
- Continue to expand on information-sharing efforts with CBOs and local partners to reach AFN audiences.

- Consider feedback gathered in WMP pre-season and post-season survey waves to inform customer and partner communication approach.

Resources:

- Further explore transportation and paratransit agency services throughout Liberty's service territory.
- Seek opportunities to increase accessibility and awareness of PSPS preparedness materials, workshops, and assistance programs.

AFN Self-Identification:

- Continue to improve participation in AFN self-identification through a focus on program communication, internal awareness, and integration into business processes where possible.
- Explore further collaboration opportunities to increase AFN self-identification with local partners (*e.g.*, healthcare providers, CBOs, etc.).

Liberty provides additional information on its programs to support AFN populations during wildfire emergencies and PSPS events in Appendix G – Liberty's 2023 AFN Plan.

8.5.4 Collaboration on Local Wildfire Mitigation Planning

In this section, the electrical corporation must provide a high-level overview of its plans, programs, and/or policies for collaborating with communities on local wildfire mitigation planning (*e.g.*, wildfire safety elements in general plans, community wildfire protection plans, local multi-hazard mitigation plans) within its service territory. The narrative must be no more than one page.

In addition, the electrical corporation must provide the following information in tabular form, providing no more than one page of tabulated information in the main body of the WMP and the full table in an Appendix as needed.

- List of county, city, and tribal agencies and non-governmental organizations (*e.g.*, nonprofits, fire safe councils) within the service territory with which the electrical corporation has collaborated or intends to collaborate on local wildfire mitigation planning efforts (*i.e.*, non-wildfire emergency planning activities)
  - For each entity, the local wildfire mitigation planning program/plan/document, level of collaboration (*e.g.*, meeting attendance, verbal or written comments), and date the electrical corporation provided its last feedback. Reference the Utility Initiative Tracking ID where appropriate.

- In a separate table, the electrical corporation must provide a list of current gaps and limitations in its collaboration efforts with local partners on local wildfire planning efforts. Where gaps or limitations exist, the electrical corporation must indicate proposed means and methods to increase collaborative efforts.

Liberty hosts a series of public workshops each year to provide communities in its service territory with information regarding wildfire mitigation programs and PSPS procedures. Liberty presents wildfire mitigation and PSPS preparedness content at local fire safety council meetings, senior center meetings, local homeowner's association meetings, and meetings of county and tribal representatives. In addition, Liberty meets with the Wildfire Safety Community Advisory Board at least twice a year to disseminate information and to allow participants to voice their concerns regarding wildfire mitigation planning.

Liberty provides information on collaboration efforts in local wildfire mitigation planning in Table 8-69 and Table 8-70.

Table 8-69. Liberty Collaboration in Local Wildfire Mitigation Planning

Name of County, City, or Tribal Agency or Civil Society Organization (*e.g.*, nongovernmental organization, fire safe council)	**Program, Plan, or Document**	**Last Version of Collaboration**	**Level of Collaboration**
Sierra County Fire Safe & Watershed Council	Home/FireSafeSC (firesafesierracounty.org)	Wildland Urban Interface Project to reduce hazardous fuels upon 65 acres adjacent to Sierraville, CA.	Liberty is a Council stakeholder. Attended an in person meeting 04/28/2022 at 10 AM, PDT. Provided verbal comments and input.
Nevada County Quarterly Wildfire Stakeholder Meeting	Fire adapted communities and community archetypes		Meets Quarterly. Attended January 5, 2:00 PM.
Liberty and NV Energy Fire Mitigation/PSPS Collaboration	None	Coordination on PSPS exercises and wildfire mitigation.	Meets Monthly. Virtual meeting 3/1/2023.
Washoe Tribe	Tribal Government Wildfire Safety		Attended an in person meeting on 09/07/2022 at 6:00 pm PDT. Provided PSPS briefing.

Table 8-70. Liberty Gaps and Limitations in Collaborating on Local Wildfire Mitigation Planning

Subject of Gap or Limitation	**Brief Description of Gap or Limitation**	**Strategy for Improvement**
Need year round representation area Fire Safe Councils	Due to the size of its territory Liberty needs and additional FTE who can be dedicated as a Liaison to local Fire Departments and Fire Safe Councils in the seven county Liberty service area.	**Strategy:** Dedicate and train a Fire Protection Specialist to be assigned as a local wildfire planning liaison available as needed for local planning efforts. **Target timeline**: Training of Wildfire Planning Liaison to be complete by April 2023.

8.5.5 Best Practice Sharing with Other Electrical Corporations

In this section, the electrical corporation must provide a high-level overview of its policy for sharing best practices and collaborating with other electrical corporations on technical and programmatic aspects of its WMP program. The narrative must be no more than one page.

In addition, the electrical corporation must provide a list in tabular form of relevant electrical corporations and other entities it has shared or collaborated or intends to continue to share or collaborate or begin sharing or collaborating, with on best practices for technical or programmatic aspects of its WMP program.

For each entity, the best practice subject, date(s) of collaboration, whether the collaboration is technical or programmatic, list of electrical corporation partners, a description of the best practice sharing/collaborative activity with a reference, and any outcomes from that sharing or activity.

Reference the Utility Initiative Tracking ID where appropriate.

The overview and table must be no longer than two pages in the main body of the WMP. The full table can be included as an appendix as needed.

Tracking ID: WMP-CO-05

Liberty cooperates and shares best practices with other electrical corporations and entities on technical and programmatic aspects of its WMP program. For instance, because of Liberty's proximity to Nevada, there are several collaborative efforts between NV Energy and Liberty. For example, Liberty and NV Energy share weather data and fuel sampling resources in order to reduce costs of these respective programs to customers. Further, NV Energy and Liberty hold recurring meetings to share updates to system hardening programs and to discuss local staffing and resources and other wildfire mitigation-related activities.

Liberty provides information on best practice sharing with other electrical corporations in Table 8-71.

Table 8-71. Liberty Best Practice Sharing with Other Electrical Corporations

Best Practice Subject	**Dates of Collaboration (YYYY–YYYY)**	**Technical or Programmatic**	**Electrical Corporation Partner(s)**	**Description of Best Practice Sharing or Collaborating**	**Outcome**
Covered conductor effectiveness	2020–Current	Technical	PGE, SCE, SDGE, Liberty, PacifiCorp, BVES	The IOUs commissioned a joint study to assess the effectiveness and reliability of covered conductors for overhead distribution system hardening. The aim is to develop consistent criteria and measurements for evaluating effectiveness of Covered Conductor. Refer to Appendix F.	This program is in progress. Refer to Appendix F.
Access and Functional Needs Joint IOU Statewide Council	2021 – Current	Programmatic	PGE, SCE, SDGE, Liberty, PacifiCorp, BVES	This council provides an opportunity for Joint IOUs and Access and Functional Needs stakeholders throughout California to develop the utilities' annual Plan to Address AFN Populations During De-Energization Events, share feedback, and hold discussions to raise awareness of AFN population needs and challenges.	This program is in progress. Liberty has enhanced its support of AFN customers since 2021, as discussed in its 2023 AFN Plan.
Liberty and NV Energy Fire Mitigation and PSPS Collaboration Meeting	Recurring monthly from 10/10 2022 to present	Programmatic	NV Energy	Liberty Utilities and NV Energy Wildfire Prevention and Emergency Management personnel meet monthly. Topics discussed include wildfire prevention programs in coordination with local Fire agencies, and PSPS coordination to include participation in each other's emergency management exercises.	This program is in progress. To date it has resulted in greater coordination between companies. Liberty is launching a program with local fire agencies that is being modeling on a successful program at NV Energy.
IOU Exercises	As scheduled	Programmatic	PacifiCorp	Liberty will participate in the PacifiCorp's PSPS exercise to be conducted Eureka CA, on 03/28/2022. Exercise play will include PacifiCorp's coordination on Mutual Aid with Liberty and PG&E.	Liberty anticipates greater understanding and coordination between companies with regard to PSPS execution and mutual aid.

Best Practice Subject	**Dates of Collaboration** **(YYYY–YYYY)**	**Technical or Programmatic**	**Electrical Corporation Partner(s)**	**Description of Best Practice Sharing or Collaborating**	**Outcome**
Nevada County Fire Adapted Communities and Community Archetypes	Meets Quarterly	Programmatic	Tahoe Donner Public Utility District (TDPUD)	This group is employing the new “Fire Adapted Communities Pathways Tool” to understand the various community archetypes in Nevada County and to identify strategies for engaging and working with these communities around wildfire mitigation.	Improved coordination on wildfire mitigation in Nevada County CA.
Fire response and resource protection	September 2021	Technical	PG&E	During the Caldor Fire (2021) Liberty coordinated Mutual Aid with PG&E. PG&E provided seven Structure and Infrastructure Protection Teams (“SIPT”) to assist with fireproofing poles, etc. prior to the fire reaching the Meyers/South Lake Tahoe vicinity. PG&E/Liberty mutual aid was coordinated through the CAL FIRE EOC.	Mitigation of the loss of electric poles and substation in the burn area

9. Public Safety Power Shutoff

9.1 Overview

In Sections 9.1–9.5 of the WMP,[106] the electrical corporation must:

- Provide a high-level overview of key PSPS statistics
- Identify circuits that have been frequently de-energized and provide measures for how the electrical corporation will reduce the need for, and impact of, future PSPS implementation on those circuits
- Describe expectations for how the electrical corporation's PSPS program will evolve over the next 3 and 10 years
- Describe any lessons learned for PSPS events occurring since the electrical corporation's last WMP submission
- Describe the electrical corporation's protocols for PSPS implementation

9.1.1 Key PSPS Statistics

In this section, the electrical corporation must include a summary table of PSPS event data. These data must be calculated from the same source used in the GIS data submission (*i.e.*, they should be internally consistent). If it is not possible to provide these data from the same source, the electrical corporation must explain why.

Liberty has not executed a PSPS event since the program was developed in 2019. There have been two potential events in which Liberty has made notifications to customers and other partners of the possibility of a PSPS where the decision was ultimately made not to de-energize. These potential PSPS events are captured in Table 9-1.

[106] Annual information included in the following sections must align with Table 10 of the QDR.

Table 9-1. Liberty Potential PSPS Event Statistics

	No. of Events	Total Circuits De-energized	Total Customers[107] Potentially Impacted	Total Customer Minutes of Interruption
2019	1	0	5,794	0
2020	0	0	0	0
2021	1	0	6,036	0
2022	0	0	0	0

9.1.2 Identification of Frequently De-energized Circuits

Public Utilities Code section 8386(c)(8) requires the "[i]dentification of circuits that have frequently been de-energized pursuant to a PSPS event to mitigate the risk from wildfire and the measures taken, or planned to be taken, by the electrical corporation to reduce the need for, and impact of, future PSPS of those circuits, including, but not limited to, the estimated annual decline in circuit PSPS and PSPS impact on customers, and replacing, hardening, or undergrounding any portion of the circuit or of upstream transmission or distribution lines." To comply, the electrical corporation is required to populate a table and provide a map showing the frequently de-energized circuits.

The map must show the following:

- All circuits listed in the relevant table, colored or weighted by frequency of PSPS
- HFTD Tiers 2 and 3 contour overlay

Liberty has not executed a PSPS event since the program was developed in 2019 and thus does not have a list of circuits that have been frequently de-energized pursuant to a PSPS event.

[107] Here, "customers" is customer accounts. Liberty uses electric meters as a proxy for customers.

9.1.3 Objectives

Each electrical corporation must summarize the objectives for its 3-year and 10-year plans to reduce the scale, scope, and frequency of PSPS events.[108] These summaries must include the following:

- Identification of which initiative(s) in the WMP the electrical corporation is implementing to achieve the stated objective, including Utility Initiative Tracking IDs
- Reference(s) to applicable codes, standards, and best practices/guidelines and an indication of whether the electrical corporation exceeds an applicable code, standard, or regulation
- Method of verifying achievement of each objective
- A completion date for when the electrical corporation will achieve the objective
- Reference(s) to the WMP section(s) or appendix, including page numbers, where the details of the objective(s) are documented and substantiated

Liberty's three-year and 10-year PSPS objectives are provided in Table 9-2. Liberty PSPS Objectives (three-year plan) and Table 9-3. Liberty PSPS Objectives (10-year plan).

[108] Annual information included in this section must align with Table 12 of the QDR.

Table 9-2. Liberty PSPS Objectives (three-year plan)

Objectives for Three Years (2023–2025)	**Applicable Initiative(s) & Tracking ID(s)**	**Applicable Regulations, Codes, Standards, and Best Practices**	**Method of Verification (*i.e.*, program)**	**Completion Date**	**Reference (section & page Number)**
Continue to build on PSPS risk and wildfire consequence model.	WMP-SA-06; WMP-SA-07	OEIS WMP Guidelines	Model	12/31/2025	Section 6, pp. 64-110
Improvements to weather forecasting.	WMP-SA-01	None	Model	12/31/2023	Section 8.3.2, pp. 262-266
Reduce the possible duration of PSPS event by reducing recovery time through staff training.	WMP-EP-04	None	Training documentation	Ongoing	Section 8.4.5, pp. 338-342
Strategic installation of automatic reclosers and fault indicators to minimize scope and duration.	WMP-GDOM-GH-08; WMP-SA-02	None	QDR	Ongoing	Section 8.1.2.8, p. 169; Section 8.3.3.1, pp. 267-268
Install microgrid and continue to evaluate more locations for microgrids and line removal opportunities.	WMP-GDOM-GH-07; WMP-GDOM-GH-09	None	QDR	12/31/2024	Section 8.1.2, pp. 156-173
Assist critical and medically sensitive customers with backup battery power during PSPS events.	WMP-EP-05	Liberty AFN Plan	Program	12/31/2025	Section 8.4.6, pp. 343-345

Table 9-3. Liberty PSPS Objectives (10-year plan)

Objectives for Ten Years **(2026–2032)**	**Applicable Initiative(s) & Tracking ID(s)**	**Applicable Regulations, Codes, Standards, and Best Practices**	**Method of Verification (*i.e.*, program)**	**Completion Date**	**Reference (section & page Number)**
Reduce the total number of customers affected by PSPS events through continued grid hardening efforts.	WMP-GDOM-GH-01; WMP-GDOM-GH-02; WMP-GDOM-GH-03; WMP-GDOM-GH-05	None	Number of customers impacted by a PSPS event, if applicable.	12/31/2030	Section 8.1.2, pp. 156-173
Reduce the frequency of PSPS by incorporating grid hardening efforts and asset health into PSPS thresholds and decision making process.	WMP-GDOM-GH-01; WMP-GDOM-GH-02; WMP-GDOM-GH-03; WMP-GDOM-GH-05;	None	Number of PSPS events, if applicable.	12/31/2030	Section 8.1, pp. 145-203 Section 9.2, pp. 382-390
Evaluate SRP program for reduction of ignition potential and adjust PSPS zones and/or thresholds if possible to reduce PSPS impacts.	WMP-SA-02; WMP-GDOM-GO-01	None	Ignition reduction	Still being evaluated	Section 8.1.8, pp. 191-196 Section 8.3.3, pp. 266-270
Research new technologies that have the potential to reduce PSPS impacts.	WMP-GDOM-GH-06	None	WMP	Ongoing	Section 8.1.2.6, pp. 166-167
Assist critical and medically sensitive customers with backup battery power during PSPS events.	WMP-EP-05	None	Program	12/31/2025	Section 8.4.6, pp. 343-345

9.1.4 Targets

Initiative targets are forward-looking quantifiable measurements of activities identified by each electrical corporation in its WMP. Electrical corporations will show progress toward completing targets in subsequent reports, including QDRs and WMP Updates.

The electrical corporation must list all targets it uses to track progress on reducing the scope, scale, and frequency of PSPS for the three years of the Base WMP. Energy Safety's Compliance Assurance Division and third parties must be able to track and audit each target.[109] For each initiative target, the electrical corporation must provide the following:

- Utility Initiative Tracking IDs.
- Projected targets for the three years of the Base WMP and relevant units.
- The expected "x% risk impact" for each of the three years of the Base WMP. The expected x% risk impact is the expected percentage risk reduction per year, as described in Section 7.2.2.2.
- Method of verifying target completion.

The electrical corporation's targets must provide enough detail to effectively inform efforts to improve the performance of the electrical corporation's initiatives aimed at reducing the scope, scale, and frequency of its PSPS events.

Liberty does not have PSPS-specific targets outside of other related WMP targets that are also aimed at reducing the scope, scale, and frequency of potential PSPS events. Liberty provides its PSPS-related targets for 2023-2025 in Table 9-4.

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[109] Annual information included in this section must align with Tables 1 and 12 of the QDR.

Table 9-4. Liberty PSPS-Related Targets

Initiative Activity	Tracking ID	2023 Target & Unit	x% Risk Impact 2023[110]	2024 Target & Unit	x% Risk Impact 2024	2025 Target & Unit	x% Risk Impact 2025	Method of Verification
Install system automation equipment	WMP-GDOM-GH-08	8 automatic reclosers installed	See footnote	8 automatic reclosers installed	See footnote	4 automatic reclosers installed	See footnote	QDR, GIS
Grid monitoring systems	WMP-SA-02	10 circuits	See footnote	10 circuits	See footnote	10 circuits	See footnote	Work order, invoices
Fire detection and alarm systems	WMP-SA-03	8 camera installations	See footnote	Unknown	See footnote	Unknown	See footnote	Invoices, QDR
WMP risk modeling initiatives (Ignition/PSPS likelihood/consequence)	WMP-SA-06; WMP-SA-07;	Model enhancements; Refer to Section 6	See footnote	Model enhancements; Refer to Section 6	See footnote	Model enhancements; Refer to Section 6	See footnote	WMP risk model results
Collaboration and coordination with PSPs	WMP-EP-02	Continued engagement with local stakeholders and PSPs to prepare for and respond to fire-related event; Meet with Community Advisory Boards	See footnote	Continued engagement with local stakeholders and PSPs to prepare for and respond to fire-related event; Meet with Community Advisory Boards	See footnote	Continued engagement with local stakeholders and PSPs to prepare for and respond to fire-related event; Meet with Community Advisory Boards	See footnote	Liberty communications and event tracker
Customer support in wildfire and PSPS emergencies	WMP-EP-05	Conduct Incident Command Training for all identified IC members and hold Virtual PSPS Functional and Tabletop exercises; Continued implementation of Liberty's 2022 AFN Plan;	See footnote	Conduct Incident Command Training for all identified IC members and hold Virtual PSPS Functional and Tabletop exercises; Continued implementation of Liberty's 2022 AFN Plan;	See footnote	Conduct Incident Command Training for all identified IC members and hold Virtual PSPS Functional and Tabletop exercises; Continued implementation of	See footnote	Liberty communications and event tracker

[110] Liberty does not currently have sufficient information to calculate

Initiative Activity	Tracking ID	2023 Target & Unit	x% Risk Impact 2023[110]	2024 Target & Unit	x% Risk Impact 2024	2025 Target & Unit	x% Risk Impact 2025	Method of Verification
		Continued maintenance of emergency response plans; Enhanced documentation and use of lessons learned to update plans.		Continued maintenance of emergency response plans; Enhanced documentation and use of lessons learned to update plans.		Liberty's 2022 AFN Plan; Continued maintenance of emergency response plans; Enhanced documentation and use of lessons learned to update plans.		
Public outreach and education awareness for wildfires, PSPS, outages from protective equipment and device settings, and vegetation management	WMP-CO-01	Continue to survey customers, CBOs, community partners and stakeholders to understand wildfire and PSPS awareness and the needs of customers. Strengthen and expand AFN CBO partnerships. Identify emerging channels and technologies to better communicate with customers, community and stakeholders.	See footnote	Continue to survey customers, CBOs, community partners and stakeholders to understand wildfire and PSPS awareness and the needs of customers. Strengthen and expand AFN CBO partnerships. Identify emerging channels and technologies to better communicate with customers, community and stakeholders.	See footnote	Continue to survey customers, CBOs, community partners and stakeholders to understand wildfire and PSPS awareness and the needs of customers. Strengthen and expand AFN CBO partnerships. Identify emerging channels and technologies to better communicate with customers, community and stakeholders.	See footnote	Wildfire Awareness Survey results, AFN Annual Plan and Quarterly Reports, Liberty communications and event tracker

9.1.5 Performance Metrics Identified by the Electrical Corporation

Performance metrics indicate the extent to which an electrical corporation's Wildfire Mitigation Plan is driving performance outcomes. Each electrical corporation must:

- List the performance metrics the electrical corporation uses to evaluate the effectiveness of reducing reliance on PSPS[111]

For each of these performance metrics listed, the electrical corporation must:

- Report the electrical corporation's performance since 2020 (if previously collected)
- Project performance for 2023-2025
- List method of verification

The electrical corporation must ensure that each metric's name and values are the same in its WMP reporting as its QDR reporting (specifically, QDR Table 2 and QDR Table 3). Metrics listed in this section that are the same as performance metrics required by Energy Safety and reported in QDR Table 2 (Performance Metrics)[112] must match those reported in QDR Table 2. Metrics listed in this section that are not the same as any of the performance metrics identified by Energy Safety and reported in QDR Table 2 must match those reported in QDR Table 3.

The electrical corporation must:

- Summarize its self-identified performance metric(s) in tabular form
- Provide a brief narrative that explains trends in the metrics

Table 9-5 provides an example of the minimum acceptable level of information.

In addition to the table, the electrical corporation must provide a narrative (two pages maximum) explaining its method for determining its projected performance on these metrics (*e.g.*, PSPS consequence modeling, retrospective analysis).

Refer to Table 9-5 for the list of performance metrics that Liberty uses to evaluate its PSPS program. The projected performance of metrics is determined by considering historical performance of that metric and improvements or enhancements related to the metric that would increase the performance of the metric. For instance, Liberty improved its customer

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111 There may be overlap between the performance metrics the electrical corporation uses and performance metrics required by Energy Safety. The electrical corporation must list these overlapping metrics in this section in addition to any unique performance metrics it uses.

112 The performance metrics identified by Energy Safety are included in Energy Safety's Data Guidelines.

notification database for PSPS events subsequent to 2021, and thus Liberty expects the metric measuring the percentage of potentially impacted customers notified before a PSPS event to increase in future years.

Table 9-5. Liberty PSPS Performance Metrics Results by Year

Performance Metrics	2020	2021	2022	2023 Projected	2024 Projected	2025 Projected	Method of Verification (*e.g.*, third-party evaluation, QDR)
Percentage of potentially impacted customers notified at least 24 hours before a potential PSPS event	0	89%[113]	0	100%	100%	100%	Customer communications database
Percentage of potentially impacted MBL customers that either positively confirmed notification or received physical visits and door hangers before a potential PSPS event	0	100%	0	100%	100%	100%	Customer communications database
Percentage of impacted customers notified at least 24 hours before a PSPS event	No PSPS Event	No PSPS Event	No PSPS Event	100%	100%	100%	Customer communications database, QDR
Numbers of circuits de-energized	0	0	0	0	0	0	QDR
Numbers of customers impacted	0	0	0	0	0	0	QDR

[113] Liberty has corrected technical issues within its notification system to address issues identified during its September 19, 2021 Potential PSPS Event leading to 89% customer notification specific to the Liberty potential PSPS event. Liberty understands that close to 100% of the potentially impacted customers were notified of potential de-energization, however 89% received notifications specific to the Liberty potential PSPS event.

9.2 Protocols on PSPS

The electrical corporation must describe its protocols on PSPS implementation including:

- Risk thresholds (*e.g.*, wind speed, FPI, etc.) and decision-making process that determine the need for a PSPS. Where the electrical corporation provides this information in another section of the WMP, it must provide a cross-reference here rather than duplicating responses.
- Method used to compare and evaluate the relative consequences of PSPS and wildfires.
- Outline of the strategic decision-making process for initiating a PSPS (*e.g.*, a decision tree). Where the electrical corporation provides this information in another section of the WMP, it must provide a cross-reference here rather than duplicating responses.
- Protocols for mitigating the public safety impacts of PSPS, including impacts on first responders, health care facilities, operators of telecommunications infrastructure, and water electrical corporations/agencies.

Risk thresholds and decision-making protocols: Liberty uses a combination of Energy Release Component ("ERC") percentile, wind gust, and Fosberg Fire Weather Index ("FFWI") to assess de-energization decisions. The current threshold for most PSPS zones is 40 mph wind gust and FFWI of 50, with slightly higher thresholds for windier circuits.

Liberty utilizes weather stations throughout its service territory and collaborates with Reax Engineering, a fire and weather scientific consultant, the National Weather Service ("NWS") in Reno, Nevada, and local fire officials, to monitor local weather conditions and evaluate when a PSPS should be initiated. The initiation of PSPS events is influenced by the following factors:

- Red Flag Warnings: Issued by the NWS to alert of the onset, or possible onset, of critical weather or dry conditions that would lead to increases in utility-associated ignition probability and rapid rates of fire spread.
- Low humidity levels: Potential fuels are more likely to ignite when relative humidity is low and vapor pressure deficit is high.
- Forecast sustained winds and gusts: Fires burning under high winds can increase ember production rates and spotting distances. Winds also can transfer embers from lower fire risk areas into high-risk areas, igniting spot fires and increasing wildfire potential.
- Dry fuel conditions: Trees and other vegetation act as fuel for wildfires. Fuels with low moisture levels easily ignite and can spread rapidly.
- Observed Energy Release Component ("ERC")
- Observed wind gusts

- Observed Fosberg Fire Weather Index (“FFWI”)
- Observed Burning Index (“BI”)

In a case where the NWS forecasts three-second gusts greater than 50 mph, Liberty will check the location of those speeds, and areas where those speeds would peak, for the proximity to service equipment. If the gusts are near service equipment, the equipment is assessed to see if it is scheduled for repair. Liberty then monitors humidity and temperature levels to evaluate fuel conditions and forest susceptibility to fire for those areas. If an area is identified to be at risk of causing a wildfire, Liberty will first attempt to de-energize that line so that load at the end of the line can continue to be served. If load has to be dropped, Liberty will attempt to minimize the lost load and customer disruption.

Liberty employs two de-energization decision trees, one for the Topaz and Muller 1296 r3 PSPS zones, and another for all other zones. In each case, the ERC, observed wind gust, and FFWI criteria are evaluated simultaneously to test whether any exceed the defined threshold:

Figure 9-1 below represents the de-energization decision tree for Topaz and Muller 1296 r3 PSPS zones:

Figure 9-1: De-energization Decision Tree for Topaz and Muller 1296 r3 PSPS Zones

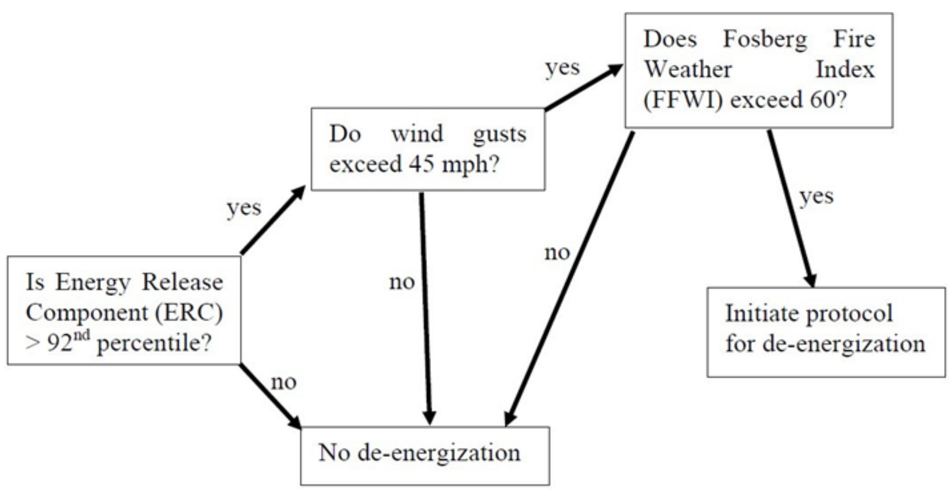
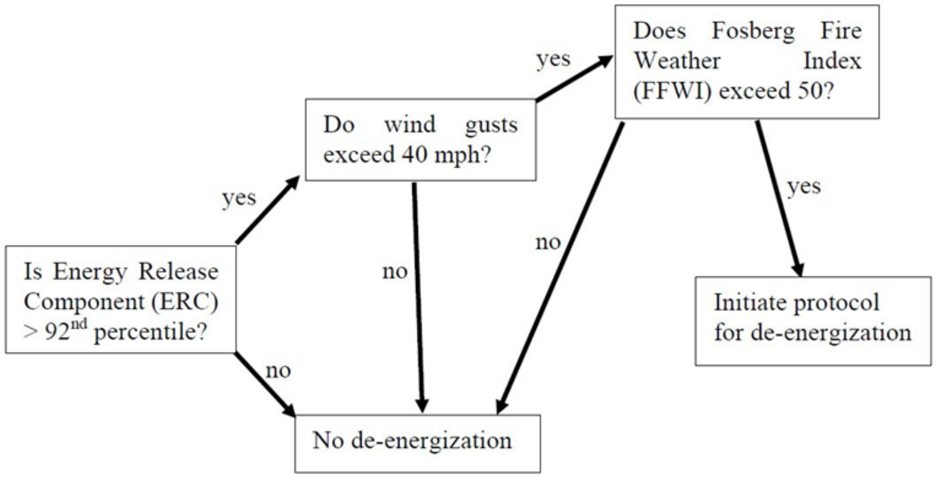


Figure 9-2 below represents the de-energization decision tree for all other zones.

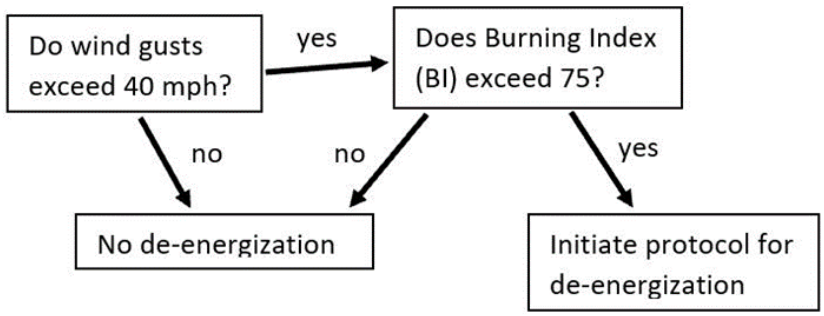
Figure 9-2: De-energization Decision Tree for other PSPS zones



In January 2021, Liberty's fire and weather scientific consultant, Reax Engineering, formulated an enhanced version of its fire weather forecasting tool to include an additional parameter known as Burning Index, or BI. BI adds an increased layer of information regarding fire potential to its existing predictive formula. It accounts for predominant fuel type, live and dead fuel moisture, and short-term fluctuations in fire weather conditions. Use of this new formula with increased information from newly installed additional weather stations will enable further granularity in the area of alternative responses to initiating a PSPS, such as managing recloser technology, de-energizing specific circuits and /or increasing patrols in specific geographic areas of concern. Liberty now utilizes both the current predictive formula and the enhanced model to assess de-energization decisions.

Figure 9-3 below shows the current BI/gust de-energization formulation that is being evaluated by back testing against historical weather station observations and archived weather forecast data. The purpose of this formulation is to try to better capture "black swan" events, where extremely high winds may still have the ability to cause dangerous fire conditions even though temperatures are low and humidity levels are not critical, which can happen in the spring or fall more than the middle of the typical fire season.

Figure 9-3: De-energization Decision Tree that Liberty is Utilizing in Addition to Figures 9-1/9-2



In 2024, Liberty will add Technosylva's FireRisk application to its weather forecasting and fire potential modeling capabilities. FireRisk provides daily asset-based risk forecasting to support operational needs, including situational awareness needs, such as monitoring conditions for a potential PSPS. The addition of FireRisk to Liberty's situational awareness tools will provide near-to-live weather forecasting and help to identify locations and periods of concern in its service territory, given the PSPS thresholds that Liberty has set to identify when PSPS may be implemented.

PSPS likelihood and consequences: Recent PSPS risk analysis includes estimating the frequency, or likelihood of a PSPS event given historic weather data gridded on Liberty's overhead lines. Gridded Real Time Mesoscale Analysis ("RTMA") data was analyzed to estimate the frequency with which Liberty's overhead network is exposed to wind gust and spell out values close to these thresholds. The result of this analysis is shown in Figure 9-4 and Figure 9-5 for July and November and the full year detailed months are in Appendix B. These tables provide an estimate of the annualized number of line-mile hours that exceed the wind gust and FFWI thresholds by month.

Figure 9-4: Annualized Line Mile Hours Exceeding Joint FFWI/Wind Gust Criteria by Month, July

		Wind gust (mph)					
		35	**40**	**45**	**50**	**55**	**60**
FFWI	**45**	52	11	2	0	0	0
	50	46	11	2	0	0	0
	55	30	10	2	0	0	0
	60	21	9	2	0	0	0
	65	13	7	2	0	0	0
	70	2	1	1	0	0	0

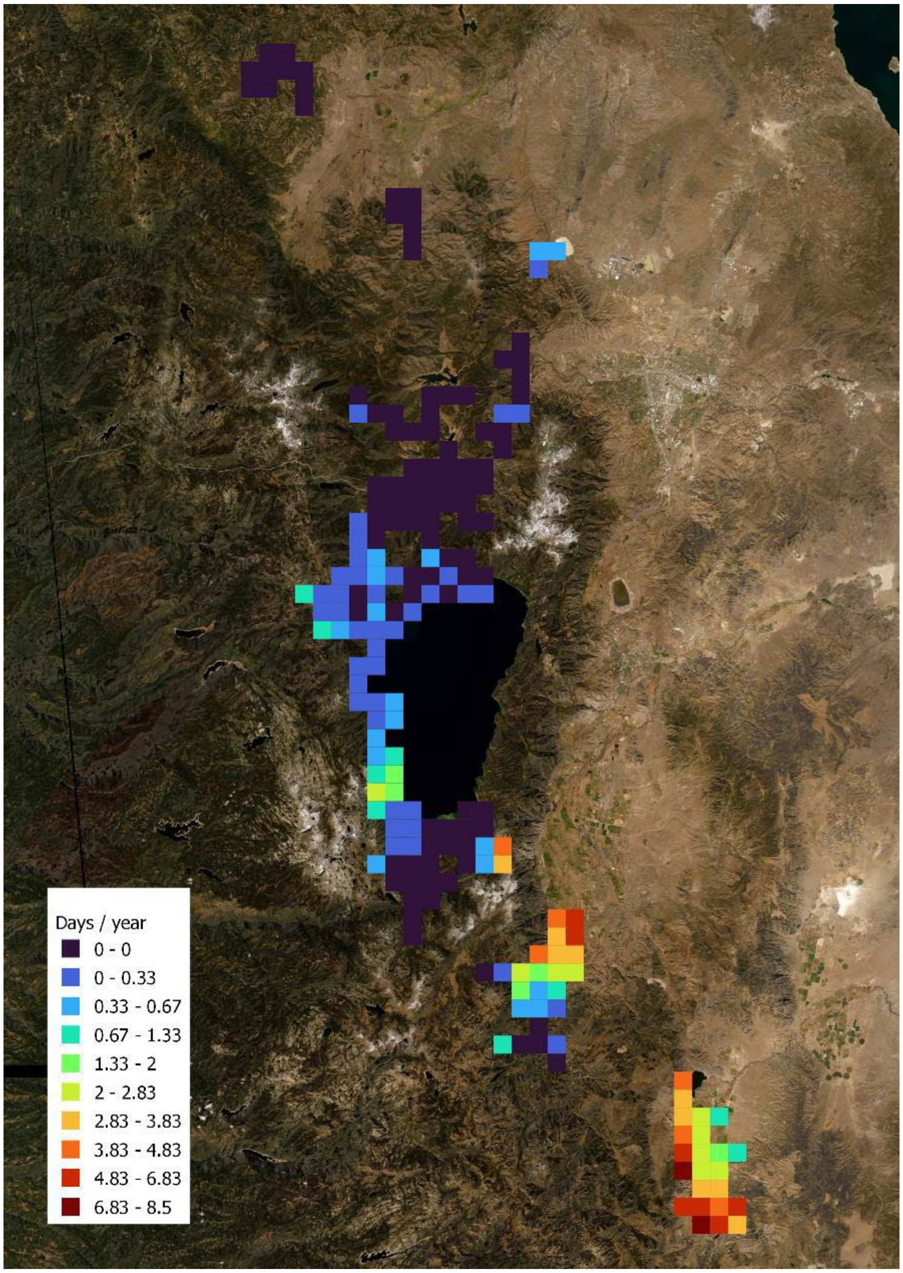
Figure 9-5: Annualized Line Mile Hours Exceeding Joint FFWI/Wind Gust Criteria by Month, November

		Wind gust (mph)					
		35	**40**	**45**	**50**	**55**	**60**
FFWI	**45**	1,631	1,119	742	463	265	182
	50	1,190	894	587	407	249	178
	55	907	735	515	365	241	176
	60	701	615	452	326	227	165
	65	527	485	384	291	204	155
	70	390	366	302	242	176	139

The monthly results demonstrate that wind gust and FFWI thresholds are conducive to PSPS likelihood year-round and independent of fuel dryness. However, precipitation usually will preclude fire spread in Liberty's service territory from approximately December-April and these months are not factored into PSPS as a mitigation of fire risk. PSPS is most likely to occur in May to June, during low snow fall years, and from September to November for most years. The results also shows that peak PSPS frequency occurs during November, but only in years where season-ending precipitation has not occurred. Although fuel moistures may trend toward seasonal lows in July and August, these tend to be the least windy months in Liberty's service territory because incoming troughs occur less frequently than later in the year, particularly October and November.

Although the analysis captures the seasonality of elevated fire weather conditions in Liberty's service territory, it provides no information regarding spatial patterns of elevated fire weather conditions. Another analysis performed on this dataset shows the PSPS risk map of the number of hourly records where wind gust exceeds 40 mph and FFWI simultaneously exceeds 50 in RTMA pixels containing overhead lines. See Figure 9-6 for the estimated number of days where wind gust and FFWI exceed thresholds (wind gust > 40 mph and FFWI > 50) by identifying days where 3 or more hourly records exceeded the same thresholds as the total annual hours in the same gridded plot. Since fuel dryness or presence of snow cover was not included in this analysis, Figure 9-6 represents an upper limit on expected PSPS frequency, with actual PSPS frequency expected to be considerably lower.

Figure 9-6: Number of days per year where 3 or more hourly records jointly exceed wind gust of 40 mph and FFWI 50



The purpose of the PSPS consequence model is to measure the anticipated adverse effects from a PSPS for the community at risk. The average PSPS duration is assumed to be a constant value for every circuit and weather condition, so that the PSPS consequence is only a function of the demographics of the circuit's customers. Therefore, for each circuit, given the average PSPS duration, the average CMI can be calculated based on the number of total customers expected to be impacted. A MAVF that considers safety equivalent facilities ("EF"), financial impacts, and reliability is used to calculate an overall dimensionless CoRE score for each circuit. The calculation of safety employs a weighted count of impacted customers that includes extra weight for the number of medical customers and critical infrastructure customers expected to be impacted by the de-energized circuit.

Evaluating consequences of PSPS and Wildfire: To measure the PSPS risk reduction, calculating both a baseline PSPS risk and a post-mitigation PSPS risk must be possible for comparison. Liberty can calculate baseline PSPS risk because it has quantitative estimates of PSPS likelihood and PSPS consequence. These baseline PSPS risk calculations are provided in Section 6.2. However, the post-mitigation PSPS risk associated with a wildfire mitigation would be equal to the baseline PSPS risk because the PSPS thresholds (*i.e.*, wind speed, etc.) are not currently planned to be impacted by wildfire mitigation activities such as covered conductors. Thus, at present, the PSPS risk reduction associated with covered conductor would be zero.

It would be possible to demonstrate a reduction in post-mitigation PSPS risk if the PSPS thresholds were risk-informed, that is, if PSPS thresholds were based explicitly on the tradeoff between expected wildfire risk and PSPS risk for a specific circuit. For example, a circuit that supplies power to many customers and has low wildfire risk should have a higher PSPS threshold (and therefore lower PSPS likelihood) than a circuit that supplies power to only a few customers and has high wildfire risk. If PSPS thresholds were risk-informed, then PSPS thresholds should increase for circuits with lower wildfire risk. Therefore, if a given circuit were to have its wildfire risk reduced due to mitigation activities, then its risk-informed PSPS threshold should be increased, thus lowering the likelihood of a PSPS event and therefore its PSPS risk.

Protocols for mitigating the public safety impacts of PSPS: Liberty provides ongoing public electric safety courses and information to help prepare the public for when an emergency event occurs. These programs are provided year-round to schools, businesses, service clubs, trade shows, and expositions. Additionally, Liberty routinely provides electric safety training to local and regional law enforcement, fire, county and state transportation, and other emergency response agencies.

During an emergency event, Liberty may utilize stand-by personnel, trained in general electrical safety, to observe and report hazardous conditions and assist in perimeter safety around identified hazards due to unsafe conditions until qualified electric personnel arrive. Personnel safety is identified as a key element in Liberty's Emergency Response Plan. Electric trade personnel, including ground persons, helpers, apprentices, journeyman linemen, trouble men, and inspectors are provided safety and skills training to perform in both daily and emergency situations. Only trained personnel may perform safety sensitive functions, including switching, de-energizing, overhead and underground operations, repairing and assessing damage.

To improve employee and public safety, the design, installation and operation of equipment and automatic protection schemes for transmission and substation equipment must remain in place. Employees follow procedures in accordance with OSHA 1910.269 regulations. Non-trade personnel that are mobilized to assist with emergency repair (metering, meter reading, construction, etc.) are trained in general electric safety before assisting in emergency field response.

Liberty will respond to immediate life safety concerns as its top priority. Once a hazardous situation is reported, immediate response will be provided by line crews, trouble men, inspectors or other trained personnel to assess and mitigate risk. Additionally:

- All field response employees shall undergo safety training aligned with their respective roles.
- All electrical switching and reporting shall be managed by the appropriate controlling parties to enhance employee and public safety.
- Liberty will provide regular public information, typically in the form of media messages or alerts, regarding unsafe or hazardous areas or conditions that the public should be informed about.
- In the event of an area emergency that is life or property threatening, the Emergency Alert System ("EAS") shall be enabled through the local or county Emergency Management or Public Safety office. Liberty will advise the emergency management agencies when such alert is essential.
- Public safety agencies will be utilized, as necessary, for traffic control and perimeter safety until qualified personnel arrive to clear the hazard situation. Agencies will be used, if necessary, to control public disturbances and establish safety controls for the public.
- Employees will be monitored for appropriate meal breaks, hours worked, and safety compliance when emergencies are expected to last more than 24 hours. Shifts will be established to cover work, and employees will be given appropriate rest periods.
- Weather and road conditions will be monitored for worsening conditions so that workers are not stranded at remote work locations.
- Work may be curtailed until safe work conditions prevail.

In coordination with the communities that it serves, Liberty has also established a network of Community Resource Centers ("CRCs") to assist communities during extreme weather events. Planning factors for meeting the safety needs for access and functional needs ("AFN") and vulnerable populations have included local demographic data, as well as the company database of medical baseline customers. The establishment of CRCs was informed by presentations and discussions in seven Town Hall Meetings held in each of the seven communities in Liberty's service territory. Plan creation included consultation with regional and local government, advisory boards, public safety partners, representatives of people/communities with access and functional needs, tribal representatives, senior citizen groups, business owners, community resource organizations, and public health and healthcare providers.

- Locations: If Liberty anticipates that the power will be off for an extended period, Liberty will open CRCs in the affected areas. The CRC locations selected by Liberty were identified through a rigorous process, which included input from fire and meteorological experts, as well as those areas most prone to extreme weather, as indicated by historical data. Liberty has selected CRC locations in various regions of its service territory, including Walker, Markleeville, South Lake Tahoe, Truckee Tahoe Airport, Loyalton, and Portola.
- Accommodations: All CRCs are in fixed facility locations known to the public. CRCs will have backup power or are in areas that are contiguous to PSPS zones that would not be shut off in the event of a PSPS. They are ADA-compliant and meet the needs of people with access and functional needs, medical baseline, and other AFN utility customers. FEMA's June 2020 Mass Care Emergency Assistance Pandemic Planning Considerations were used to provide for adequate space for the estimated occupancy and comply with social distancing and public health protocols.
- Services provided: Each CRC site meets fire codes and has at least two egress routes. Once activated, CRCs will operate in 14-hour shifts from 8:00 AM to 10:00 PM daily, until power to the affected community has been restored. The CRCs will provide device charging stations, cellular network services, chairs, and restrooms. Volunteer organizations will provide bottled water and snacks to impacted area residents. Preidentified Liberty subject matter experts ("SMEs") will collaborate with volunteer staff at activated CRCs to communicate real-time PSPS updates directly to impacted community members.

9.3 Communication Strategy for PSPS

In Section 8.4.4 of the WMP, the electrical corporation must discuss all public communication strategies for wildfires, outages due to wildfires and PSPS, and service restoration. Thus, in this section, the electrical corporation is only required to provide a cross-reference to Section 8.4.4 and any other section of the WMP providing details of the emergency public communication strategy for PSPS implementation.

Refer to Section 8.4.4.

9.4 Key Personnel, Qualifications, and Training for PSPS

In Section 8.4.2.2 of the WMP, the electrical corporation must discuss all key personnel planning, qualifications, and training for wildfires, outages due to wildfires, and PSPS, and service restoration. Thus, in this section, the electrical corporation is only required to provide a cross-reference to Section 8.4.2.2 and any other section of the WMP providing details of key personnel, qualifications, and training for PSPS implementation.

Refer to Section 8.4.2.2.

9.5 Planning and Allocation of Resources for Service Restoration due to PSPS

In Section 8.4.5.2 of the WMP, the electrical corporation must address planning of appropriate resources (*e.g.*, equipment, specialized workers) and allocation of those resources to assure the safety of the public during service restoration. Thus, in this section, the electrical corporation is only required to provide a cross-reference to Section 8.4.5.2 and any other section of the WMP providing details of resource planning for PSPS implementation.

Refer to Section 8.4.5.2.

10. Lessons Learned

An electrical corporation must use lessons learned to drive continuous improvement in its WMP. Electrical corporations must include lessons learned due to ongoing monitoring and evaluation initiatives, collaboration with other electrical corporations and industry experts, and feedback from Energy Safety and other regulators.

The electrical corporation must provide a summary of new lessons learned since its most recent WMP submission, and any ongoing improvements to address existing lessons learned. This must include a brief narrative describing the new key lessons learned and a status update on any ongoing improvements due to existing lessons learned. The narrative should be limited to two pages.

The electrical corporation must also provide a summary of how it continuously monitors and evaluates its wildfire mitigation efforts to identify lessons learned. This must include various policies, programs, and procedures for incorporating feedback to make improvements.

Lessons learned can be divided into the three main categories: (1) internal monitoring and evaluation, (2) external collaboration with other electrical corporations, and (3) feedback from Energy Safety or other authoritative bodies. The following are examples of specific potential sources of lessons learned:

- Internal monitoring and evaluation initiatives:
  - Tracking of risk events
  - Findings from root cause analyses and after-action reviews
  - Drills and exercises
  - Feedback from community engagement
  - PSPS events
- Feedback from Energy Safety or other authoritative bodies:
  - Areas for continued improvement identified by Energy Safety in the previous WMP evaluation period
  - Findings from wildfire investigations
  - Findings from Energy Safety Compliance Division assessments
- Collaborations with other electrical corporations

In addition to the above potential sources of lessons learned, the electric corporation must detail lessons learned from any and each catastrophic wildfire ignited by its facilities or equipment in the past 20 years, as listed in Section 0. The electric corporation must also detail specific mitigation measures implemented as a result of these lessons learned and demonstrate how the mitigation measures are being integrated into the electric corporation's wildfire mitigation strategy.

For each lesson learned, the electrical corporation must identify the following in Table 10-1:

- Year the lesson learned was identified
- Subject of the lesson learned
- Specific type or source of lesson learned (as identified in the bullet lists above)
- Brief description of the lesson learned that informed improvement to the WMP
- Brief description of the proposed improvement to the WMP and which initiative(s) or activity(s) the electrical corporation intends to add or modify
- Estimated timeline for implementing the proposed improvement
- Reference to the documentation that describes and substantiates the need for improvement including:
    - Where relevant, a hyperlinked section and page number in the appendix of the WMP
    - Where relevant, the title of the report, date of report, and link to the electrical corporation web page where the report can be downloaded
    - If any lessons learned were derived from quantifiable data, visual/graphical representations of these lessons learned in the supporting documentation

Liberty provides its WMP lessons learned in Table 10-1.

Liberty continuously monitors and evaluates its wildfire mitigation efforts to identify lessons learned, including through its annual WMP filing with Energy Safety. In addition to reporting on its own WMP programs, progress, and lessons learned, Liberty also receives feedback and areas for continued improvement from Energy Safety and other stakeholders. Liberty addresses all findings from Energy Safety Compliance Division assessments and captures findings as part of the process to identify lessons learned. Liberty also monitors and evaluates its WMP programs, budgets, related exercises and trainings, communications and outreach, and other projects through ongoing planning processes such as its capital budgeting processes.

Table 10-1. Liberty WMP Lessons Learned

ID Number	Year of Lesson Learned	Subject	Type or Source of Lesson Learned	Description of Lesson Learned	Proposed WMP Improvement	Timeline for Implementation	Reference
1	2020-2022	Risk Assessment and Mapping	Internal	The fire risk map and circuit risk analysis can be utilized as the baseline for Liberty's wildfire risk assessment. The designated high Reax wildfire areas can be used by operations and engineering for planning of wildfire mitigation work.	Liberty will continue to utilize its fire risk map and circuit risk analysis to inform discussions and decisions regarding prioritizing WMP initiative work. Liberty will continue to develop its risk modeling team and capabilities during the 2023-2025 WMP cycle.	Ongoing	Section 6, pp. 64-110
2	2020-2022	Risk Assessment and Mapping	Risk Modeling Working Group and OEIS	Liberty has gained a greater understanding of best practices across the CA IOUs regarding the following topics: • Modeling baselines • Fire consequence • Asset risk events and ignitions • Vegetation risk events and ignitions • PSPS likelihood • PSPS consequence and reliability analysis and impacts • Modeling algorithms, components, and interdependencies • Smoke and suppression impacts • Climate change impacts	Liberty will continue to participate in the Joint IOU Wildfire Risk Modeling Working Group to understand best practices across the California IOUs (*i.e.*, further integration of community vulnerability, improvements to wildfire consequence modeling).	Ongoing	Section 6, pp. 64-110
3	2020-2022	Situational Awareness	Internal and Reax	Continuous monitoring tools, such as Fire Potential Index ("FPI"), and installation of fault detection equipment has allowed Liberty to develop initial work processes and PSPS plans to monitor and adjust operations based on adverse conditions. Ongoing operational planning that fully utilizes real-time weather data, fault detection anomalies, and predictive wildfire assessment tools are in the early phases of full integration into Liberty work processes. Planning and incorporating an effective situational awareness plan requires an interactive system of data collection, analysis, and work planning	The collection of data needs to be analyzed, and business processes are currently in the development phase for full integration of an interactive system of data collection, analysis, and work planning.		Section 8.3, pp. 256-283

ID Number	Year of Lesson Learned	Subject	Type or Source of Lesson Learned	Description of Lesson Learned	Proposed WMP Improvement	Timeline for Implementation	Reference
4	2022	Risk Events	OEIS	Many of Liberty's risk events are grouped in categories defined as "other" and "unknown."	Refer to Appendix D, LU-22-04 and Liberty's QDR submissions.	Ongoing	Appendix D
5	2020-2022	Grid Hardening	Joint IOU CC Working Group and OEIS	Lessons learned from other utilities covered conductor and grid hardening programs, regarding effectiveness, assessing alternatives, costs, and other best practices. Refer to Appendix F.	Continue to participate in the Joint IOU CC Working Group. Refer to Sections 8.1.2.1 and 8.1.2.6 and Appendix D and F.	Ongoing	Section 8.1.2, pp. 156-173
6	2020-2022	Wildfire Mitigation Strategy Development; Grid Hardening	Internal	Liberty did not meet all grid hardening targets over the 2020-2022 WMP cycle (*e.g.*, 2021 covered conductor, pole replacements, fuse replacements, and tree attachment removals) primarily because the Tamarack and Caldor fires in Liberty's service territory significantly impacted line construction resource availability and supply chain issues impacted material availability. Rather than automatically rolling missed targets into the subsequent year, Liberty reassesses its initiatives every year and makes decisions informed by its risk assessment, resource constraints and cost impacts.	As discussed in Section 7 of Liberty's 2023 WMP, Liberty plans to select a portfolio of initiatives that aligns with its current risk methodology and risk, and other operational and compliance considerations. Liberty continually reprioritizes its workload, including wildfire mitigation efforts, based on changing conditions and workload constraints.	Ongoing	Section 7, pp. 111-144 Section 8.1.2, pp. 156-173
7	2020-2022	Asset Inspections	Internal	Liberty understands that ground-based inspections have limitations, which is why it is considering other technologies, such as infrared inspections, to enhance inspection practices.	Pilot infrared asset inspections.	2023	Section 8.1.3, pp. 173-180
8	2020-2022	Asset Inspections	Internal and OEIS	Liberty had a need to create and implement a formal Asset Inspection QA/QC Program.	Continue to implement and enhance Liberty's Asset Inspection QA/QC Program described in Section 8.1.6.	2023-2025	Section 8.1.3, pp. 173-180
9	2020-2022	Vegetation Management		Liberty has recognized the importance of utilizing emerging technology to make data-driven and risk-informed decisions to prioritize vegetation management work. In 2020, Liberty piloted LiDAR inspections on its South Lake Tahoe circuits to identify and mitigate encroachments. Liberty implemented LiDAR inspections on its entire service territory in 2021 to	Liberty intends to continue LiDAR inspections of vegetation around electric facilities on an annual basis to manage tree encroachments. Liberty is exploring using LiDAR technology to	Ongoing	Section 8.2, pp. 204-255

ID Number	Year of Lesson Learned	Subject	Type or Source of Lesson Learned	Description of Lesson Learned	Proposed WMP Improvement	Timeline for Implementation	Reference
				continue to efficiently manage tree clearances. Liberty intends to explore use cases for tree health monitoring and further risk analysis utilizing LiDAR technology.	identify locations affected by tree mortality and other vegetation and location risk factors. Liberty will continue to monitor change detection on an annual basis to recognize workload trends and to inform program decisions. Liberty will continue to streamline efficiencies and the integration of its portfolio of vegetation initiatives to cooperatively manage vegetation along its system.		
10	2020-2022	Grid Operations and PSPS	Internal and External PSPS-related events and exercises	In 2020 and 2021, Liberty developed, implemented, and improved PSPS operations and communications protocols. These protocols, in combination with the development of the FPI and PSPS forecasting tools have helped to inform day-to-day operational decision-making.	Liberty continually looks to improve FPI and PSPS forecast accuracy and will incorporate additional model forecast data into the existing tools where possible.	Ongoing	Section 8.1.8, pp. 191-196 Section 9, pp. 371-391
11	2020-2021	Stakeholder Cooperation and Community Engagement	Internal and through stakeholder cooperation	A major lesson learned for Liberty throughout 2020 and 2021 was that the engagement of Community Based Organizations and Public Safety Partners is essential to reaching and preparing customers and stakeholders for potential PSPS events. An increased focus on these relationships and communication has driven Liberty's resource additions and bandwidth to perform additional outreach, feedback collection, and networking. More positions were added in 2021 to expand CBO relationship networks and communications channels, including a bilingual Outreach Coordinator.	Continued increased focus on these relationships and communication to perform additional outreach, feedback collection, and networking.	Ongoing	Section 8.5, pp. 345-370
12	2020-2022	PSPS and AFN Customer Support	Internal and through stakeholder cooperation and	Liberty has made significant improvements to its AFN Plan.	Liberty provides detailed descriptions of its improvements to its AFN Plan in Section 8.4.6.	Ongoing	Section 8.4.6, pp. 343-345

ID Number	Year of Lesson Learned	Subject	Type or Source of Lesson Learned	Description of Lesson Learned	Proposed WMP Improvement	Timeline for Implementation	Reference
			AFN Statewide Council				
13	2020-2022	Wildfire Outreach and Communication	Wildfire and PSPS Awareness Surveys	CBO feedback gathered through surveys has informed the outreach and communications approach in a few ways, including highlighted effectiveness of increased use of email and local media driving website traffic to existing PSPS information. Increased messaging around preparation of emergency kits and readiness was also a focus for Liberty in 2022.	Continue to incorporate results and feedback from the Wildfire and PSPS Awareness Surveys.	Ongoing	Section 8.5.2, pp. 355-360

11. Corrective Action Program

In this section, the electrical corporation must describe its corrective action program. The electrical corporation must present a summary description of the relevant portions of its existing procedures.

The electrical corporation must report on how it maintains a corrective action program to track formal actions and activities undertaken to:

- Prevent recurrence of risk events
- Address findings from wildfire investigations (both internal and external)
- Address findings from Energy Safety's Compliance Assurance Division (*i.e.*, audits and notices of defect and violation)
- Address areas for continued improvement identified by Energy Safety as part of the WMP evaluation

The electrical corporation must report on how it reviews each improvement area in accordance with its corrective action program. At a minimum, the electrical corporation must:

- **Identify insufficient occurrence and response**: Identify targeted corrective actions for areas where the event occurrence, response, or feature was insufficient.
- **Identify actions to reduce recurrence**: Identify improvement actions (as applicable) to reduce the likelihood of recurrence, improve response/mitigation actions, or improve operational procedures or practices.
- **Track implementation**: Track the improvement action plan and schedule in the electrical corporation's action tracking system.
- **Improve external communication**: For areas where weaknesses were identified in the response of external agencies, develop a communication plan to share the information and conclusion with the responsible agency. The completion of this action and the agency's response must be documented.
- **Integrate lessons learned from across the industry**: Identify applicable generic lessons learned to improve the overall effectiveness of the electrical corporation WMP.
- **Share lessons learned with others**: Identify and communicate any significant generic lessons learned that should be disseminated broadly (*i.e.*, to other electrical corporations and responsible regulatory authorities, such as Energy Safety or CAL FIRE).

The WMP should not include detailed corrective action plans for each risk event, finding, and/or improvement area. However, this documentation must be made available to Energy Safety upon request.

Liberty's corrective action procedures vary across programs and situations. Examples of corrective action procedures are provided in Table 11-1.

Table 11-1: Examples of Liberty Corrective Action Procedures

Category or Issue or Program	**Identify insufficient occurrence and response**	**Identify actions to reduce recurrence**	**Track implementation**
Emergency Response	Past emergency response in certain emergencies, particularly during winter storms, left areas of improvement in response time and resource allocation.	Training and preparedness exercises aimed at prepositioning resources based on pending events to improve response times and reduce outage length.	Lessons learned and hotwash post emergencies to review progress.
Asset Inspections and Asset Management	If an insufficient occurrence is found, the location and issue is entered in Fulcrum and management is notified that a corrective action is necessary. The issue is immediately corrected, if possible, otherwise follow up happens depending on severity of the issue.	Recommended actions to reduce recurrence are entered as comments into Fulcrum. Management will convene and review recommendations for adequacy and may expand the necessary actions to reduce recurrence. If management recognizes that more issues of a similar nature could occur, follow up inspections are requested and tracked in Fulcrum for complete follow through of the corrective action across the system. Depending on	Implementation of the corrective action is tracked to completion through the Fulcrum database.

Category or Issue or Program	Identify insufficient occurrence and response	Identify actions to reduce recurrence	Track implementation
		severity of the issue, it may be shared with other utilities during collaboration meetings.	
Risk Events	Liberty tracks cause of ignition when it is possible to make a determination. In some cases, the cause investigation can lead to corrective action.	The ignition cause can result in multiple types of corrective action. Depending on the circumstance, inspection may be warranted of all locations with the same equipment and type of construction to determine if there is potential for recurring event. Other actions require review of construction standards that will assist in preventing a risk event in the future. Some situations may lead to the inspection of the immediate area of the risk event to determine if a similar hazard exists within the area and to review if relevant standards or inspection processes help to identify and prevent similar issues from happening	Inspection applications have been created to capture results of follow-up inspections. Construction standards and inspection process documentation is reviewed and updated as necessary.

Category or Issue or Program	**Identify insufficient occurrence and response**	**Identify actions to reduce recurrence**	**Track implementation**
Risk Events	Equipment malfunction or failure that leads to a risk event when it was designed to reduce risk events. For example, expulsion fuses are meant to eliminate spark potential upon operation. Failures of these fuses have shown potential for additional risk as opposed to the reduced risk for which they were originally designed for.	A program is currently in development to simultaneously replace expulsion fuses and perform any additional equipment replacement or repair in the same area.	Application in development to track work locations and progress on replacement.
Vegetation Management	Vegetation Management QA/QC program is performed by third party to review work and check for completion.	Third party audit results are reviewed by Liberty to identify any corrective actions identified. Corrective actions are sent back to the contractor that performed the work to take the necessary corrective actions. Once the rework is complete, the third party auditor will recheck for completion and share results with Liberty. If consistent recurring trends are identified, Liberty will review the deficiencies with the contractor so that further	Third party audit results.

Category or Issue or Program	Identify insufficient occurrence and response	Identify actions to reduce recurrence	Track implementation
		training or benchmarking can be performed to prevent the trend from continuing.	

Liberty provides further information regarding its corrective action procedures below:

Improve external communication: Liberty has not identified weaknesses in communication to external agencies.

Integrate lessons learned from across the industry: Liberty is consistently tracking mitigations deployed throughout the industry by various utilities. Liberty engineering and operations staff participate regularly in internal collaboration meetings and external collaboration meetings where lessons learned are shared with other utilities, public safety partners, etc. Lessons learned of a critical nature are pursued for correction immediately.

Additionally, larger IOUs with significantly more resources are often able to allocate more time to research, development, and studies on emerging technologies that can help to mitigate fire risk. These larger utilities are often the first to implement these mitigations, processes, and programs. As a small IOU, Liberty learns from the experiences of the larger IOUs and will take the opportunity to deploy similar proven-effective mitigations. Through working groups, workshops, research papers, and wildfire mitigation presentations and plans, Liberty learns from the experiences of industry experts and can integrate some of these processes as more information becomes available.

Share lessons learned with others: Liberty engineering and operations staff participate regularly in utility collaboration and public safety partner meetings where lessons learned are shared. Additionally, lessons learned are shared publicly in Section 10 of Liberty's 2023 WMP. Liberty's annual PSPS Post Season Report, filed at the CPUC, integrates lessons learned for PSPS events and exercises. Additionally, Liberty communicates with other stakeholders through various utility working groups, workshops, and outreach events discussed throughout its 2023 WMP.

12. Notices of Violation and Defect

Within a Notice of Violation ("NOV") or Notice of Defect ("NOD"), Energy Safety directs an electrical corporation to correct a violation or defect within a specific timeline, depending on the risk category of the violation or defect. The electrical corporation has 30 days to respond to the NOV or NOD and provide a plan for corrective action. Following completion of the corrective action, the electrical corporation must provide Energy Safety with documentation validating the resolution or correction of the identified violation or defect. Energy Safety includes the electrical corporation's response and the resolution status of any violations or defects in the summaries it provides to the CPUC.

Liberty did not receive any NOVs and NODs from Energy Safety in 2022 and does not have any open NOVs and NODs from Energy Safety as of January 1, 2023.

Appendix A
Office of Energy Safety WMP Definitions

Appendix A: Office of Energy Safety WMP Definitions

Unless otherwise expressly stated, the following words and terms, for the purposes of these Guidelines, have the meanings shown in this chapter.

Terms Defined in Other Codes

Where terms are not defined in these Guidelines and are defined in the Government Code, Public Utilities Code, or California Public Resources Code, such terms have the meanings ascribed to them in those codes.

Terms Not Defined

Where terms are not defined through the methods authorized by this section, such terms have ordinarily accepted meanings such as the context implies.

Definition of Terms

Term	Definition
Access and functional needs population (AFN)	Individuals, including, but not limited to, those who have developmental or intellectual disabilities, physical disabilities, chronic conditions, or injuries; who have limited English proficiency or are non-English speaking; who are older adults, children, or people living in institutionalized settings; or who are low income, homeless, or transportation disadvantaged, including, but not limited to, those who are dependent on public transit or are pregnant. (California Government Code 8593.3(f)(1) and
Asset (utility)	Electric lines, equipment, or supporting hardware.
At-risk species	See “high-risk species.”
Benchmarking	A comparison between one electrical corporation’s protocols, technologies used, or mitigations implemented, and other electrical corporations’ similar endeavors.
Calibration	Adjustment of a set of code input parameters to maximize the resulting agreement of the code calculations with observations in a specific scenario.[1]

[1] Adapted from T. G. Trucano, L. P. Swiler, T. Igusa, W. L. Oberkampf, and M. Pilch, 2006, “Calibration, validation, and sensitivity analysis: What’s what,” Reliability Engineering and System Safety, vol. 91, no. 10–11, pp. 1331–1357.

Term	Definition
Catastrophic wildfire	A fire that caused at least one death, damaged over 500 structures, or burned over 5,000 acres.
Circuit miles	The total length in miles of separate transmission and/or distribution circuits, regardless of the number of conductors used per circuit (i.e., different phases).
Consequence	The adverse effects from an event, considering the hazard intensity, community exposure, and local vulnerability.
Contact by object ignition likelihood	The likelihood that a non-vegetative object (such as a balloon or vehicle) will contact utility-owned equipment and result in an ignition.
Contact by vegetation ignition likelihood	The likelihood that vegetation will contact utility-owned equipment and result in an ignition.
Contractor	Any individual in the temporary and/or indirect employ of the electrical corporation whose limited hours and/or time-bound term of employment are not considered “full-time” for tax and/or any other purposes.
Critical facilities and infrastructure	Facilities and infrastructure that are essential to public safety and that require additional assistance and advance planning to ensure resiliency during PSPS events. These include the following: Emergency services sector: • Police stations • Fire stations • Emergency operations centers • Public safety answering points (e.g., 9-1-1 emergency services) Government facilities sector: • Schools • Jails and prisons Health care and public health sector: • Public health departments • Medical facilities, including hospitals, skilled nursing facilities, nursing homes, blood banks, health care facilities, dialysis centers, and hospice facilities (excluding doctors' offices and other non-essential medical facilities)

Term	Definition
	Energy sector: • Public and private utility facilities vital to maintaining or restoring normal service, including, but not limited to, interconnected publicly owned electrical corporations and electric cooperatives Water and wastewater systems sector: • Facilities associated with provision of drinking water or processing of wastewater, including facilities that pump, divert, transport, store, treat, and deliver water or wastewater Communications sector: • Communication carrier infrastructure, including selective routers, central offices, head ends, cellular switches, remote terminals, and cellular sites Chemical sector: • Facilities associated with manufacturing, maintaining, or distributing hazardous materials and chemicals (including Category N-Customers as defined in D.01-06-085) Transportation sector: • Facilities associated with transportation for civilian and military purposes: automotive, rail, aviation, maritime, or major public transportation (D.19-05-042 and D.20-05-051)
Customer hours	Total number of customers, multiplied by average number of hours (e.g., of power outage).
Danger tree	Any tree located on or adjacent to a utility right-of-way or facility that could damage utility facilities should it fall where (1) the tree leans toward the right-of-way, or (2) the tree is defective because of any cause, such as: heart or root rot, shallow roots, excavation, bad crotch, dead or with dead top, deformity, cracks or splits, or any other reason that could result in the tree or main lateral of the tree falling. (California Code of Regulation Title 14 § 895.1)

Term	Definition
Data cleaning	Calibration of raw data to remove errors (including typographical and numerical mistakes).
Dead fuel moisture content	Moisture content of dead vegetation, which responds solely to current environmental conditions and is critical in determining fire potential.
Detailed inspection	In accordance with General Order (GO) 165, an inspection where individual pieces of equipment and structures are carefully examined, visually and through routine diagnostic testing, as appropriate, and (if practical and if useful information can be so gathered) opened, and the condition of each is rated and recorded.
Disaster	A serious disruption of the functioning of a community or a society at any scale due to hazardous events interacting with conditions of exposure, vulnerability, and capacity, leading to one or more of the following: human, material, economic, and environmental losses and impacts. The effect of the disaster can be immediate and localized but is often widespread and could last a long time. The effect may test or exceed the capacity of a community or society to cope using its own resources. Therefore, it may require assistance from external sources, which could include neighboring jurisdictions or those at the national or international levels. (United Nations Office for Disaster Risk Reduction [UNDRR].)
Discussion-based exercise	Exercise used to familiarize participants with current plans, policies, agreements, and procedures or to develop new plans, policies, agreements, and procedures. Often includes seminars, workshops, tabletop exercises, and games.
Electrical corporation	Every corporation or person owning, controlling, operating, or managing any electric plant for compensation within California, except where the producer generates electricity on or distributes it through private property solely for its own use or the use of its tenants and not for sale or transmission to others.

Term	Definition
Emergency	Any incident, whether natural, technological, or human caused, that requires responsive action to protect life or property but does not result in serious disruption of the functioning of a community or society. (FEMA/UNDRR.)
Enhanced inspection	Inspection whose frequency and thoroughness exceed the requirements of a detailed inspection, particularly if driven by risk calculations.
Equipment ignition likelihood	The likelihood that utility-owned equipment will cause an ignition through either normal operation (such as arcing) or failure.
Exercise	An instrument to train for, assess, practice, and improve performance in prevention, protection, response, and recovery capabilities in a risk-free environment. (FEMA.)
Exposure	The presence of people, infrastructure, livelihoods, environmental services and resources, and other high-value assets in places that could be adversely affected by a hazard.
Fire ecology	A scientific discipline concerned with natural processes involving fire in an ecosystem and its ecological effects, the interactions between fire and the abiotic and biotic components of an ecosystem, and the role of fire as an ecosystem process.
Fire Potential Index (FPI)	Landscape scale index used as a proxy for assessing real-time risk of a wildfire under current and forecasted weather conditions.
Fire season	The time of year when wildfires are most likely for a given geographic region due to historical weather conditions, vegetative characteristics, and impacts of climate change. Each electrical corporation defines the fire season(s) across its service territory based on a recognized fire agency definition for the specific region(s) in California.

Term	Definition
Frequency	The anticipated number of occurrences of an event or hazard over time.
Frequent PSPS events	Three or more PSPS events per calendar year per line circuit.
Fuel density	Mass of fuel (vegetation) per area that could combust in a wildfire.
Fuel management	Removal or thinning of vegetation to reduce the potential rate of propagation or intensity of wildfires.
Fuel moisture content	Amount of moisture in a given mass of fuel (vegetation), measured as a percentage of its dry weight.
Full-time employee (FTE)	Any individual in the ongoing and/or direct employ of the electrical corporation whose hours and/or term of "employment are considered “full-time” for tax and/or any other purposes."
Game	A simulation of operations that often involves two or more teams, usually in a competitive environment, using rules, data, and procedures designed to depict an actual or assumed real-life situation.
Goals	The electrical corporation’s general intentions and ambitions.
GO 95 nonconformance	Condition of a utility asset that does not meet standards established by GO 95.
Grid hardening	Actions (such as equipment upgrades, maintenance, and planning for more resilient infrastructure) taken in response to the risk of undesirable events (such as outages) or undesirable conditions of the electrical system to reduce or mitigate those events and conditions, informed by an assessment of the relevant risk drivers or factors.

Term	Definition
Grid topology	General design of an electric grid, whether looped or radial, with consequences for reliability and ability to support PSPS (e.g., ability to deliver electricity from an additional source).
Hazard	A condition, situation, or behavior that presents the potential for harm or damage to people, property, the environment, or other valued resources.[3]
Hazard tree	See danger tree
High Fire Threat District (HFTD)	Areas of the state designated by the CPUC as having elevated wildfire risk, where each utility must take additional action (per GO 95, GO 165, and GO 166) to mitigate wildfire risk. (D.17-01-009.)
High Fire Risk Area (HFRA)	Areas that the electrical corporation has deemed at high risk from wildfire, independent of HFTD designation.
Highly rural region	In accordance with 38 CFR 17.701, area with a population of less than seven persons per square mile, as determined by the United States Bureau of the Census. For purposes of the WMP, "area" must be defined as a census tract.
High-risk species	Species of vegetation that (1) have a higher risk of either coming into contact with powerlines or causing an outage or ignition, or (2) are easily ignitable and within close proximity to potential arcing, sparks, and/or other utility equipment thermal failures. The status of species as "high-risk" must be a function of species-specific characteristics, including growth rate; failure rates of limbs, trunk, and/or roots (as compared to other species); height at maturity; flammability; and vulnerability to disease or insects.
High Wind Warning (HWW)	Level of wind risk from weather conditions, as declared by the National Weather Service (NWS). For historical NWS data, refer to the Iowa State University archive of NWS watches/warnings.[2]

Term	Definition
HWW overhead (OH) circuit mile day	Sum of OH circuit miles of utility grid subject to a HWW each day within a given time period, calculated as the number of OH circuit miles under a HWW multiplied by the number of days those miles are under said HWW. For example, if 100 OH circuit miles are under a HWW for one day, and 10 of those miles are under the HWW for an additional day, then the total HWW OH circuit mile days would be 110.
Ignition consequence	The total anticipated adverse effects from an ignition at each location in the electrical corporation service territory. This considers the likelihood that an ignition will transition into a wildfire (wildfire spread likelihood) and the consequences that the wildfire will have on each community it reaches (wildfire consequence).
Ignition likelihood	The total anticipated annualized number of ignitions resulting from utility-owned assets at each location in the electrical corporation service territory. This considers probabilistic weather conditions, type and age of equipment, and potential contact of vegetation and other objects with utility assets.
Ignition probability	The relative possibility that an ignition will occur, quantified as a number between 0 percent (impossibility) and 100 percent (certainty). The higher the probability of an event, the more certainty there is that the event will occur. (Often informally referred to as likelihood or chance.)
Ignition risk	The total anticipated annualized impacts from ignitions at a specific location. This considers the likelihood that an ignition will occur, the likelihood the ignition will transition into a wildfire, and the potential consequences – considering hazard intensity, exposure potential, and vulnerability – the wildfire will have on each community it reaches.

Term	Definition
Impact/consequence of ignition	The effect or outcome of a wildfire ignition upon objectives that may be expressed by terms including, although not limited to, maintaining health and safety, ensuring reliability, and minimizing economic and/or environmental damage.
Incident command system (ICS)	A standardized on-scene emergency management construct. It is specifically designed to provide an integrated organizational structure that reflects the complexity and demands of single or multiple incidents, without being hindered by jurisdictional boundaries. The ICS is the combination of facilities, equipment, personnel, procedures, and communications operating within a common organizational structure, designed to aid in the management of resources during incidents.
Initiative	Measure or activity, either proposed or in process, designed to reduce the consequences and/or probability of wildfire or PSPS.
Integrated public alert warning system (IPAWS)	System allowing the President to send a message to the American people quickly and simultaneously through multiple communications pathways in a national emergency. IPAWS also is available to United States federal, state, local, territorial, and tribal government officials to alert the public via the Emergency Alert System (EAS), Wireless Emergency Alerts (WEA), National Oceanic and Atmospheric Administration (NOAA) Weather Radio, and other NWS dissemination channels; the internet; existing unique warning systems; and emerging distribution technologies.
Invasive species	A species (1) that is non-native (or alien) to the ecosystem under consideration and (2) whose introduction causes or is likely to cause economic or environmental harm or harm to human health.
Level 1 finding	In accordance with GO 95, an immediate safety and/or reliability risk with high probability for significant impact.

Term	Definition
Level 2 finding	In accordance with GO 95, a variable safety and/or reliability risk (non-immediate and with high to low probability for significant impact).
Level 3 finding	In accordance with GO 95, an acceptable safety and/or reliability risk.
Limited English proficiency (LEP) population	Population with limited English working proficiency based on the International Language Roundtable scale.
Line miles	The number of miles of transmission and/or distribution conductors, including the length of each phase and parallel conductor segment.
Live fuel moisture content	Moisture content within living vegetation, which can retain water longer than dead fuel.
Locally relevant	In disaster risk management, generally understood as the scale at which disaster risk strategies and initiatives are considered the most effective at achieving desired outcomes. This tends to be the level closest to impacting residents and communities, reducing existing risks, and building capacity, knowledge, and normative support. Locally relevant scales, conditions, and perspectives depend on the context of application.
Match-drop simulation	Wildfire simulation method forecasting propagation and consequence/impact based on an arbitrary ignition.
Memorandum of Agreement (MOA)	A document of agreement between two or more agencies establishing reciprocal assistance to be provided upon request (and if available from the supplying agency) and laying out the guidelines under which this assistance will operate. It can also be a cooperative document in which parties agree to work together on an agreed-upon project or meet an agreed objective.

Term	Definition
Mitigation	Activities to reduce the loss of life and property from natural and/or human-caused disasters by avoiding or lessening the impact of a disaster and providing value to the public by creating safer communities.
Model uncertainty	The amount by which a calculated value might differ from the true value when the input parameters are known (i.e., limitation of the model itself based on assumptions).[3]
Multi-attribute value function (MAVF)	Risk calculation methodology introduced during CPUC's Safety Model Assessment Proceedings (S-MAP) and Risk Assessment and Mitigation Phase (RAMP) proceedings. This methodology is established in D.18-12-014 but may be subject to change pursuant to R.20-07-013.
Mutual aid	Voluntary aid and assistance by the provision of services and facilities, including but not limited to electrical corporations, communication, and transportation. Mutual aid is intended to provide adequate resources, facilities, and other support to electrical corporations whenever their own resources prove inadequate to cope with a given situation.
National Incident Management System (NIMS)	A systematic, proactive approach to guide all levels of government, nongovernment organizations, and the private sector to work together to prevent, protect against, mitigate, respond to, and recover from the effects of incidents. NIMS provides stakeholders across the whole community with the shared vocabulary, systems, and processes to successfully deliver the capabilities described in the National Preparedness System. NIMS provides a consistent foundation for dealing with all incidents, ranging from daily occurrences to incidents requiring a coordinated federal response.
Near miss	Term previously used for an event with probability of ignition (now “Risk event”).

Term	Definition
Objectives	Specific, measurable, achievable, realistic, and timely outcomes for the overall WMP strategy, or mitigation initiatives and activities that a utility can implement to satisfy the primary goals and subgoals of the WMP program.
Operations-based exercise	Type of exercise that validates plans, policies, agreements, and procedures; clarifies roles and responsibilities; and identifies resource gaps in an operational environment. Often includes drills, functional exercises (FEs), and full-scale exercises (FSEs).
Overall utility risk	The comprehensive risk due to both wildfire and PSPS incidents across a utility's territory; the aggregate potential of adverse impacts to people, property, critical infrastructure, or other valued assets in society.
Overall utility risk, ignition risk	See Ignition risk.
Overall utility risk, PSPS risk	See PSPS risk.
Parameter uncertainty	The amount by which a calculated value might differ from the true value based on unknown input parameters. (Adapted from Society of Fire Protection Engineers [SFPE] guidance.)
Patrol inspection	In accordance with GO 165, a simple visual inspection of applicable utility equipment and structures designed to identify obvious structural problems and hazards. Patrol inspections may be carried out in the course of other company business.
Performance metric	A quantifiable measurement that is used by an electrical corporation to indicate the extent to which its WMP is driving performance outcomes.

Term	Definition
Population density	Population density is calculated using the American Community Survey (ACS) one-year estimate for the corresponding year or, for years with no such ACS estimate available, the estimate for the immediately preceding year.
Preparedness	A continuous cycle of planning, organizing, training, equipping, exercising, evaluating, and taking corrective action in an effort to ensure effective coordination during incident response. Within the NIMS, preparedness focuses on planning, procedures and protocols, training and exercises, personnel qualification and certification, and equipment certification.
Priority essential services	Critical first responders, public safety partners, critical facilities and infrastructure, operators of telecommunications infrastructure, and water electrical corporations/agencies.
Property	Private and public property, buildings and structures, infrastructure, and other items of value that may be destroyed by wildfire, including both third-party property and utility assets.
Protective equipment and device settings	The electrical corporation's procedures for adjusting the sensitivity of grid elements to reduce wildfire risk, other than automatic reclosers (such as circuit breakers, switches, etc.). For example, PG&E's "Enhanced Powerline Safety Settings" (EPSS).
PSPS consequence	The total anticipated adverse effects of a PSPS for a community. This considers the PSPS exposure potential and inherent PSPS vulnerabilities of communities at risk.
PSPS event	The period from notification of the first public safety partner of a planned public safety PSPS to re-energization of the final customer.
PSPS exposure potential	The potential physical, social, or economic impact of a PSPS event on people, property, critical infrastructure, livelihoods, health, local economies, and other high-value assets.

Term	Definition
PSPS likelihood	The likelihood of a PSPS being required by a utility given a probabilistic set of environmental conditions.
PSPS risk	The total anticipated annualized impacts from a PSPS event at a specific location. This considers the likelihood a PSPS event will be required due to environmental conditions exceeding design conditions and the potential consequences – considering exposure potential and vulnerability – of the PSPS event for each affected community.
Public safety partners	First/emergency responders at the local, state, and federal levels; water, wastewater, and communication service providers; community choice aggregators (CCAs); affected publicly owned electrical corporations/electrical cooperatives; tribal governments; Energy Safety; the Commission; the California Office of Emergency Services; and CAL FIRE.
Red Flag Warning (RFW)	Level of wildfire risk from weather conditions, as declared by the NWS. For historical NWS data, refer to the Iowa State University archive of NWS watches/warnings.[2]
RFW OH circuit mile day	Sum of OH circuit miles of utility grid subject to RFW each day within a given time period, calculated as the number of OH circuit miles under RFW multiplied by the number of days those miles are under said RFW. For example, if 100 OH circuit miles are under RFW for one day, and 10 of those miles are under RFW for an additional day, then the total RFW OH circuit mile days would be 110.
Risk	A measure of the anticipated adverse effects from a hazard considering the consequences and frequency of the hazard occurring.[5]

[2] https://mesonet.agron.iastate.edu/request/gis/watchwarn.phtml.
5 Adapted from D. Coppola, 2020, “Risk and Vulnerability,” Introduction to International Disaster Management, 4th ed.

Term	Definition
Risk component	A part of an electric corporation's risk analysis framework used to determine overall utility risk.
Risk evaluation	The process of comparing the results of a risk analysis with risk criteria to determine whether the risk and/or its magnitude is acceptable or tolerable. (ISO 31000:2009.)
Risk event	An event with probability of ignition, such as wire down, contact with objects, line slap, event with evidence of heat generation, or other event that causes sparking or has the potential to cause ignition. The following all qualify as risk events: • Ignitions • Outages not caused by vegetation • Outages caused by vegetation • Wire-down events • Faults • Other events with potential to cause ignition
Risk management	Systematic application of management policies, procedures, and practices to the tasks of communication, consultation, establishment of context, and identification, analysis, evaluation, treatment, monitoring, and review of risk. (ISO 31000.)
Rule	Section of Public Utilities Code requiring a particular activity or establishing a particular threshold.
Rural region	In accordance with GO 165, area with a population of less than 1,000 persons per square mile, as determined by the U.S. Bureau of the Census.[3] For purposes of the WMP, "area" must be defined as a census tract.
Seminar	An informal discussion, designed to orient participants to new or updated plans, policies, or procedures (e.g., to review a new external communications standard operating procedure).

[3] https://www.cpuc.ca.gov/gos/GO95/go_95_rule_18.htm

Term	Definition
Sensitivity analysis	Process used to determine the relationships between the uncertainty in the independent variables (“input”) used in an analysis and the uncertainty in the resultant dependent variables (“output”). (SFPE guidance.)
Slash	Branches or limbs less than four inches in diameter, and bark and split products debris left on the ground as a result of utility vegetation management. (This definition is consistent with California Public Resources Code section 4525.7.)
Span	The space between adjacent supporting poles or structures on a circuit consisting of electric lines and equipment. "Span level" refers to asset-scale granularity.
Tabletop exercise (TTX)	A discussion-based exercise intended to stimulate discussion of various issues regarding a hypothetical situation. Tabletop exercises can be used to assess plans, policies, and procedures or to assess types of systems needed to guide the prevention of, response to, or recovery from a defined incident.
Target	A forward-looking, quantifiable measurement of work to which an electrical corporation commits to in its WMP. Electrical corporations will show progress toward completing targets in subsequent reports, including QDRs and WMP Updates.
Trees with strike potential	Trees that could either “fall in” to a power line or have branches detach and “fly in” to contact a power line in high-wind conditions.
Uncertainty	The amount by which an observed or calculated value might differ from the true value. For an observed value, the difference is “experimental uncertainty”; for a calculated value, it is “model” or “parameter uncertainty.” (Adapted from SFPE guidance.)

Term	Definition
Urban region	In accordance with GO 165, area with a population of more than 1,000 persons per square mile, as determined by the U.S. Bureau of the Census. For purposes of the WMP, "area" must be defined as a census tract.
Utility-related ignition	See reportable ignition.
Validation	Process of determining the degree to which a calculation method accurately represents the real world from the perspective of the intended uses of the calculation method without modifying input parameters based on observations in a specific scenario. (Adapted from ASTM E 1355.)
Vegetation management (VM)	Trimming and removal of trees and other vegetation at risk of contact with electric equipment.
Verification	Process to ensure that a model is working as designed, that is, that the equations are being properly solved. Verification is essentially a check of the mathematics. (SFPE guidance.)
Vulnerability	The propensity or predisposition of a community to be adversely affected by a hazard, including the characteristics of a person, group, or service and their situation that influences their capacity to anticipate, cope with, resist, and recover from the adverse effects of a hazard.
Wildfire consequence	The total anticipated adverse effects from a wildfire on a community that is reached. This considers the wildfire hazard intensity, the wildfire exposure potential, and the inherent wildfire vulnerabilities of communities at risk.
Wildfire exposure potential	The potential physical, social, or economic impact of wildfire on people, property, critical infrastructure, livelihoods, health, environmental services, local economies, cultural/historical resources, and other high-value assets. This may include direct or indirect impacts, as well as short- and long-term impacts.

Term	Definition
Wildfire intensity	The potential intensity of a wildfire at a specific location within the service territory given a probabilistic set of weather profiles, vegetation, and topography.
Wildfire mitigation strategy	Overview of the key mitigation initiatives at enterprise level and component level across the electrical corporation's service territory, including interim strategies where long-term mitigation initiatives have long implementation timelines. This includes a description of the enterprise-level monitoring and evaluation strategy for assessing overall effectiveness of the WMP.
Wildfire risk	See Ignition risk.
Wildfire spread likelihood	The likelihood that a fire with a nearby but unknown ignition point will transition into a wildfire and will spread to a location in the service territory based on a probabilistic set of weather profiles, vegetation, and topography.
Wildland-urban interface (WUI)	The line, area, or zone where structures and other human development meet or intermingle with undeveloped wildland or vegetation fuels (National Wildfire Coordinating Group). Enforcement agencies also designate the WUI as the area at significant risk from wildfires, established pursuant to Title 24, Part 2, Chapter 7A.
Wire down	Instance where an electric transmission or distribution conductor is broken and falls from its intended position to rest on the ground or a foreign object.
Work order	A prescription for asset or vegetation management activities resulting from asset or vegetation management inspection findings.
Workshop	Discussion that resembles a seminar but is employed to build specific products, such as a draft plan or policy (e.g., a multi-year training and exercise plan).

Definitions of Initiatives by Category

Category	Section #	Initiative	Definition
Overview of the Service Territory	5.4.5	Environmental compliance and permitting	Development and implementation of process and procedures to ensure compliance with applicable environmental laws, regulations, and permitting related to the implementation of the WMP.
Risk Methodology and Assessment	6	Risk Methodology and Assessment	Development and use of tools and processes to assess the risk of wildfire and PSPS across an electrical corporation's service territory.
Wildfire Mitigation Strategy Development	7	Wildfire Mitigation Strategy Development	Development and use of processes for deciding on a portfolio of mitigation initiatives to achieve maximum feasible risk reduction and that meet the goals of the WMP.
Grid Design, Operations, and Maintenance	8.1.2.1	Covered conductor installation	Installation of covered or insulated conductors to replace standard bare or unprotected conductors (defined in accordance with GO 95 as supply conductors, including but not limited to lead wires, not enclosed in a grounded metal pole or not covered by: a "suitable protective covering" (in accordance with Rule 22.8), grounded metal conduit, or grounded metal sheath or shield). In accordance with GO 95, conductor is defined as a material suitable for: (1) carrying electric current, usually in the form of a wire, cable or bus bar, or (2) transmitting light in the case of fiber optics; insulated conductors as those which are surrounded by an insulating material (in accordance with Rule 21.6), the dielectric strength of which is sufficient to withstand the

Category	Section #	Initiative	Definition
			maximum difference of potential at normal operating voltages of the circuit without breakdown or puncture; and suitable protective covering as a covering of wood or other non-conductive material having the electrical insulating efficiency (12kV/in. dry) and impact strength (20ft.-lbs) of 1.5 inches of redwood or other material meeting the requirements of Rule 22.8-A, 22.8-B, 22.8-C or 22.8-D.
Grid Design, Operations, and Maintenance	8.1.2.2	Undergrounding of electric lines and/or equipment	Actions taken to convert overhead electric lines and/or equipment to underground electric lines and/or equipment (i.e., located underground and in accordance with GO 128).
Grid Design, Operations, and Maintenance	8.1.2.3	Distribution pole replacements and reinforcements	Remediation, adjustments, or installations of new equipment to improve or replace existing distribution poles (i.e., those supporting lines under 65kV), including with equipment such as composite poles manufactured with materials reduce ignition probability by increasing pole lifespan and resilience against failure from object contact and other events.
Grid Design, Operations, and Maintenance	8.1.2.4	Transmission pole/tower replacements and reinforcements	Remediation, adjustments, or installations of new equipment to improve or replace existing transmission towers (e.g., structures such as lattice steel towers or tubular steel poles that support lines at or above 65kV).

Category	Section #	Initiative	Definition
Grid Design, Operations, and Maintenance	8.1.2.5	Traditional overhead hardening	Maintenance, repair, and replacement of capacitors, circuit breakers, cross-arms, transformers, fuses, and connectors (e.g., hot line clamps) with the intention of minimizing the risk of ignition.
Grid Design, Operations, and Maintenance	8.1.2.6	Emerging grid hardening technology installations and pilots	Development, deployment, and piloting of novel grid hardening technology.
Grid Design, Operations, and Maintenance	8.1.2.7	Microgrids	Development and deployment of microgrids that may reduce the risk of ignition, risk from PSPS, and wildfire consequence. "Microgrid" is defined by Public Utilities Code section 8370(d).
Grid Design, Operations, and Maintenance	8.1.2.8	Installation of system automation equipment	Installation of electric equipment that increases the ability of the electrical corporation to automate system operation and monitoring, including equipment that can be adjusted remotely such as automatic reclosers (switching devices designed to detect and interrupt momentary faults that can reclose automatically and detect if a fault remains, remaining open if so).
Grid Design, Operations, and Maintenance	8.1.2.9	Line removals (in HFTD)	Removal of overhead lines to minimize the risk of ignition due to the design, location, or configuration of electric equipment in HFTDs.
Grid Design, Operations, and Maintenance	8.1.2.10	Other grid topology improvements to minimize risk of ignitions	Actions taken to minimize the risk of ignition due to the design, location, or configuration of electric equipment in HFTDs not covered by another initiative.

Category	Section #	Initiative	Definition
Grid Design, Operations, and Maintenance	8.1.2.11	Other grid topology improvements to mitigate or reduce PSPS events	Actions taken to mitigate or reduce PSPS events in terms of geographic scope and number of customers affected not covered by another initiative.
Grid Design, Operations, and Maintenance	8.1.2.12	Other technologies and systems not listed above	Other grid design and system hardening actions which the electrical corporation takes to reduce its ignition and PSPS risk not otherwise covered by other initiatives in this section.
Grid Design, Operations, and Maintenance	8.1.3.1	Asset inspections	Inspections of overhead electric transmission lines, equipment, and right-of-way.
Grid Design, Operations, and Maintenance	8.1.4	Equipment maintenance and repair	Remediation, adjustments, or installations of new equipment to improve or replace existing connector equipment, such as hotline clamps.
Grid Design, Operations, and Maintenance	8.1.5	Asset management and inspection enterprise system(s)	Operation of and support for centralized asset management and inspection enterprise system(s) updated based upon inspection results and activities such as hardening, maintenance, and remedial work.
Grid Design, Operations, and Maintenance	8.1.6	Quality assurance / quality control	Establishment and function of audit process to manage and confirm work completed by employees or contractors, including packaging QA/QC information for input to decision-making and related integrated workforce management processes.
Grid Design, Operations, and Maintenance	8.1.7	Open work orders	Actions taken to manage the electrical corporation’s open work orders resulting from inspections that prescribe asset management activities.

Category	Section #	Initiative	Definition
Grid Design, Operations, and Maintenance	8.1.8.1	Equipment Settings to Reduce Wildfire Risk	The electrical corporation’s procedures for adjusting the sensitivity of grid elements to reduce wildfire risk.
Grid Design, Operations, and Maintenance	8.1.8.2	Grid Response Procedures and Notifications	The electrical corporation’s procedures it uses to respond to faults, ignitions, or other issues detected on its grid that may result in a wildfire.
Grid Design, Operations, and Maintenance	8.1.8.3	Personnel Work Procedures and Training in Conditions of Elevated Fire Risk	Work activity guidelines that designate what type of work can be performed during operating conditions of different levels of wildfire risk. Training for personnel on these guidelines and the procedures they prescribe, from normal operating procedures to increased mitigation measures to constraints on work performed.
Grid Design, Operations, and Maintenance	8.1.9	Workforce Planning	Programs to ensure that the electrical corporation has qualified asset personnel and to ensure that both employees and contractors tasked with asset management responsibilities are adequately trained to perform relevant work.
Vegetation Management and Inspection	8.2.2.1	Vegetation inspections	Inspections of vegetation around and adjacent to electrical facilities and equipment that may be hazardous by growing, blowing, or falling into electrical facilities or equipment.
Vegetation Management and Inspection	8.2.3.1	Pole clearing	Plan and execution of vegetation removal around poles per Public Resources Code section 4292 and outside the requirements of Public Resources Code section 4292 (e.g., pole clearing performed outside of the State Responsibility Area).

Category	Section #	Initiative	Definition
Vegetation Management and Inspection	8.2.3.2	Wood and slash management	Actions taken to manage all downed wood and “slash” generated from vegetation management activities.
Vegetation Management and Inspection	8.2.3.3	Clearance	Actions taken after inspection to ensure that vegetation does not encroach upon electrical equipment and facilities, such as tree trimming.
Vegetation Management and Inspection	8.2.3.4	Fall-in mitigation	Actions taken to identify and remove or otherwise remediate trees that pose a high risk of failure or fracture that could potentially strike electrical equipment.
Vegetation Management and Inspection	8.2.3.5	Substation defensible space	Actions taken to reduce ignition probability and wildfire consequence due to contact with substation equipment.
Vegetation Management and Inspection	8.2.3.6	High-risk species	Actions taken to reduce the ignition probability and wildfire consequence attributable to high- risk species of vegetation.
Vegetation Management and Inspection	8.2.3.7	Fire-resilient rights-of-way	Actions taken to promote vegetation communities that are sustainable, fire-resilient, and compatible with the use of the land as an electrical corporation right-of- way.
Vegetation Management and Inspection	8.2.3.8	Emergency response vegetation management	Planning and execution of vegetation activities in response to emergency situations including weather conditions that indicate an elevated fire threat and post- wildfire service restoration.
Vegetation Management and Inspection	8.2.4	Vegetation management enterprise system	Operation of and support for centralized vegetation management and inspection enterprise system(s) updated based upon inspection results and activities such as hardening, maintenance, and remedial work.

Category	Section #	Initiative	Definition
Vegetation Management and Inspection	8.2.5	Quality assurance / quality control	Establishment and function of audit process to manage and confirm work completed by employees or contractors, including packaging QA/QC information for input to decision-making and related integrated workforce management processes.
Vegetation Management and Inspection	8.2.6	Open work orders	Actions taken to manage the electrical corporation's open work orders resulting from inspections that prescribe vegetation management activities.
Vegetation Management and Inspection	8.2.7	Workforce planning	Programs to ensure that the electrical corporation has qualified vegetation management personnel and to ensure that both employees and contractors tasked with vegetation management responsibilities are adequately trained to perform relevant work.
Situational Awareness and Forecasting	8.3.2	Environmental monitoring systems	Development and deployment of systems which measure environmental characteristics, such as fuel moisture, air temperature, and velocity.
Situational Awareness and Forecasting	8.3.3	Grid monitoring systems	Development and deployment of systems that checks the operational conditions of electrical facilities and equipment and detects such things as faults, failures, and recloser operations.
Situational Awareness and Forecasting	8.3.4	Ignition detection systems	Development and deployment of systems which discover or identify the presence or existence of an ignition, such as cameras.

Category	Section #	Initiative	Definition
Situational Awareness and Forecasting	8.3.5	Weather forecasting	Development methodology for forecast of weather conditions relevant to electrical corporation operations, forecasting weather conditions and conducting analysis to incorporate into utility decision- making, learning and updates to reduce false positives and false negatives of forecast PSPS conditions.
Situational Awareness and Forecasting	8.3.6	Fire potential index	Calculation and application of a landscape scale index used as a proxy for assessing real-time risk of a wildfire under current and forecasted weather conditions.
Emergency Preparedness	8.4.2	Emergency preparedness plan	Development and integration of wildfire- and PSPS-specific emergency strategies, practices, policies, and procedures into the electrical corporation's overall emergency plan based on the minimum standards described in GO 166.
Emergency Preparedness	8.4.3	External collaboration and coordination	Actions taken to coordinate wildfire and PSPS emergency preparedness with relevant public safety partners including the state, cities, counties, and tribes.
Emergency Preparedness	8.4.4	Public emergency communication strategy	Development and integration of a comprehensive communication strategy to inform essential customers and other stakeholder groups of wildfires, outages due to wildfires, and PSPS and service restoration, as required by Public Utilities Code section 768.6.
Emergency Preparedness	8.4.5	Preparedness and planning for service restoration	Development and integration of the electrical corporation's plan to restore service after an outage due to a wildfire or PSPS event.

Category	Section #	Initiative	Definition
Emergency Preparedness	8.4.6	Customer support in wildfire and PSPS emergencies	Development and deployment of programs, systems, and protocols to support residential and non- residential customers in wildfire emergencies and PSPS events.
Community Outreach and Engagement	8.5.2	Public outreach and education awareness program	Development and deployment of public outreach and education awareness program(s) for wildfires; outages due to wildfires, PSPS events, and protective equipment and device settings; service restoration before, during, and after the incidents and vegetation management.
Community Outreach and Engagement	8.5.3	Engagement with access and functional needs populations	Actions taken understand, evaluate, design, and implement wildfire and PSPS risk mitigation strategies, policies, and procedures specific to access and functional needs customers.
Community Outreach and Engagement	8.5.4	Collaboration on local wildfire mitigation planning	Development and integration of plans, programs, and/or policies for collaborating with communities on local wildfire mitigation planning, such as wildfire safety elements in general plans, community wildfire protection plans, and local multi-hazard mitigation plans.
Community Outreach and Engagement	8.5.5	Best practice sharing with other utilities	Development and integration of an electrical corporation's policy for sharing best practices and collaborating with other electrical corporations on technical and programmatic aspects of its WMP program.

Appendix B
Supporting Documentation for Risk Methodology and Assessment

Appendix B: Supporting Documentation for Risk Methodology and Assessment

Note: As part of its 2023-2025 WMP, the electrical corporation is required to provide the "Summary Documentation" as defined by this appendix. For all other requirements in this appendix, the electrical corporation must be readily able to provide the defined documentation in response to a data request by Energy Safety or designated stakeholders.

The risk modeling and assessment in the main body of these Guidelines and electrical corporation's WMP are focused on providing a streamlined overview of the electrical corporation risk framework and key findings from the assessment necessary to understand the wildfire mitigation strategy presented in Section 7.

The focus of this appendix is to provide additional information pertaining to the risk modeling approach used by the electrical corporation. This includes the following:

- Additional detail on model calculations supporting the calculation of risk and risk components
- Additional detail on the calculation of risk and risk components
- More detailed presentation of the risk findings

The following sections establish the reporting requirements for the approaches used by the electrical corporation to calculate each risk and risk component. These have been synthesized and adapted from guidance documents on model quality assurance developed by many agencies, with a focus on guidance related to machine learning, artificial intelligence, and fire science and engineering. These guidance documents include those from the Institute of Electrical and Electronics Engineers (IEEE),[1] the Society of Fire Protection Engineers (SFPE),8 the American Society for Testing and Materials (ASTM International),9 the U.S. Nuclear Regulatory Commission (NRC),10 the Electric Power Research Institute (EPRI),52 the National Institute of Standards and Technology (NIST),11 and the International Organization for Standardization (ISO).12

Summary Documentation

The electrical corporation must provide high-level information on the calculation of each risk and risk component used in its risk analysis. The summary documentation must include each of the following:

- High-level bow tie schematic showing the inputs, outputs, and interaction between risk components in the format shown in Figure B-1. An example is provided below.
- High-level calculation procedure schematic in the format shown in Figure B-2. This schematic must show the logical flow from input data to outputs, including separate

[1] IEEE, 2022, "P2841/D2: Draft Framework and Process for Deep Learning Evaluation."

items for any intermediate calculations in models or sub-models and any input from subject matter experts.

- High-level narrative describing the calculation procedure in a concise executive summary. This narrative must include the following:
  - Purpose of the calculation/model
  - Assumptions and limitations
  - Description of the calculation procedure shown in the bow tie and high-level schematics
  - Description of how outputs will be characterized and presented (e.g., visualization) to decision makers
  - Concise description and timeline of planned changes to the calculation procedure over the triennial WMP cycle, including any key improvements from the Energy Safety Wildfire Risk Modeling Working Group and plans to align with the consensus Risk Modeling Requirements by January 1, 2024.

Reference the following sections of Liberty's 2023 WMP:

- Section 6: Risk Methodology and Assessment

Also see attached reports in Appendix B:

- B1 - WMP Model Documentation_TSYL_2024_Appendix
- B2 – Phase 2 Implementation of Direxyon Suite
- B3 - Reax Liberty Fire Risk Modeling_2022
- B4 - Reax Liberty PSPS Threshold Exceedance Frequency Analysis_2022
- B5 - Liberty Fire Potential Index 2022

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Technosylva Statement of Confidentiality

This document has been developed by Technosylva, Inc. in support of our IOU customers for use in WMP development and submittal, and subsequent data requests. Confidential sections have been removed from this document and the remaining sections are considered non-confidential and can be shared in their entirety.

Confidential information is provided in its entirety to the customer to support their understanding of modeling and technical details employed in the subscription products used by the customer. As necessary, Technosylva will endeavor to provide additional generic descriptions for this confidential content to support customer submittal requirements when requested.

1 Technical Model Documentation

1.1 Purpose

The Office of Energy Infrastructure (OEIS) requires transparency in risk calculation methodologies supporting Wildfire Mitigation. Per the guidelines, OEIS has specific requirements for technical documentation, substantiation, and data governance of the models used in risk calculations for the WMP. This template outlines the required technical documentation and substantiation for the models, while the [WMP Data Governance Framework]() covers the data governance requirements for the models.

1.2 Applicability

The applicability of the model documentation and governance applies to every model included in the [Wildfire Mitigation Plan]() filed with the OEIS.

2 Technical Documentation

2.1 Problem or Function

2.1.1 Problem Modeled

Define the problem modeled for function performed by the program, for example, calculation of fire growth, smoke spread, people movement, etc.

The application of wildfire behavior modeling and risk analysis is used to quantify the potential impacts from possible electric utility infrastructure asset caused ignitions. The basis of this modeling is that not all ignitions (fires) are created equal, and each asset caused ignition can have substantially different consequence based on ignition location and related landscape characteristics.

The wildfire modeling and risk analysis derives a set of consequence metrics that quantify impacts. This includes potential acres burned, population impacted, number of buildings threatened, and estimated number of buildings destroyed. These are currently derived using an 8-hour simulation duration, based on a typical first burning period. Testing is underway to evaluate different fire durations based on suggestions in the most recent WMP Guidelines.

Technosylva's Wildfire Analyst™ (WFA) product is used to conduct the modeling, deliver modeling outputs, and monitor and visualize results with software applications.

The wildfire behavior modeling and risk analysis is applied to address two different, yet similar, scenarios. First, the modeling is used with historical re-analysis WRF weather data to support the mitigation planning process. The WFA FireSight, previously called Wildfire Risk Reduction Model (WRRM), is used to quantify risk metrics from millions of wildfire simulations using the numerous WRF weather scenarios defined. This wildfire consequence data is then combined with probability of failure and ignition analysis developed internally to define composite risk values to support prioritization decision making for asset hardening and related mitigation.

Secondly, the modeling is also used with daily WRF-based weather forecast data to calculate consequence based risk metrics for all assets as possible ignition sources to support operational requirements. Other key input datasets such as surface and canopy fuels, and live fuel moisture and dead fuel moisture, are developed daily using Machine Learning (ML) models to calculate the wildfire behavior outputs as part of the risk analysis model. Wildfire risk forecasts are derived daily, or sometimes twice daily, with a multi-day outlook on an hourly basis. This information is used as input into key decision making related to operational requirements, such as PSPS, resource allocation and deployment, field operations, etc.

Note that the Technosylva Wildfire Analyst™ product is comprised of three discrete applications – FireSim, FireRisk and FireSight. "FireRisk" is the new name for the application formerly called "FireCast". This was renamed to better meet platform functionality naming consistency. Accordingly, all references to FireRisk are identical to all functionality previously provided under the name "FireCast". Also note that the platform is now called Wildfire Analyst. "Enterprise" has been removed from the product platform name. To meet PacifiCorp requirements, a subscription to all three applications is required.[1] These include:

1. WFA FireRisk – daily asset-based risk forecasting to support operational needs, such as PSPS (previously called FireCast), including all situational awareness capabilities.
2. WFA FireSim – on-demand wildfire spread modeling to support real-time incident analysis and "what if" analysis for pending weather events to support operational needs.
3. WFA FireSight – risk analysis for assets using historical fire scenarios to ensure comprehensive understanding of asset ignition probability and consequence to support mitigation planning, such as WMP prioritization and development (previously called WRRM). FireSight includes integration of outage analytics, probability of outage/failure, and probability of ignition as well as built-in integrations to support calculations for risk reduction, mitigation effectiveness and risk spend efficiency.

FireRisk and FireSim support operational needs while FireSight supports enterprise risk management and mitigation planning needs. FireSight is implemented separately from FireRisk and FireSim.

2.2 Technical Description

2.2.1 Theoretical and Mathematical Foundations

Convey a thorough understanding of the theoretical and mathematical foundations, referencing the open literature where appropriate.

The basis of the wildfire risk modeling for electric utility assets lies in the published, proven and accepted fire science for wildfire behavior modeling. The Technosylva WFA product used to create risk metrics for both operational and planning initiatives utilizes the best-in-class fire science available. Technosylva has been able to operationalize proven wildfire behavior models and validate these models through on-going collaboration with CAL FIRE and the US Forest Service Missoula Fire Laboratory as the only unique vendor selected. This collaboration provides the operational platform to test and validate a suite of wildfire behavior and risk models that are utilized for statewide intelligence and operations by CAL FIRE, and by each IOU in California for operations and mitigation.

To support the model R&D and implementation, Technosylva regularly publishes peer reviewed and accepted articles regarding these models. Technosylva has been involved in 30+ publications over the past 24 months, with 11 as the principal investigator. Some of these publications are referenced on the Technosylva web site at https://technosylva.com/scientific-research/.

The published fire science provides the theoretical foundation for the operational models, tempered by validation analysis conducted on an on-going basis, to continually refine the models to match what occurs with observed wildfire behavior. The rest of this section provides a detailed description of the theoretical and mathematical foundation for the WFA models.

2.3 Theoretical Foundation

2.3.1 Phenomenon and Physical Laws (Model Basis)

Describe the theoretical basis of the phenomenon and the physical laws on which the model is based.

Fire is a self-sustained and usually uncontrolled sequence of processes basically carried out by the combination of fuel, oxygen and heat. In forest fires (also referred to as wildland fire or wildfire), the fuel is given by the vegetation layer composed of trees, bushes and all kinds of dead and living foliage (organic matter). The oxygen is abundantly present in the atmosphere and the heat is caused by the combustion of the flame and transported mainly by radiation and convection within the vegetation.

A quick review of the process involved could be described as follows. Consider a homogeneous flammable solid material like wood to which an external heat flux has been imposed. As the solid material absorbs the heat it raises its temperature at a rate dependent on the net heat capacity of the material (mix of all the components of the solid, including water). As the temperature increases, the moisture content in the solid diminishes and eventually dries up the solid. A further increase of the temperature causes the pyrolysis process of the wood (around 550 K), the organic material decomposes into a stream of volatile gasses (smoke, carbon and oxygen) and into solid remains like char (nearly pure carbon), and ashes (incombustible minerals like calcium, potassium, etc). The pyrolyzed fuel vapor convects and diffuses, mixing with the oxygen of the atmosphere and forming a combustible mixture. The high gas temperature favors the initiation of a gas phase combustion reaction in the combustible-oxidizer mixture. The compound molecules break apart, the atoms recombine with the oxygen to form water, carbon dioxide and some other products. The whole process is ruled by many factors, the types of char and volatile, the amount of oxygen and the exact chemical reactions taking place. The temperature difference between the gasses released in the pyrolysis process and the ambient air together with the gained temperature due to the oxidation reaction (around 1000 K), generates a buoyancy flow that raises up the hot combusting gas forming the characteristic flames of the fire.

In the wildland, fire behavior deeply depends on the vegetation (type, size and vertical arrangement), terrain, wind and moisture conditions of the vegetation (dead and living material). From a descriptive perspective, wildfires main observables are the fires Rate of Spread (ROS), flame length, flame intensity, heat per unit area, flame depth, and residence time. Depending on the behavior of the fire it may be classified as surface and crown fire. Surface fires burn loose needles, moss, lichen, herbaceous vegetation, shrubs, small trees and sampling that are at or near the surface of the ground. Crown fires burn forest canopy fuels, which include live and dead foliage/ branches, lichens in trees, and tall shrubs that lie well above the surface fuels. They are usually ignited by a surface fire. Crown fires can be passive or active. Passive crown fires involve the burning of individual trees or small groups of trees (often called torching). Active crown fires, or also referred to as running crown fires, present a solid wall of flame from the surface through the canopy fuel layers.

Fire growth from an ignition point can be split into four distinct phases (Fire science 2021), in the first phase the fire starts to burn slowly as the influx of air caused by the buoyancy flow of hot gasses causes the flames to tilt inwards. Once the fire has spread enough from the ignition point, wind is able to enter the already burned vegetation and pushes the flames away from the center and tilts them towards the unburned fuels, increasing the heat transfer, and therefore accelerating the fire. As the fire moves further away from the center, the acceleration of the fire depends more on the local characteristics of the curvilinear front. Finally, the fire may reach a steady-state when the fire line is uniform enough so that it can be considered of infinite length.

2.3.2 Governing Equations

Present the governing equations and the mathematical model employed.

Fire modeling is a highly challenging problem from both the physical and the numerical point of view, and consequently historical advances in this field have always been forced to a compromised position due to the desire of practical usefulness, computer capabilities, required input data, and existing numerical methods. It is only by the consideration of these requirements that the primary natural approaches to the problem can be understood. The primary broad approaches are physical models, quasi-empirical models, and empirical ones.

Physical models are the most complex and have the advantage to be more generally valid across different fuels and weather conditions (Cruz 2017). They are usually posed as a set of coupled differential equations derived from conservation laws and defined on a usually bidimensional domain representing the vegetation layer considered as a porous medium where the main variables develop. The degree of approximation of the initial semi-physical description of the problem, as well as the rest of physical effects considered in the modeling may vary greatly from one model to another. Despite these different approaches, a conventional 2D multiphase model, sketching vegetation temperature through a convection reaction diffusion equation, and a solid combustible material evolution in time may serve as a simple example for illustration purposes.

Density and Heat capacity of vegetation
Temperature variation
Diffusive transport
Heat transport through the vegetation
Combustion reaction heat
Ambient temperature

$$\rho c \frac{\partial T}{\partial t} - K \Delta T + \mathbf{v} \nabla T = Q(\rho, T) + R(T) - h(T - T_{\infty})$$

Wind velocity
Radiation from the flames above the ground
Vertical cooling

$$\frac{\partial \rho}{\partial t} = f(\rho, T)$$

Solid fuel variation
Usually model by the Arrhenius law

Example of a 2D multiphase model sketching vegetation temperature and solid combustible

Even though physical models are very promising, they are not easy to make operational because in many cases the detailed input data they need is not readily available, and because they require a lot of computer processing capability, as they usually use adaptive meshes to keep track of the burning front. Some numerical methods used for solving these models are the Finite Element Method (FEM), Finite Difference methods (FDM), etc.

Empirical and semi-empirical models are mainly based on experimental data: laboratory runs, controlled outdoor fires, or well documented wildland fires. The difference between the empirical and semi-empirical approach is that the former ones contain no physical basis at all and are generally statistical in nature, while the later use some form of physical framework on which the statistical model is based (Andrews 2018, Sullivan 2009). These models are largely developed to support decision making and are the main operational models used today. They are typically able to predict the source dataset with mean absolute percent errors between 20 and 40% (Cruz et al. 2013)

Further review of existing fire modeling approaches can be found in Catchpole and De Mestre (1986), Weber (1991), Pastor et al. (2003), Sullivan (2009a,b,c)

2.3.3 Assumptions

Identify the major assumptions on which the fire model is based and any simplifying assumptions.

The following are some of major assumptions contained in the models

- The physical framework development is based on an idealized situation in steady state spread which may not fit some extreme behavior of fires.
- Fuels are assumed to be continuous and uniform for the scale of the input (typically between 10 to 30 meter (m) resolution)
- Fire characteristics at a point only depend on the conditions at that point (point-functional model). This means that there are certain non-local phenomena like:
  - Increase of ROS due to a concave front.
  - Fire interaction between different parts of the same fire or a different one
- Fire spread is assumed to be elliptical although there are several variations such as double ellipse, oval, egg-shape, etc.
- Weather is given hourly and is assumed to remain constant during that time. There is no interpolation in time to compute the evolution of weather between hours.
- Reliability of weather inputs in the mid-range forecast (2 to 5 days)
- Fire is not coupled with the atmosphere in any way. This may seem like a major limitation in the model as wind is a main contribution to fire spread and at present many models (specially physical ones) try to couple wind and fire. The main reasons for us not to consider the coupling is:
  - It would make it infeasible to run millions of simulations considering the coupling effect.
  - Empirical and semi-empirical models have been developed using an average wind speed as an input, so it is not clear that considering more granular wind at the front is advisable.
- Fire is always assumed to be fully developed. Fire acceleration, flashover, or decay is not considered.
- Atmospheric instability which may have a deep impact on ROS (beer 1991) is not considered in the model.
- Gusts are not considered in the model
- No interaction between slope and wind other than creating an effective or equivalent wind. This means that fire is assumed to have an elliptical shape no matter the alignment of wind and slope.
- Models have been developed with scarce empirical data. The abundance of today’s fire data sources, however, is allowing us to better adjust models to observed fire patterns.
- Fuel array description of the vegetation may not perfectly describe fuel characteristics.
- Spotting is only considered in surface fires

2.3.4 Independent Review Results (see Guide ASTM E 1355)

Provide the results of any independent review of the theoretical basis of the model. Guide E1355 recommends a review by one or more recognized experts fully conversant with the chemistry and physics of the fire phenomena but not involved with the production of the model.

The core models implemented in WFA form the basis of most operational propagation models in use today (Andrews et al 1980, Gould 1991). They have been implemented in well-known software like NEXUS (Scott and Reinhardt 2001), Fire and Fuels Extension to Forest Vegetation Simulator (FFE-FVS) (Reinhardt and Crookston 2003), FARSITE (Finney 2004), Fuel Management Analyst (FMAPlus) (Carlton2005), FlamMap (Finney 2006) and BehavePlus (Andrews et al.2008). Nevertheless, forest fires are a very difficult phenomenon to simulate which depends on many different factors and typical simulations are able to predict the source dataset with mean absolute percent errors between 20 and 40% (Cruz et al. 2013)

One of the important facts in fire simulation is the definition of the fuel models, with analysis providing different results for different fuels and regions. For example, Sanders (2001) observed a pattern of over-prediction by FARSITE in fuel models 1,2, 5 by a large margin, moderate in fuel 10 and some underprediction for fuel model 8. Zigner et al (2020) used two case studies during strong winds revealing that FARSITE was able to successfully reconstruct the spread rate and size of wildfires when spotting was minimal. However, in situations when spotting was an important factor in rapid downslope wildfire spread, both FARSITE and FlamMap were unable to simulate realistic fire perimeters. Ross et al. (2006) used measurements from temperature sensors during prescribed burns in the Appalachian Mountains to recreate the fires and compared fire behavior simulated by FARSITE. They obtained a set of ROS adjustment factors that better represented the observed fire behavior obtaining a ROS adjustment factor of 1.5 and 2 for fuels 9 and 11 respectively, and a decreasing factor of 0.2 to the fuel type 6.

Apart from these reviews Technosylva has been constantly improving the accuracy and performance of the published fire models to better adjust the results to observed fire behavior. This includes a better definition of the fuel types, improved forecast of live fuel moisture content, modifications to the crown fire modeling initialization scheme, and automatic fire adjustment based on data assimilation techniques using ROS adjustment factor. In addition, Technosylva has implemented more than 21 additional models into the WFA platform to enhance accuracy and address known limitations of published fire models. These improvements include crown fire analysis, ember and spotting, urban / non-burnable area encroachment, consequence and impact quantification, etc. It is important to note that improvement of the fire modeling platform of choice necessitates not only improvements in mathematical algorithms but substantial improvements in the accuracy and resolution of input data sources. These work in concert to enhance the modeling and outputs to match observed and expected fire behavior. A robust operationalization of fire models requires constant and on-going research, testing, validation and implementation of both models and data sources.

2.4 Mathematical Foundation

2.4.1 Techniques, Procedures, Algorithms

Describe the mathematical techniques, procedures, and computational algorithms employed to obtain numerical solutions.

The fire propagation model in WFA is a point-punctual model where the fire characteristics at a given point (cell) only depends on the conditions at that cell (weather, terrain, vegetation). This fits well in fire simulation as most of wildfire characteristics mainly depend on local characteristics (Di Gregorio et al 2003), but excludes the effects of non-local phenomena.

The overall resolution is done using a Cellular Automata (CA) where space is discretized into cells (from 10 m to 30 m resolution), and physical quantities take on a finite set of values at each cell. The potential ROS at each cell at any time is given by the propagation models (surface and crown fire). CA models directly incorporate spatial heterogeneity in topography, fuel characteristics, and meteorological conditions, and they can easily accommodate any empirical or theoretical fire propagation mechanism, even complex ones (Collin et al. 2011)

Spotting is introduced as a random event where firebrands can be lifted and generate secondary ignition points ahead of the fire (in the direction of the wind).

The time evolution is done using a Minimum Travel Time (Fast-Marching) algorithm. This algorithm is similar to the well-known Dijkstra´s (1959) algorithm but more adapted to grids instead of the original model that uses graphs. This approach has been used with success in many forest fires propagation models like FlamMap (Finney 2002) and many others (CITES). The algorithm provides a solution of the Eikonal equation of a spreading curve subject to a given speed function ROS(**x**). This is done by searching for the fastest fire travel time along straight line transects of neighboring cells in the lattice. The number of neighboring cells considered determines the angle discretization of the spreading fire. The neighborhood or degrees of freedom, u, in WFA ranges from 8 cells (Moore neighborhood) to 32 cells.

2.4.2 References to Techniques and Algorithms

Provide references to the algorithms and numerical techniques.

The Technosylva WFA platform utilizes numerous models to address specific operational requirements. These models are integrated into an extendible platform that facilitates continued improvement as R&D advancements are made. The following table lists the primary models employed on WFA :

Model	Model Reference	Notes
Surface fire	Rothermel 1972, Albini 1976 Kitral IntecChile	WFA uses the core Rothermel model for fire propagation, however it can be configured for custom versions to support any empirical or semi empirical fire model. This has been done for different models employed in other countries, i.e. Chile, Canada, etc. In this regard, WFA platform is easily extended for use in unique geographies.
Crown Fire	Van Wagner (1977,1989,1993); Finney (1998); Scott and Reinhardt (2001)	Critical surface intensity and critical ROS for crown fire initialization. Expected ROS and flame intensity.
Time Evolution	Technosylva (Monedero, Ramirez 2011)	Fast-Marching method adapted to fire simulations. Minimum Travel Time algorithm with 32 degrees of freedom.

Model	Model Reference	Notes
High-Definition Wind	Forthoffer et al (2009)	High resolution wind model obtained through the integration of the USFS WindNinja software. Note: Technosylva is also the contractor for the USFS Missoula Fire Sciences Lab. for the on-going enhancement and customization of the WindNinja software. This provides Technosylva a unique understanding of the model science foundation and implementation approaches.
Wind Adjustment Factor	Andrews 2012	Wind speed conversion with height. Based on Albini and Baughman (1979); Baughman and Albini (1980); Rothermel (1983); Andrews (2012)
Fire Shape	Andrews 2018,	Unique ellipse based solely on the effective wind speed.
Live Moisture Content	Cardil et al.	Machine learning Algorithm based on historical NDVI weather reading
Dead Moisture Content	Nelson (2002)	
Spark Modeling	Technosylva	Ignition point displacement based on wind speed
Urban Encroachment	Technosylva 2016	Includes several variations of urban encroachment algorithms developed internally to facilitate spread of fires into non-burnable urban fuels. This incorporates a distance-based friction model. Based on research publications by NIST.
Spotting	Technosylva 2019	Surface spotting model for wind driven fires. Albini (1983a, 1983b); Chase (1984); Morris (1987)
Building Loss Factor	Technosylva (Cardil xxx)	Machine Learning algorithm taking into account building conditions. Based on historical damage inspection data on buildings affected by fires over the past 13 years

Many of these models were originally published from research by the USFS Missoula Fire Sciences Laboratory. Technosylva has implemented, and enhanced these models, in addition to developing new models. Most Technosylva custom developed models are supported by journal publications as part of our corporate R&D program. Some of these models are referenced on the Technosylva web site at https://technosylva.com/scientific-research/. Key references are provided below for many of the models employed in the WFA platform.

- Beer, T. The interaction of wind and fire. Boundary-Layer Meteorol 54, 287–308 (1991). https://doi.org/10.1007/BF00183958

- Cruz Miguel G., Alexander Martin E. (2010) Assessing crown fire potential in coniferous forests of western North America: a critique of current approaches and recent simulation studies. International Journal of Wildland Fire 19, 377-398.
- Cruz, Miguel G.; Alexander, Martin E. (2013). Uncertainty associated with model predictions of surface and crown fire rates of spread. Environmental Modelling & Software. 47: 16-28.
- Scott, J.H. 2006. Comparison of crown fire modeling systems used in three fire management applications. USDA For. Serv. Res. Pap. RMRS-RP-58.
- Scott, J.H., and Reinhardt, E.D. 2001. Assessing crown fire potential by linking models of surface and crown fire behavior. USDA For. Serv. Res. Pap. RMRS-RP-29.
- Bennett, M., S.A. Fitzgerald, B. Parker, M. Main, A. Perleberg, C.C. Schnepf, and R.
- Mahoney. 2010. Reducing Fire Risk on Your Forest Property. PNW 618: 40 p.
- Fire Science Core Curriculum. 2017. OSU Extension Service, EM 9172: 197p
- Gould, James. (1991). Validation of the Rothermel fire spread model and related fuel parameters in grassland fuels. Proceedings of the Conference on Bushfire Modelling and Fire Danger Rating Systems. 51-64.
- Di Gregorio, Salvatore & Bendicenti, E.. (2003). Simulations of Forest Fires by the Cellular Automata Model.
- J. Glasa and L. Halada. On elliptical model for forest fire spread modeling and simulation. Mathematics and Computers in Simulation, 78(1):76–88, 2008.
- T. Ghisu, B. Arca, G. Pellizzaro, and P. Duce. A level-set algorithm for simulating wildfire spread. CMES Computer Modeling in Engineering & Sciences, 102(1):83–102, 2014
- Dijkstra, E. W. (1959). A note on two problems in connection with graphs. Numerische Mathematik, 1(1), 269–271.
- Finney, M A, (2002). Fire growth using minimum travel time methods. Canadian Journal of Forest Research, 1420-1421, 32(8)
- Sanders, Kristen A., "Validation and calibration of the FARSITE fire area simulator for Yellowstone National Park" (2001). *Graduate Student Theses, Dissertations, & Professional Papers*. 3990. https://scholarworks.umt.edu/etd/3990
- A. Collin, D. Bernardin & O. Séro-Guillaume (2011) A Physical-Based Cellular Automaton Model for Forest-Fire Propagation, Combustion Science and Technology, 183:4, 347-369,
- Zigner, K.; Carvalho, L.M.V.; Peterson, S.; Fujioka, F.; Duine, G.-J.; Jones, C.; Roberts, D.; Moritz, M. Evaluating the Ability of FARSITE to Simulate Wildfires Influenced by Extreme, Downslope Winds in Santa Barbara, California. *Fire* **2020**, *3*, 29. https://doi.org/10.3390/fire3030029
- Phillips, Ross J.; Waldrop, Thomas A.; Simon, Dean M. 2006. Assessment of the FARSITE model for predicting fire behavior in the Southern Appalachian Mountains. Proceedings of the 13th biennial Southern Silvicultural Research Conference. Gen. Tech. Rep. SRS-92. Asheville, NC: U.S. Department of Agriculture, Forest Service, Southern Research Station: 521-525

2.4.3 Equations and Implementation

Present the mathematical equations in conventional terminology and show how they are implemented in the code.

Summary

The mathematical model used to simulate surface fire spread is the model developed by Rothermel (1972) with some modifications from Albini (1976) and some minor adjustments from Technosylva. It accepts the initial 13 fuel models (Anderson 1982) as well as Scott and Burgan's (2005) dynamical fuels where there is a transfer load between the herbaceous and dead classes. Among other outputs this model provides the surface fire rate of spread, flame length and flame intensity in the direction of maximum spread (head front). Crown fire is implemented using the model developed by Van Wagner (1977,1993) which computes the transition viability to crown fire, as well as the expected ROS and intensity in active crown fires. Spotting is modeled as a pseudo random event. The maximum expected spotting distance from the fire is obtained using the wind-driven model developed by (Albini 1983a; Albini 1983b; Chase 1984) and then embers are generated randomly on the front of the fire and the actual traveled distance is computed also randomly based on the maximum distance available. In this modeling there is no tracking of individual embers in the air. Wind speed profiles at different heights (2m, 10m, 20ft) are obtained through a logarithmic wind profile found in Andrews (2012). Fire is assumed to spread following an elliptical shape only dependent on the effective wind speed (Andrews 2012). The time evolution is done using a Fast-Marching method on a regularly spaced landscape grid of a Cellular Automata.

Surface Fire

The default propagation engine implemented in WFA is Rothermel's (1972) surface model with the modifications proposed by Albini (1976) and the requirements to accept Scott and Burgan (2005) fuel models. The basic equation in the model predicts the heads fire rate of spread without wind or slope:

$$R_0 = I_R \, \xi \, / \, \rho_b \varepsilon Q_{ig}$$

Here I_R is the reaction intensity (energy released rate per unit area of the fire front), ξ the propagating flux ratio, ρ_b the bulk density, ε the effective heating number, and Q_{ig} the heat of ignition. The equation is derived by applying the energy conservation to a unit volume of fuel ahead of a steadily advancing fire in a homogeneous fuel bed. In this model, the ROS may be viewed as the ratio between the heat flux received by the unburned fuel ahead of the fire (numerator) and the heat required to ignite it (denominator).

The input parameters to compute the ROS in the case of no wind or slope are the moisture content and the characteristics of the vegetation. Moisture content is given by the 1h, 10h and 100h dead moisture content, and the woody and herbaceous live moisture content. Fuels are assumed to be a mixture of different vegetation types depending on their class (dead or live) and size (less than 0.25 inch, 0.25-1 inch, 1-3 inch), with each class having different surface to volume ratio and loads. The inputs required to define a fuel type is given in the following table:

			LOAD				SAV					
Fuel	1h	10h	100h	herb	woody	1h	herb	woody	Dyn	Depth	MoistExt	heat

Table: input variables for each fuel type.

Here Dyn (dynamic) is a boolean variable to define if there should be a transfer between the herbaceous load and the dead one based on the herbaceous content. In general, SAV values (the fineness of the fuel) strongly affects the ROS and flame length of the fire, while the fuel load does not affect the rate of spread but can have a strong effect on the flame length.

The effect of wind and slope can be incorporated in the model through a couple of dimensionless parameters depending on the midflame wind speed U and the terrain angle θ:

$$ROS= R_0\ (1+\Phi_w+ \Phi_s)$$

with

$$\Phi_s= 5.275\ \beta^{-0.3}\ (\tan\theta)$$

$$\Phi_w= C * U^{B}\ (\beta / \beta_{op})^{-E}$$

Where β_{op} and β are the optimum and standard packing ratios respectively, and C, B, and E are parameters depending on the surface to volume ratio σ:

$$C = 7.47 * \exp(-0.133\ \sigma^{0.55});$$

$$B = 0.02526\ \sigma^{0.54}$$

$$E = 0.715 * \exp(-0.000359 * \sigma)$$

The slope and wind factors are summed together to obtain the final ROS. If they are not aligned the resultant vector defines the direction of maximum spread (which will be between the direction of wind and the direction of slope). This final slope-wind factor can also be used to compute an equivalent or effective wind speed causing the same effect as the combined effect of wind and slope. To do that we simply inverse the equation of the wind factor to obtain:

$$U_e= [\ \Phi_e\ (\beta / \beta_{op})^{E} / C\ ]^{-B}$$

The Rothermel model predicts fire characteristics (ROS, flame length, etc) only in the direction of maximum spread (head front) obtained from the combined effect of wind and slope. To compute the ROS in a direction different from the direction of maximum spread, and to be able to use the model in a 2D landscape it is assumed that a free burning fire perimeter from a single ignition point has an elliptical shape. There are several different approaches to compute the ellipse (or ellipses) eccentricity based on wind and slope (Albini [2], Anderson 1983 [6], Alexander, etc). The present implementation follows the equations in Andrews (2008) depending on the effective wind speed U_e in mi/h in the direction of maximum spread. The length to width ratio is given by:

$$L/W = 0\ .1+ 0.25\ U_e$$

Or equivalently the eccentricity e is given by

$$e= (Z^2 - 1)^{0.5} / Z$$

so that the ROS in any direction ϕ is given by

$$ROS(\phi)=ROS\ (1\text{-}e) / (1+e)$$

One of the most important variables of fire is the amount of heat it generates as this is the main contributor to fire spread and fire severity. The amount of heat can be measured using different variables like the reaction intensity (IR), the Heat per Unit Area (HPA) or the fireline intensity. The Reaction intensity is the rate of energy release per unit area within the flaming front (with units of energy/area/time), heat per unit area is the amount of heat energy released per unit are within the flaming front (units of energy/area), fire line intensity is the rate of heat energy released per unit time per unit length of the fire front (units of energy/distance/time). Fireline intensity is independent of the depth zone and It is calculated as the product of the available fuel energy and the ROS of the fire (Byram 1959):

$$I_B = HA \cdot ROS$$

Where The heat per unit area depends on the reaction intensity of the fire (IR) and the time that the area is in the flaming front (residence time tr)

$$H_A = I_R \cdot tr = 384 \cdot I_R / \sigma$$

In this model the flame length and Byram's intensity are closely related by:

$$FL = 0.45\ I^{\ 0.46}$$

Where the flame length is in feet and the intensity in Btu/ft/sc.

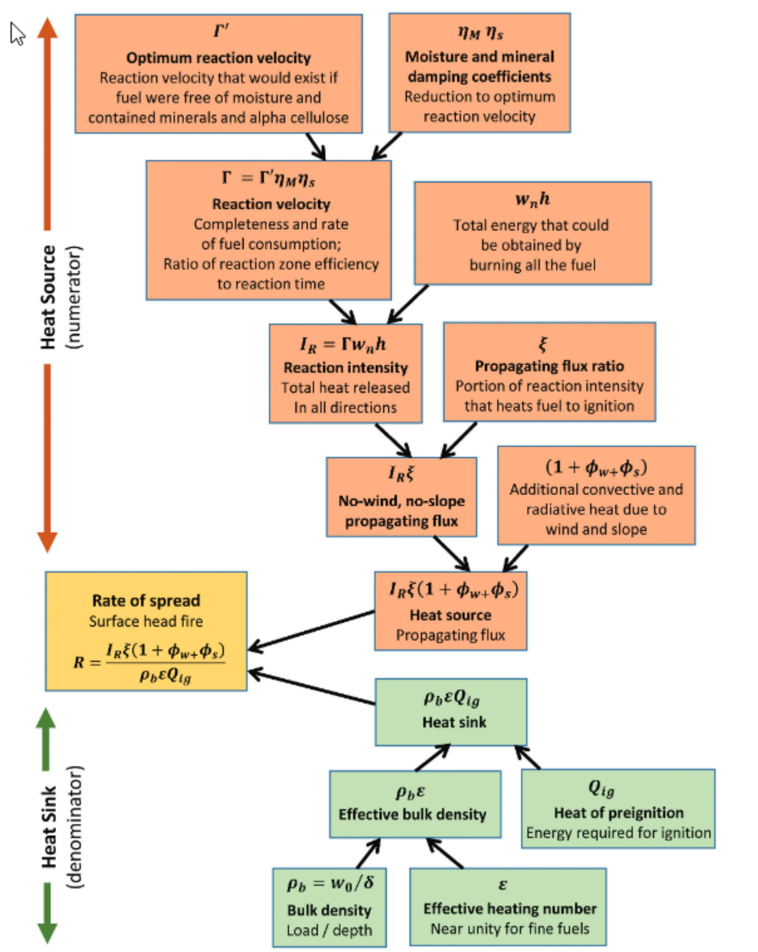


Fig X: Flow of Calculation provided in Andrews (2018)

For a much more in-depth discussion of the Rothermel surface model please read Andrews (2018) and Rothermel (1972).

Crown fire

Crown fires burn forest canopy fuels. They are usually generated by surface fires and represent a major change in fire behavior due to an increased rate of spread and heat released. Crown fires can be passive, active or conditional based on the capacity of the surface fire to move into areal fuels, and to the capacity of the burning canopy to move between individual trees.

Crown fire initiation occurs when the surface fire provides enough heat to raise the temperature of the canopy fuel to ignition temperature. In Van Wagner (1977) model, this minimum intensity is given by:

$$I_{ini} = (0.01 * CBH (460 + 25.9 FMC))^{1.5}$$

Where CBH is the canopy base height (m) and FMC is the foliage moisture content of the canopy cover. Foliar moisture content (FMC) is usually not known, but it is assumed that for most species old foliage should be around 100 percent and this value has been used as a default value when no other information is available (Scott 2001). This approach however does not consider any known humidity conditions of the site and in WFA the FMC is computed based on the 100h moisture content as follows:

$$FMC = 75 + 2 \cdot m100h$$

Once the fire has transitioned to the canopy it is necessary to have a critical mass-flow rate for the fire to be self-sustained. Vang Wagner found this critical mass to be 0.05 kg m-2 sec-1 (Scott 2001) which can be used to determine a minimum crown fire rate of spread only dependent on the Canopy Bulk Density (CBD) and given by

$$R_{active} = 3 / CBD$$

Other existing models not used in WFA are Alexander (1998) which is very similar to Van Wagner (1977) but includes additional inputs like flaming residence time, plume angle and fuel bed characteristics, Cruz et at. (1999) fire transition model, and Cruz et al. (2002) crown fire spread model given by:

$$ROS = c1\, U^{c2}\, CBD \cdot C3 \cdot e^{c4xEFM}$$

Where U is the wind at 10m, CBD the canopy bulk density, EFM is the fine dead moisture content, and C1, C2, C3, C4 are a set of regression coefficients.

The model for the ROS of crown fires was computed by Rothermel (1991) through a linear regression between observed crown ROS and the surface fire model. It states that the crown fire of an active ROS is 3.34 times the rate of spread of the surface model 10 assuming a 0.4 wind reduction factor.

$$R = 3.34(R_{10})_{40\%}$$

Based on these conditions, crown fire may be classified as:

- Surface fire if neither the intensity nor the minimum crown ROS is met
- Passive Crown fire (torching): Fire spreads through the surface fuels, occasionally torching overstory trees. Overall ROS is that of the surface fire.
- Conditional Crown: Fire cannot transition to crown, but active crown fire is possible if there was a fire transition to crown by other means
- Active Crown: Fire spreads through the overstory tree canopy if both conditions are meet

Fire Type		Active crown fire?	
		No	Yes
Transition to crown fire?	No	Surface	Conditional Crown
	Yes	Torching	Crowning

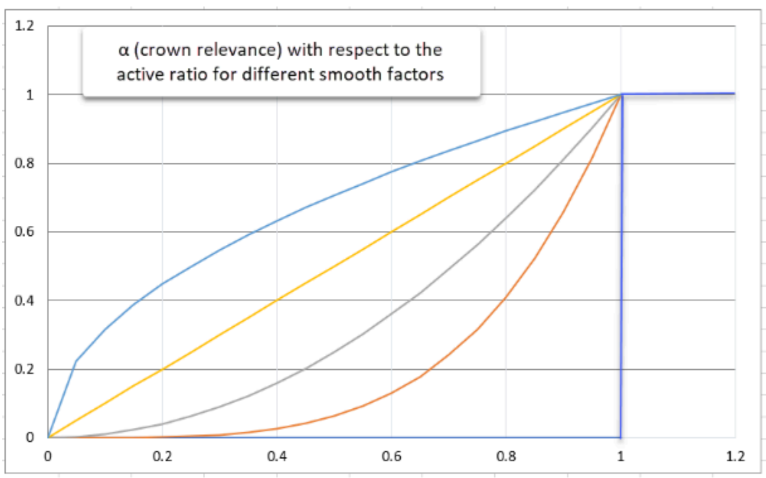
Crown fire classification as shown in BehavePlus

Van Wagner's crown fire transition and propagation models are well known and used operationally but have shown to have a significant underprediction bias when used in assessing potential crown fire behavior in conifer forests of western North America (Cruz et al. 2010). To try to correct this bias Technosylva has introduced two new parameters in the model that have been adjusted based on the analysis carried out by the scientific team using data from the last two fire seasons in California. The model introduces two new parameters 1) a crown factor multiplier for the Canopy Bulk Density (CBD) which decreases the minimum crown ROS required to have an active crown fire, and a factor that forces a smooth transition between the surface and the crown fire behavior. The final ROS of the overall fire when crown fire type is conditional or crowning is a weighted average of surface and crown ROS

$$ROS = surfROS * (1-\alpha) + \alpha * crownRos$$

Where the value α ranges from 0 to 1 and depends on the **active ratio** in the following way:

$$\alpha = activeRatio^{1/smoothFactor}$$



Example effect of the smooth factor (0 blue, 0.25 red, 0.5 gray, 1 yellow) in the crown contribution for active ratios lower than 1

At present, with WFA the crown CBD factor is set to 1.2 and the smooth factor to 0.4. This approach to provide a gradual transition in the fire's rate of spread (and flame length) from the initial onset of crowning similar to the crown fraction burned (CFB) (Alexander 1998) used in other modeling systems like FlamMap, FARSITE or Nexus, with the main difference being the smoothing function itself. Cruz et al. observes that there is no evidence of such a smooth transition between surface and crown fire regimes in the experimental data but rather an abrupt transition is observed far more commonly. In our context, however, where the main aim is to produce a forecast risk and not to simulate an individual fire we consider that it is important to reflect the fact that the fire conditions are close to generate an active crown fire.

For a more in-depth discussion of the crown fire models please read Cruz et al (2010) Scott et al. (2006)

Wind adjustment factor

Fire simulations require wind speed at midflame to compute surface fire spread and at 20ft to compute crown fire characteristics. To convert the wind between the two heights, WFA uses the wind adjustment factor (WAF) found in Andrews (2012) and implemented in the software BehavePlus and Farsite. The model is based on the work of Albini and Baughman (1979) and Baughman and Albini (1980), using some assumptions made by Finney (1998). This implementation considers two different models for sheltered and unsheltered conditions from the overstory. As described in Andrews (2012), the unsheltered WAF is based on an average wind speed from the top of the fuel bed to a height of twice the fuel bed depth. The sheltered WAF is based on the assumption that the wind speed is approximately constant with height below the top of a uniform forest canopy. Sheltered WAF is based on the fraction of crown space occupied by tree crowns. The unsheltered WAF model is used if crown fill portion is less than 5 percent. Midflame wind speed is the 20-ft wind multiplied by the WAF.

Unsheltered WAF depends on the surface fuel bed depth (in feet):

$$WAF = \frac{1.83}{\ln ln\left(\frac{20+0.36H}{013H}\right)}$$

Sheltered WAF:

$$WAF = \frac{0.555}{\sqrt{fH}*\ln ln\left(\frac{20+0.36H}{0.13H}\right)}$$

With H, the canopy height, and f ,the crown fill portion, depending on the canopy cover (CC) and the crown ratio (CR):

f = CC*CR / 3

CR = (CH-CBH) / CH

CR is the ratio of the crown length to the total height of a tree.

Time evolution

The fire models can predict the potential ROS of the front at any point and direction but are not able to compute the evolution of the fire perimeter in time. The main models to do that are:

1) Using Huygens principle of wave propagation like in Farsite (xxx) and discretizing in time
2) Using a Minimum Travel Time Algorithm or Fast Marching method, and discretizing in space
3) Using the more general but usually slower Level Set Method.

In the context of wildfires, Huygens principle states that each point on a fire front is in itself the source of an elliptical wavelet (fire) which spreads out in an independent way in the forward direction. This approach is numerically solved by splitting the perimeter into a set of nodes, computing the evolution of those nodes in the direction normal to the perimeter based on the ROS given by the propagation model and a given time steps, and then reconstructing the front based on the position of the transported nodes. The main weakness of vector-based approaches is the need for a computationally costly algorithm for generating the convex hull fire-spread perimeter at each time step, especially in the presence of fire crossovers and unburned islands (Ghisu et al. 2014). Raster based implementations are computationally more efficient (Glasa et al. 2008), but can suffer from significant distortion of the produced fire shape if the number of neighboring cells considered (number of possible spread directions) is low.

Spotting

Wildfires can create powerful updrafts which launch burning firebrands into the atmosphere, these firebrands are then carried horizontally by the wind landing some distance downwind from the source and creating a new ignition. Due to its unpredictable nature, fire-spotting modeling, here, is considered through a statistical approach.

Encroachment

Encroachment is a critical component in the WFA fire modeling simulations as it affects the number of buildings, assets, facilities and population impacted. It does not have a relevant effect on other impact metrics. To take advantage of enhanced algorithms for spread encroachment using adjacent fuels and fire behavior data, the non-burnable (and especially urban) fuel classification needed to be updated to provide better granularity and characterization of the type of urban/WUI. Accordingly, to test these methods an enrichment of the current fuels data was developed by Technosylva to delineate urban fuels into different types of urban and also a level of density of buildings. This enhancement of the basic Scott and Burgan fuel models is used in combination with enhanced encroachment algorithms to more accurately calculate potential impacts to buildings and population.

Urban areas have been classified into classes depending on their structure (roads, urban core, isolated, sparse) and their surrounding fuels, characterized as high versus low fire behavior fuels). Specific encroachment factors can then be applied to each grouping.

Spark Modeling

Electrical failures can cause sparks and produce an ignition meters away from the asset location. To take this into account, the WFA allows the ignition point location to be displaced if the underlying vegetation type is either non-combustible or WUI. This displacement is in the direction of the wind and is proportional to the wind speed. The displacement distance and wind speed algorithm has been developed using expert opinion from electric utility engineers familiar with asset failure and ignition probability.

Weather

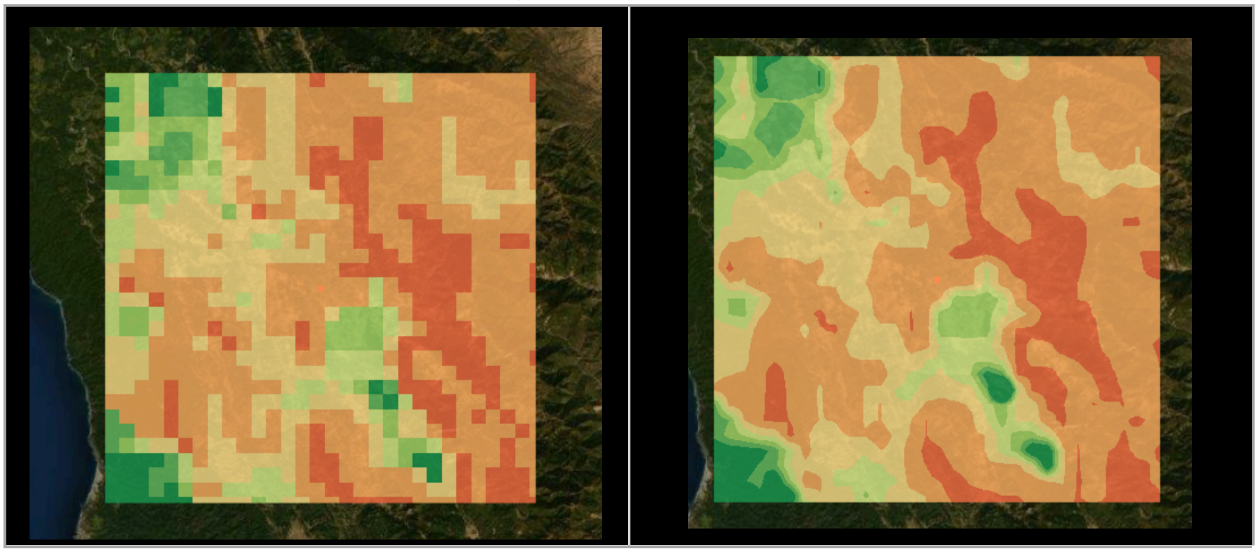
WFA requires historical daily weather data to run the fire simulations. The minimum required variables are the wind speed at 10m, the dead moisture content, and the live moisture content. More explicitly:

- Northward 10m wind speed
- Eastward 10m wind speed
- Dead moisture content 1hr
- Dead moisture content 10hr
- Dead moisture content 100hr
- Herbaceous moisture content

- Woody moisture content

The dead moisture may be given by the client or may be computed based on the Nelson model. Similarly, the herbaceous moisture content may be provided by the client or may be computed using Technosylva's Machine Learning algorithm based on historical NDVI weather reading. The Technosylva DFM model has been developed to meet customer needs using the latest modeling approaches. The input wind speed required by the propagation model is 20ft; to convert the initial 10m wind speeds to 20ft, we use a logarithmic profile from Andrews (2012) leading to a 13% wind speed reduction.

Weather data is obtained from the Weather Research and Forecasting (WRF) Model weather forecast data. The forecast weather has a 2 km resolution which can lead to sharp changes in weather conditions between neighboring cells. In order to increase accuracy and meet the underlying 30m cell size resolution of the fuels data, weather data is interpolated spatially using a bilinear interpolation scheme. The smoothing of the source weather data ensures that integration with the wildfire behavior models results in outputs that do not have hard edges in the data.



Left: Initial weather definition. Right interpolated weather definition

Impact and consequence value calculation

Wildfire spread modeling is undertaken with asset ignition locations to derive potential impacts. The output impact values (risk metrics) are assigned back to the asset ignition point location. Using this approach allows us to differentiate between the risk output associated with different assets (and their ignition locations) using the same weather data although weather values may vary based on spatial location and time of day (hourly). For both operational and mitigation applications, the wildfire spread modeling is conducted using High Performance Computers (HPC) and typically involves hundreds of millions of spread simulations. The amount of simulation will vary depending operational use with daily forecasts versus mitigation planning use with hundreds of weather scenarios.

The main goal for the WFA simulations is to create a forecast risk associated to each ignition point and surrounding area. This is done by running individual simulations and associating the following main risk metrics back to each ignition point. The following baseline risk metrics are calculated from the spread simulations

- Acres Burned (referred to as Fire Size Potential)
- Number of Buildings Threatened
- Estimated Number of Buildings destroyed
- Population impacted

Numerous conventional fire behavior outputs are also calculated, the most important being:

- Rate Of Spread (ROS)
- Flame Length (FL)
- Fire Behavior Index (FBI) – combination of ROS and FL

2.4.4 Limitations (see Guide ASTM E 1895)

Identified the limitations of the model based on the algorithms and numerical techniques.

The Technosylva WFA platform Is an integration of numerous speciality models designed to address specific scientific requirements and methods.

The following assumptions applied to the models used in WFA:

- The physical framework development is based on an idealized situation in steady state spread
- Rate Of Spread at a point only depends on the conditions at that point (point-functional models). This means that there is no increase in speed due to non-local contributions of the fire front.
- Fire model is not directly coupled with the atmosphere. Fire will not modify local atmosphere. However, this is being addressed with seamless integration with the WRF-SFIRE model in development at San Jose State University, Wildfire Interdisciplinary Research Center. WRF-SFIRE is an option available to WFA customers to address specific convection based fire scenarios.
- Fire is always assumed to be fully developed with fire acceleration, flashover, or decay not being considered.
- Atmospheric instability, which may have a deep impact on ROS (Beer 1991), is not considered in the model in any way.
- Gusts are not considered in the model
- No interaction between slope and wind other than creating an effective or equivalent wind. This means that fire is assumed to have an elliptical shape no matter the alignment of wind and slope.
- Experimental data is scarce and the empirical adjustment of models have been based on wind tunnel experiments and a few well documented fires
- Fuel array description of the vegetation may not perfectly describe fuel characteristics.
- Spotting is only considered in surface fires

2.5 Data Libraries

Provide background information on the source, contents, and use of data libraries.

This section provides a brief summary of the key input datasets required for wildfire behavior analysis and risk analysis. The following categories of input data are:

1. Landscape characteristics
2. Weather and atmospheric data

3. Fuel moisture
4. Values at risk (highly valued resources and assets)
5. Possible ignition sources
6. Fire activity

2.5.1 Landscape Characteristics

This includes a range of possible data that describe the characteristics of the landscape. The most important data are related to surface and canopy fuels, and vegetation. There are many publications available that describe these datasets, many from the USFS Missoula Fire Lab. Most use the Scott & Burgan 2005 Fuels Model Set standard for classification of fuels data.

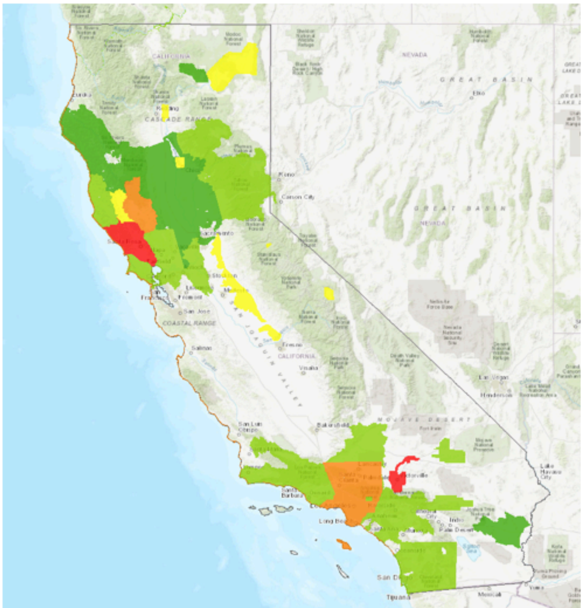
Standard fire behavior analysis input layers are:

1. Terrain – elevation, slope, aspect
2. Surface fuels (Scott & Burgan 2005)
3. Canopy fuels
    a. Canopy height
    b. Canopy base height
    c. Canopy bulk density
    d. Canopy closure
4. WUI and and Non Forest Land Use classes (Technosylva, 2020)

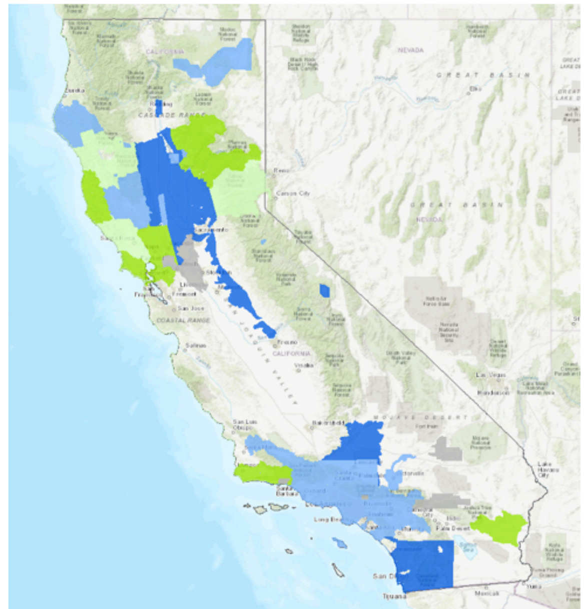
2.5.2 Surface and Canopy Fuels

For these layers, data developed by Technosylva is used. Technosylva provides an annual fuel updating subscription where initial fuels is developed using advanced remote sensing object segmentation methods using high resolution imagery, available LiDAR & GEDI, and other standard imagery sources, such as NAIP , Sentinel 2 and Landsat. This is supplemented with in-the-field surveys to verify the fuels for possible areas of concern and to validate the fuels classification. Surface and canopy fuels data is critical for accurate fire behavior modeling, so it is paramount that this data is up-to-date, and when used, results in the observed and expected fire behavior.

Survey Date



Point Cloud Density



Survey Date

- 2019
- 2018
- 2017
- 2016
- 2013

Summary

- 2019 → 14,906,880 ac
- 2018 → 26,874,880 ac
- 2017 → 4,423,040 ac
- 2016 → 6,377,600 ac
- 2013 → 2,319,360 ac

Point Cloud Density (point/m2)

- 0 - 5
- 5 - 10
- 10 - 15
- 15 - 30
- Unknown

LIDAR Data used for Technosylva Fuels 2021, with capture date and points density

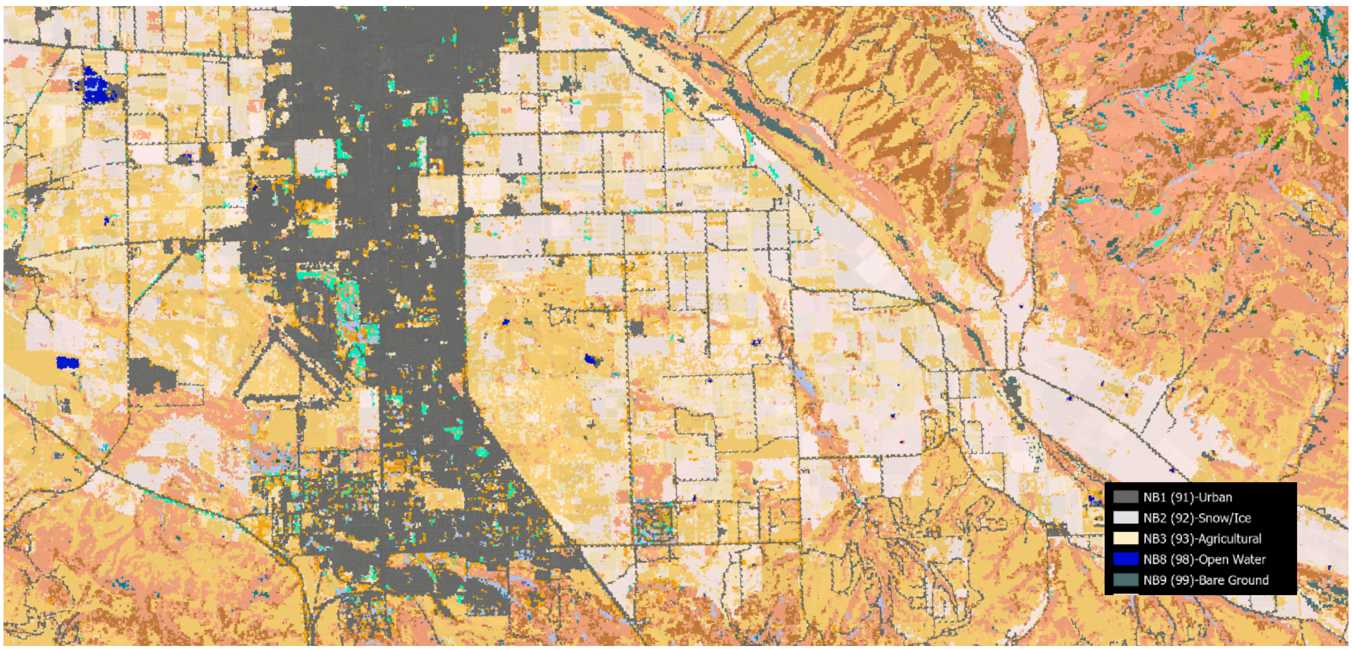
Surface and canopy fuels are updated throughout the year, to accommodate changes to the fuels, typically monthly during fire season. This ensures that all major disturbances, such as fires, urban growth, landslides, etc. are updated in the fuels data. A variety of methods, including burn severity analysis, are used to update the fuels. Up to date fuels data is critical to ensuring the fire behavior outputs from our modeling are accurate, as it is a key input into risk analysis.

Technosylva continually tests new fuels datasets that become available from other sources, such as LANDFIRE, federal risk assessment regional projects, and independent sources, such as the California Forest Observatory data. Unfortunately, the publicly available data does not perform at the level required when confronted with operational testing. In general, these publicly available data do not result in fire behavior outputs that facilitated accurate predictions. Ultimately with any fuels dataset, the quality and accuracy of the fuels is measured on whether it produces ‘observed and expected fire behavior’. Fortunately, Technosylva is able to test this data, and other fuels data including their custom data, operationally on a daily basis with CAL FIRE and the IOUs against active wildfires to see how it performs.

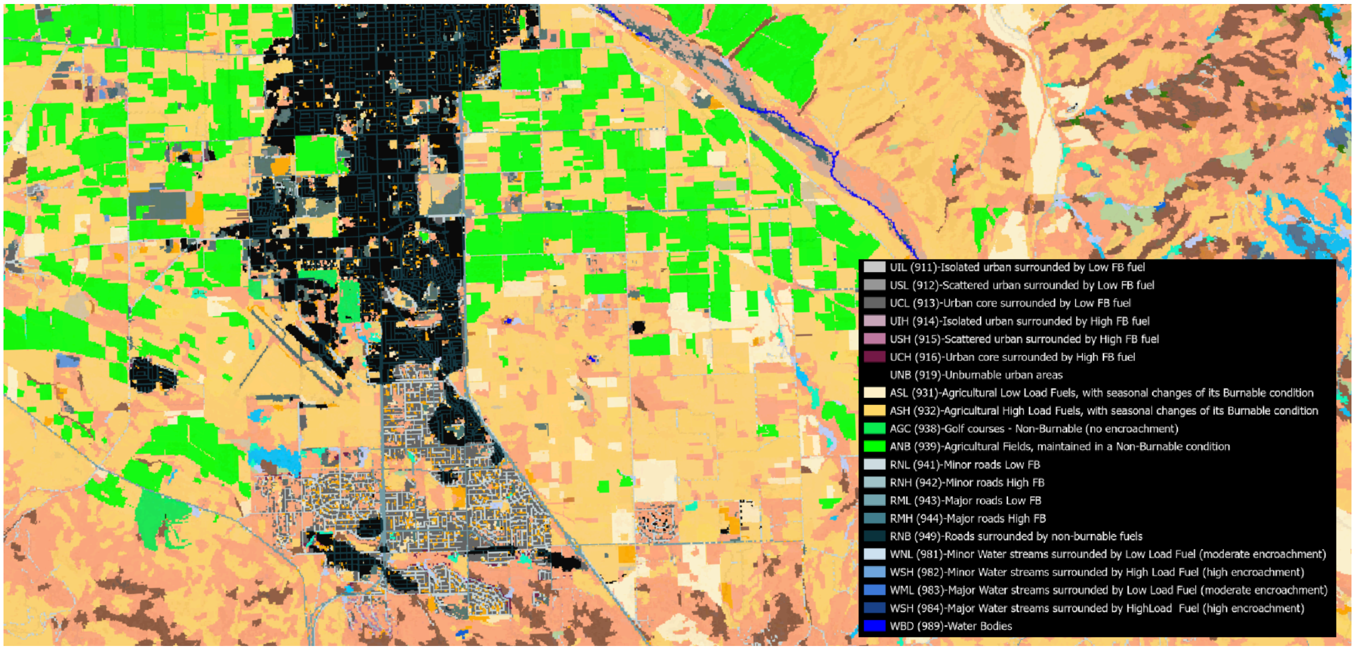
Updates to the fuels, and algorithms that use the fuels data for fire behavior modeling are on-going with us, as we continue to enhance the data and algorithms to match observed fire behavior across the state. These methods and algorithms are proprietary.

WUI and Non-Forest Fuels Land Use classes are based on a Technosylva proprietary method that characterizes WUI and other land uses classes that have been a typical limitation of the Scott and Burgan classification, as they are defined in general non burnable classes. In combination with the Surface Fuels, this provides a solid foundation for fire behavior and impact analysis.

The following two figures present an example of publicly available LANDFIRE data commonly used for fire modeling, and the custom Technosylva fuels used.



LandFire Fuels – Non Burnable Classes



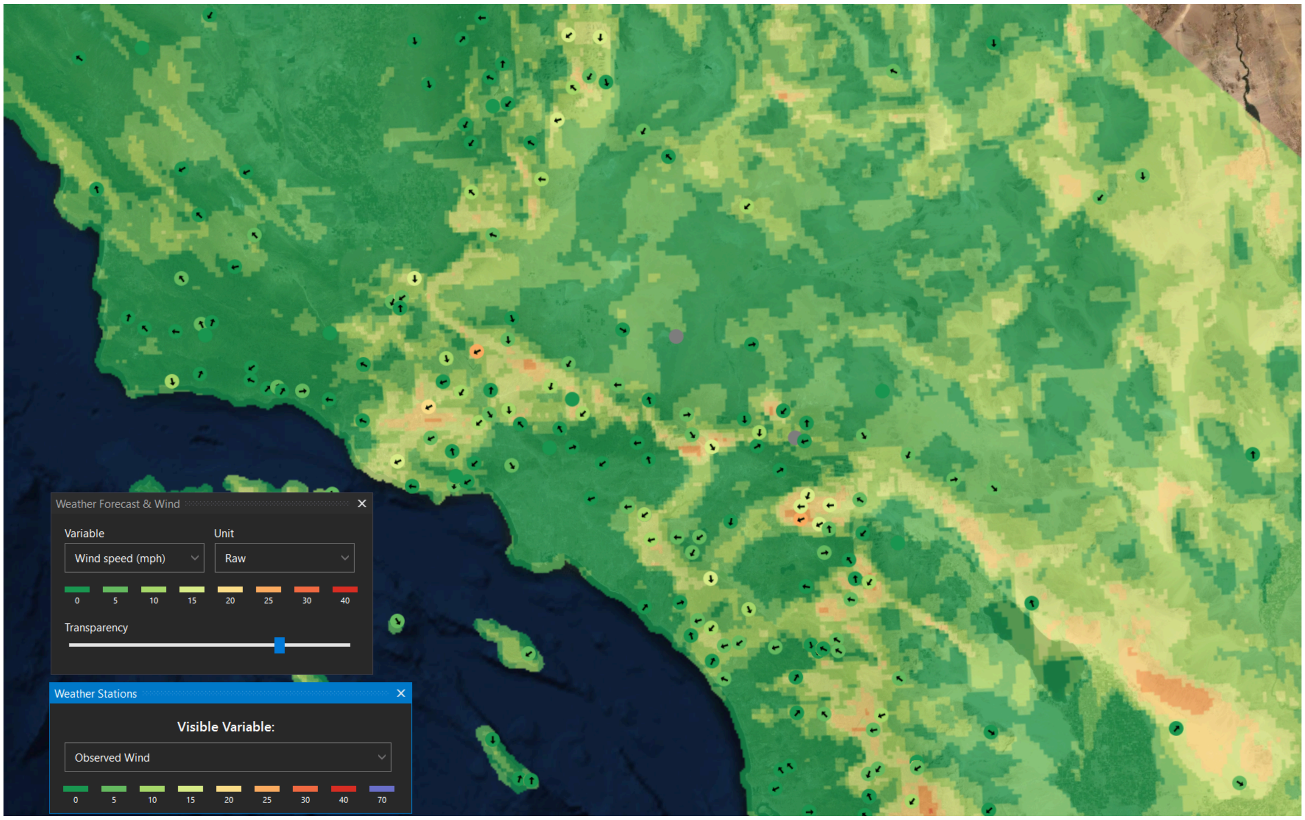
Technosylva Fuels Dec 2021 – WUI and Non-Forest Fuels Classes

2.5.3 Weather and Atmospheric Data

WRF data is developed using third party weather and predictive services experts available through commercial providers. Data is 2 km spatial resolution and hourly (temporal) for a multi-day period, up to five+ days. Multiple forecasts are generated daily.

Weather observation data can also be used along with, or independently, to support fire behavior analysis. This data is typically available through published weather stations on MesoWest, or through commercial providers, such as Synoptic. The methods of how this data can be integrated within the Technosylva software and processes is proprietary.

The following figure shows a typical 2km WRF model of wind speed overlaid with weather stations data (WFA software example).



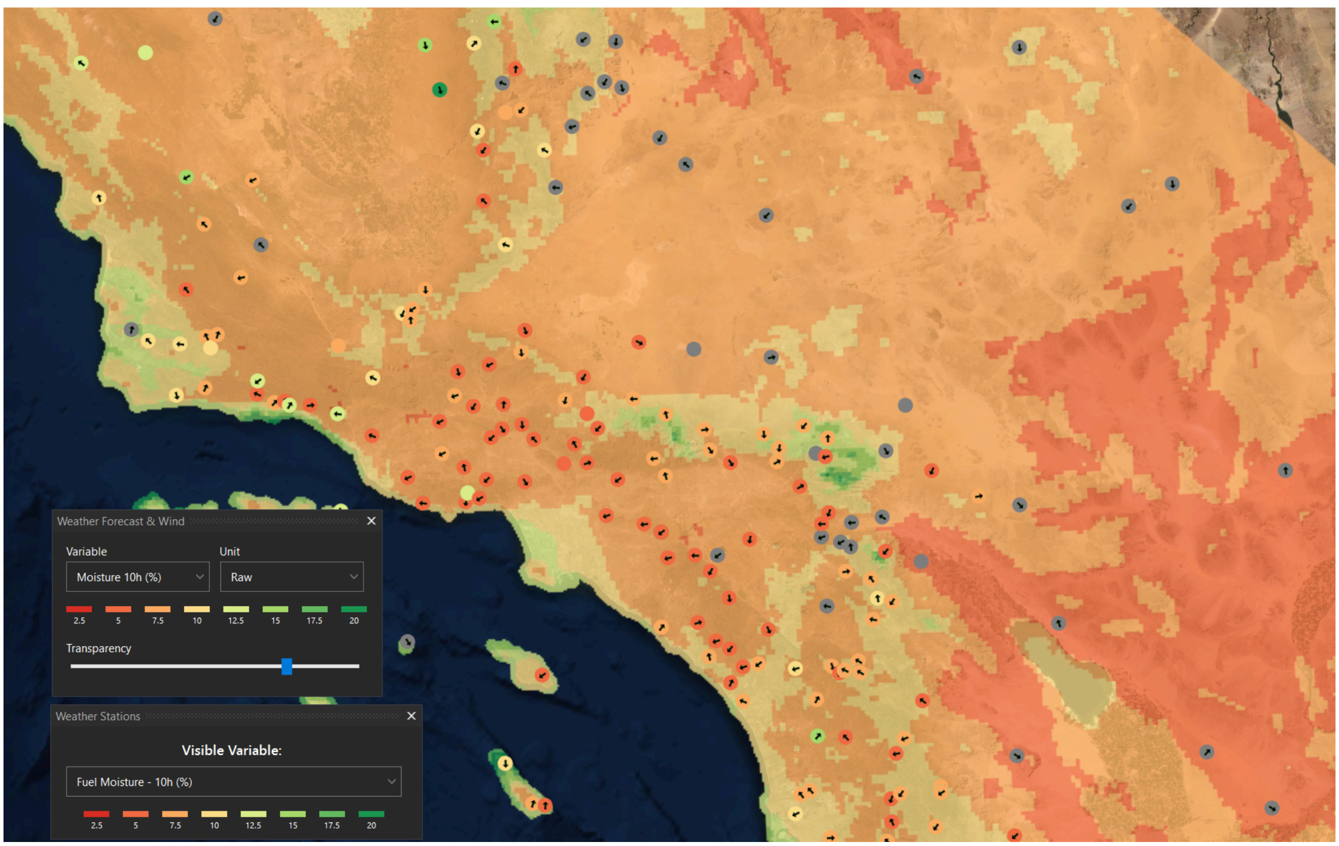
Predicted (WRF model) and Observed Wind (Weather Stations, Synoptic)

2.5.4 Fuel Moisture

Fuel moisture data is also a key input into fire behavior modeling. Fuel moisture can be characterized as either Dead or Live fuel moisture. Standard methods for measuring and quantifying fuel moistures are well documented in publications by the USFS Missoula Fire Lab and other research agencies.

However, to date the ability to accurately predict live and dead fuel moistures at high resolution has been limited. Only a few IOUs and commercial vendors are producing daily estimates that can be integrated into fire modeling. Technosylva produces both a dead and live fuel moisture data product that combines historical and current sample data with remotely sensing imagery in a machine learning model to estimate daily data products. These methods are proprietary although they are substantiated with several publications and on-going collaboration between the IOUs, Technosylva and fire weather and behavior research agencies. This fuel moisture data product is used by CAL FIRE and several IOUs across seven western US states.

The following figure shows the Technosylva Dead Fuel Moisture overlaid with weather stations data (WFA software example).



Predicted (WRF model) and Observed 10-hr Fuel Moisture (Weather Stations, Synoptic)

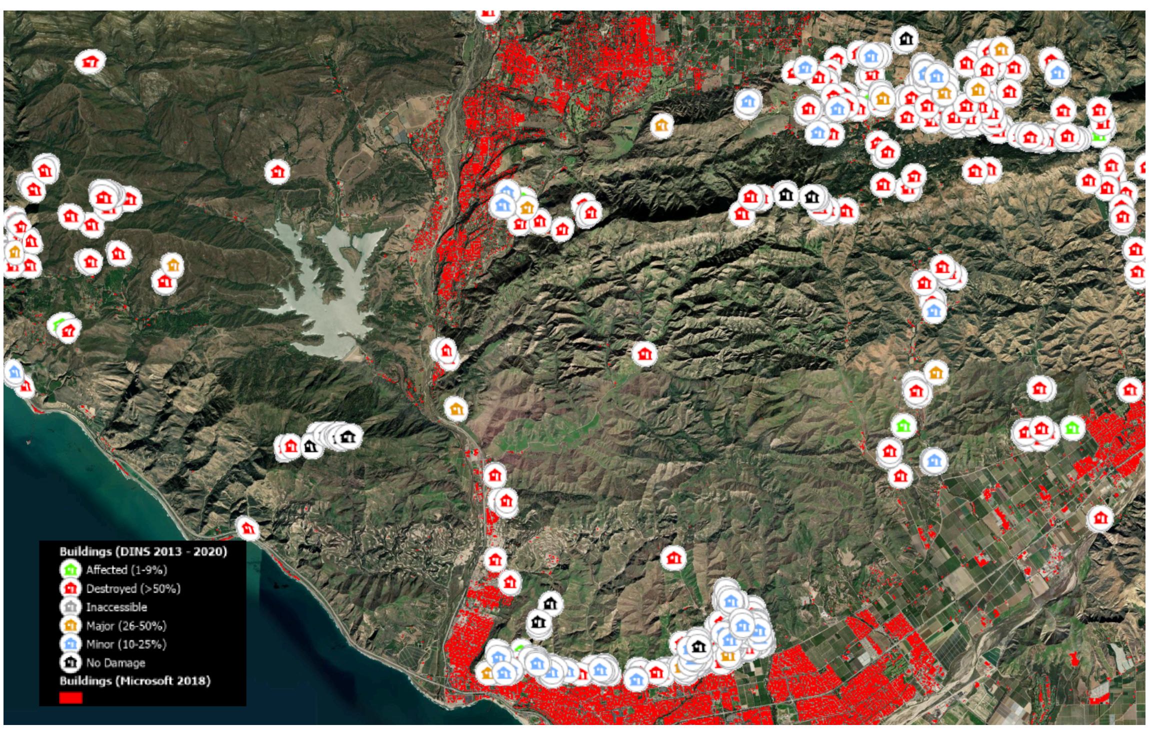
2.5.5 Values at Risk

Values-at-Risk data reflects the resources and assets that exist across that landscape that we are concerned about. Typically, 'resources' refers to natural items while 'assets' refers to man made items. Wildfire modeling is used to identify the "risk" associated with resources and assets, with risk representing the possibility of loss or harm occurring due to wildfire.

VAR data is typically characterized into public safety or financial impacts. Technosylva IOU customers use similar input datasets for VAR, such as population count (location), building footprints, and critical facilities. A variety of datasets exist to define the location and characteristics of these VAR, each with varying temporal and spatial accuracy. Census data is a common source for population data along with ORNL LandScan data (population count). LandScan has become a de facto standard for static wildfire risk assessments across the Nation in the past 10 years. It is available through the Dept. of Homeland Security HSIP program for certified vendors of government agencies, or the agencies themselves. It is typically updated every 2 years with a 90 meter spatial resolution of population count. Technosylva currently uses the latest 2021 LandScan data for calculating population impacts.

The Microsoft Buildings Footprint dataset is a publicly available free data source used as a starting point by many vendors and agencies. Technosylva has taken this data and updated it using local high resolution imagery data sources to enhance the data. The original Microsoft data is a good starting point, however it does have holes with missing data and some misrepresentation of buildings with natural features. This data was updated in 2020 by Microsoft. This provides the primary source for the buildings data used by Technosylva.

Population and buildings are the two primary datasets used as input into wildfire risk analysis, although most IOU customers add confidential data to derive more detailed consequence metrics. These are proprietary to the IOUs and cannot be shared by Technosylva.



Buildings (Microsoft 2020) and Damaged Inspections data (DINS) from CAL FIRE

2.5.6 Possible Ignition Sources

Wildfire ignition data varies greatly depending on the organization and purpose of the wildfire risk analysis. Traditionally, agency driven risk assessments will use historical fire location data to create Historical Fire Occurrence datasets, reflecting ignition density over a specific time period. This data is obtained from federal and state fire reporting systems.

IOUs are often concerned with using their assets as possible ignition sources, in equipment failure scenarios or extreme weather events, where a spark from an electric utility asset may cause a fire ignition. Risk can be assessed related to the probability of ignition for electric utility assets, or more commonly with the potential spread and impacts of a wildfire ignited by an asset. Technosylva provides integration of both ignition and spread analysis to derive risk metrics using VAR data. This focuses on assigning possible consequence back to the electric utility assets to identify those assets more prone to having significant impacts should a wildfire ignite. Different proprietary methods exist to integrate and model probability of ignition data for electric utility assets with consequence modeling. Referred to as "asset wildfire risk" this information can be used to support operational decisions, such as PSPS, resource allocation and placement, and stakeholder communication, in addition to short and long term mitigation planning efforts, reflected in IOU WMPs. The weather and fuels inputs will vary depending on the purpose of these risk analyses.

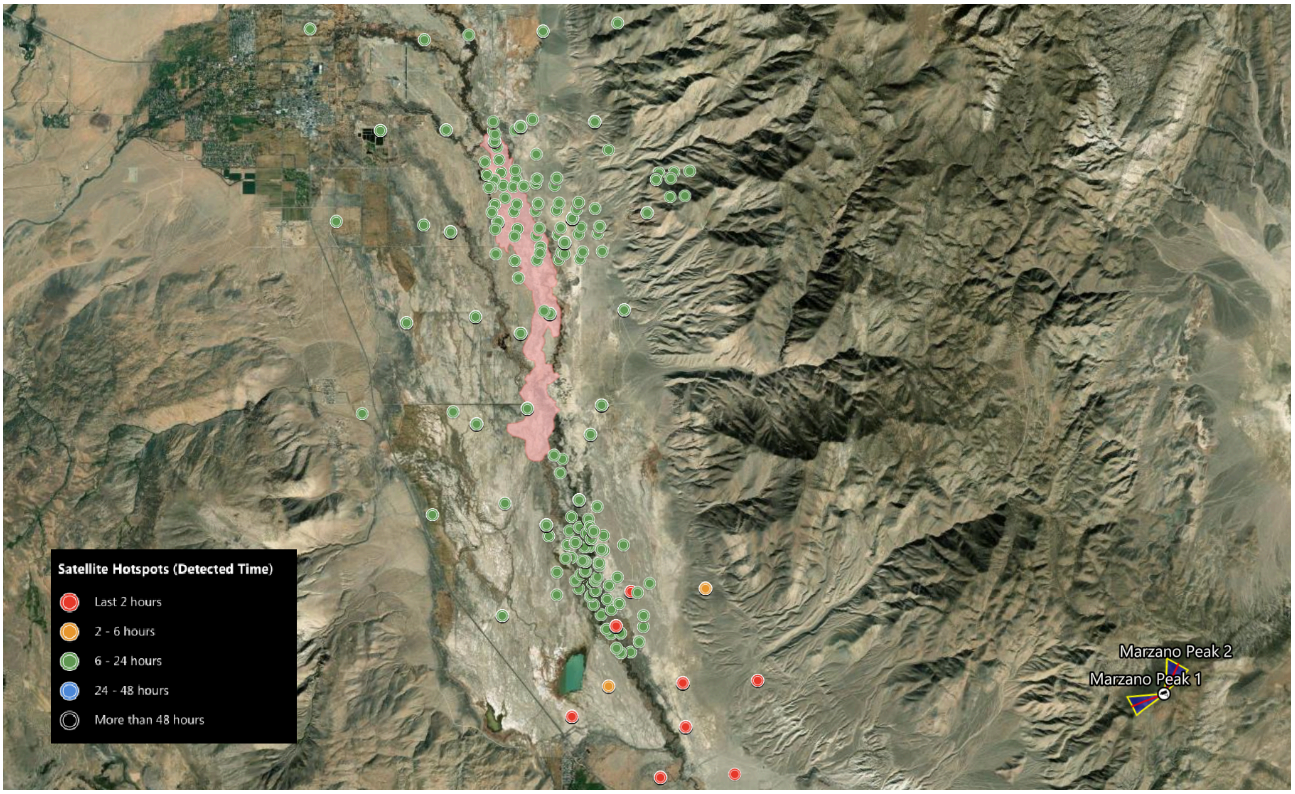
IOUs and agencies are also concerned with non-asset wildfire ignitions and the risk associated with these ignitions due to possible spread and potential impacts. Technosylva has developed proprietary methods for deriving territory wide risk that integrates millions of possible ignition points with wildfire spread modeling to derive standard risk outputs, similar to "asset risk" metrics. These output metrics vary greatly depending on the customer and purpose for using the risk data. The methods and outputs are proprietary.

2.5.7 Fire Activity

The fire activity data used to support operational situational awareness is captured from different sources:

- VIIRS and MODIS Satellite hotspots, from public sources (FIRMS)
- GOES 16 and 17 data based on agreement with providers to the IOUs
- Lighting data also from IOU's providers
- Fire Perimeters from Open Wildfire data from NIFC
- Fire activity from National Guard data from Fire Guard program
- Alert Wildfire Cameras integration

The following figure shows an example of Fire Activity data integrated into the Technosylva WFA system. All data is temporal and displayed color coded based on a selected time from the software timeline.



Hotspots, Fire Perimeters and Alert Wildfire Cameras

2.5.8 Summary of Input Data Sources

The following table presents a summary of the data sources used in the wildfire risk analysis. Some data varies slightly depending on mitigation versus operational use.

DATASET	SPATIAL RESOLUTION (meters)	TEMPORAL RESOLUTION	DATA VINTAGE	SOURCE
Landscape Characteristics				
TERRAIN	10	YEARLY		USGS
SURFACE FUELS	30/10	PRE FIRE SEASON, MONTHLY UPDATE IN FIRE SEASON, END OF FIRE SEASON	2020	TECHNOSYLVA
WUI AND NON FOREST FUELS LAND USE	30/10	TWICE A YEAR	2020	TECHNOSYLVA
CANOPY FUELS (CBD,CH,CC,CBH)	30/10	PRE FIRE SEASON, MONTHLY UPDATE IN FIRE SEASON,	2020	TECHNOSYLVA

DATASET	SPATIAL RESOLUTION (meters)	TEMPORAL RESOLUTION	DATA VINTAGE	SOURCE
		END OF FIRE SEASON		
ROADS NETWORK	30	YEARLY		USGS
HYDROGRAPHY	30	YEARLY		USGS
CROPLANDS	30	YEARLY	1997	USDA
Weather and Atmospheric Data				
WIND SPEED	2000	HOURLY / 124 HOUR FORECAST	1990	ADS/DTN
WIND DIRECTION	2000	HOURLY / 124 HOUR FORECAST	1990	ADS/DTN
WIND GUST	2000	HOURLY / 124 HOUR FORECAST	1990	ADS/DTN
AIR TEMPERATURE	2000	HOURLY / 124 HOUR FORECAST	1990	ADS/DTN
SURFACE PRESSURE	2000	HOURLY / 124 HOUR FORECAST	1990	ADS/DTN
RELATIVE HUMIDITY	2000	HOURLY / 124 HOUR FORECAST	1990	TECHNOSYLVA
PRECIPITATION	2000	HOURLY / 124 HOUR FORECAST	1990	ADS/DTN
RADIATION	2000	HOURLY / 124 HOUR FORECAST	1990	ADS/DTN
WATER VAPOR MIXING RATIO 2m	2000	HOURLY / 124 HOUR FORECAST	1990	ADS/DTN
SNOW ACCUMULATED - OBS	1000	DAILY	2008	NOAA
PRECIPITATION ACCUMULATED - OBS	4000	DAILY	2008	NOAA
BURN SCARS	10	5 DAYS	2000	NASA/ESA
WEATHER OBSERVATIONS DATA	Points	10 MIN	1990	SYNOPTIC
Fuel Moisture				
HERBACEOUS LIVE FUEL MOISTURE	250	DAILY / 5-DAY FORECAST	2000	TECHNOSYLVA

DATASET	SPATIAL RESOLUTION (meters)	TEMPORAL RESOLUTION	DATA VINTAGE	SOURCE
WOODY LIVE FUEL MOISTURE	250	DAILY / 5-DAY FORECAST	2000	TECHNOSYLVA / ADS
1 hr DEAD FM	2000	HOURLY / 124 HOUR FORECAST	1990	TECHNOSYLVA / ADS
10 hr DEAD FM	2000	HOURLY / 124 HOUR FORECAST	1990	TECHNOSYLVA / ADS
100 hr DEAD FM	2000	HOURLY / 124 HOUR FORECAST	1990	TECHNOSYLVA / ADS

DATASET	SPATIAL RESOLUTION (meters)	TEMPORAL RESOLUTION	DATA VINTAGE	SOURCE
Values at Risk				
BUILDINGS	Polygon footprints	YEARLY	2020-21	MICROSOFT/TECHNOSYLVA
DINS	Points	YEARLY	2014-21	CAL FIRE
POPULATION	90	YEARLY	2019	LANDSCAN,ORNL
ROADS	Vector lines	YEARLY	2021	CALTRANS
SOCIAL VULNERABILITY	Plexels	YEARLY	2021	ESRI GEOENRICHMENT SERVICE
FIRE STATIONS	Points	YEARLY	2021	ESRI, USGS
BUILDING LOSS FACTOR	Building footprints	YEARLY	2022	TECHNOSYLVA
CRITICAL FACILITIES	Points	YEARLY	2021	FRAP – CAL FIRE
Potential Ignitions locations				
IOU DISTRIBUTION & TRANSMISSION LINES	Linear segments	Updated quarterly	2022	IOUs
IOU POLES & EQUIPMENT	Points	Updated quarterly	2022	IOUs
Fire Activity				
HOTSPOTS MODIS	1000	TWICE A DAY	2000	NASA
HOTSPOTS VIIRS	375	TWICE A DAY	2014	NASA
HOTSPOTS GOES 16/17	3000	10 MIN	2019	NASA
FIREGUARD	Polygons	15 MIN	2020	NATIONAL GUARD
FIRE SEASON PERIMETERS	Polygons	DAILY	2021	NIFS
HISTORIC FIRE PERIMETERS	Polygons	YEARLY	1900	CAL FIRE
ALERT WILDFIRE CAMERAS	Live Feeds	1 min	Real Time	AWF Consortium
LIGHTING STRIKES	1000	1 MIN	Real Time	EARTH NETWORKS / OTHERS

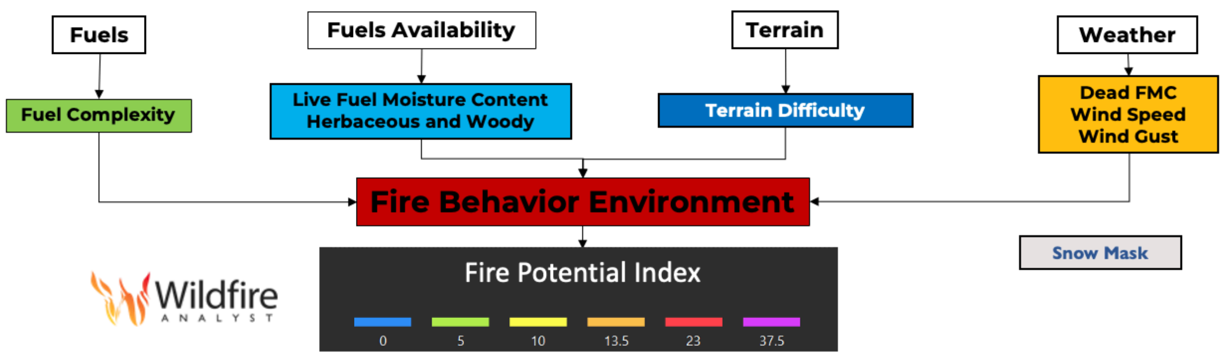
2.5.9 Fire Potential Index (FPI)

FPI quantifies the fire activity potential over the territory aiming to assist operational decision-making to reduce fire threats and risks. FPI allows agencies to easily analyze the short-term fire danger that could exist across the service territory and better communicate the wildfire potential on any given day and time, promoting safe and reliable operations.

Hexel-based (h3) FPI is a forecast product, which is produced on a daily basis, calculated every 3 hours at different h3 resolutions from level 4 to 8 (182 ac and 1km resolution approximately). One of the main advantages of this index is that it was calibrated with real fires (2012 to 2022) using VIIRS hotspots as a proxy of fire activity.

FPI estimates the expected daily number of VIIRS hotspots in a h3-hexel level 6.

FPI comprises several variables including fuels, terrain and weather:



Technosylva has integrated FPI into its operational decision-making WFA enterprise to facilitate its use operationally.

FPI promotes proactive and reactive operational measures through standard operating procedures aiming to reduce the likelihood facilities and assets will be the source of ignition for a fire when FPI is high or extreme.

FPI can be used to inform operation decisions (restrictions on the type of work being performed), as an input to PSPS decision-making and to make risk informed mitigation decisions.

Fire Potential Index products developed for electrical utilities usually include weather data: wind speed, wind gusts, and both dead and live fuel moisture content. Technosylva's FPI also includes the Fuel Complexity (fuel structure, load and age) and Terrain Difficulty. These are key inputs of the classical fire triangle that explain fire behavior.

Technosylva's Fire Potential Index (FPI) has been empirically trained and validated with real fire activity. The product is hexel-based (h3) allowing a better temporal and spatial analysis of outcomes, including the analysis by district or any administrative division.

Liberty Utilities

Phase 2 – Implementation of DIREXYON Suite

1. Table of Content

2. Executive Summary

The DIREXYON Solution specializes in advanced financial modelling and integrated decision support systems, leveraging artificial intelligence to aid asset-intensive industries in capital planning and strategic objectives. DIREXYON has offered asset management, risk management, and financial modelling solutions for over 21 years and is committed to providing end-to-end solutions to its customers. Asset managers, financial officers, project managers, and key decision-makers are provided with asset management capabilities as well as long-term forecasts of possible interventions and investment scenarios through advanced, combinatorial simulation techniques.

Investment scenarios generated by DIREXYON ensure sound resource management, optimized decision-making, and an understanding of risk's impact on desired results. And the volume at which DIREXYON can generate, and process risk-return scenarios is a key differentiator within the asset investment planning space.

DIREXYON's expertise has empowered numerous organizations to lead in risk management and financial optimization. Thanks to the team's diverse expertise in asset management, finance, accounting, IT, modeling, and mathematics, these multidisciplinary strengths foster integration of innovative ideas in IT systems and their application to financial, asset, and risk management fields. With a trusted, international track record, DIREXYON has assisted asset management and capital investments in various sectors, including infrastructure, financial institutions, and power utilities.

Leveraging the use of the DIREXYON Solution, this project is dedicated to developing an advanced fire risk model that seeks to bridge critical gaps in Liberty's risk modeling capabilities. More specifically, it will help Liberty Utilities gain insights and compare the impacts of various fire risk mitigation strategies on key metrics. Our focus is on integrating decision-making policies within existing constraints, emphasizing a comprehensive evaluation of the network's conditions. For this second phase, the following risk mitigation strategies have been configured in the DIREXYON Solution:

1. GO165 Minimum Requirements
2. Liberty Utilities' investment strategy, which includes:
    a. GO165 Minimum Requirements
    b. Bare-to-Covered conductor replacement program
    c. Proactive fuse replacement program

The figure below provides a high-level schematic of the inputs, the modeling components as well as the outputs and insights generated as part of the first phase of the implementation of DIREXYON for Liberty Utilities' distribution assets.

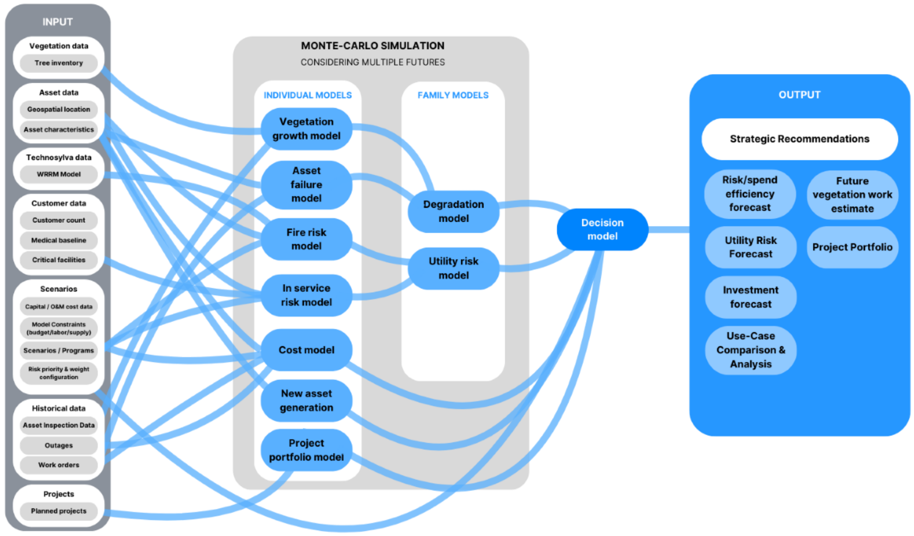


Figure 1. *DIREXYON Schematic for Liberty Utilities Fire Risk Assessment*

The fire risk component of the model constitutes the core of the model. The fire risk assessment integrates multiple factors, including asset related characteristics, equipment ignition, and vegetation contact. Simultaneously, hazard intensity, exposure potential and community vulnerability help provide a comprehensive overview of the network's resilience to fire-related incidents.

Dealing with various uncertainties in real-world scenarios, relying solely on deterministic approaches for predicting asset behavior seems impractical. Deterministic methods claim to pinpoint the exact time of asset failure, which may not align with the inherent unpredictability of real-world situations, where assets can fail before or after the predicted timeframe. Similarly, cost estimation introduces another layer of uncertainty. In contrast, Monte-Carlo simulations represent stochastic approaches capable of forecasting the probabilities associated with multiple potential outcomes for assets. At DIREXYON, our utilization of Monte-Carlo simulations involves calculating a vast array of potential scenarios for asset degradation, cost uncertainties, and other variables, offering a more realistic and robust perspective on the range of possible outcomes.

This approach ensures a thorough examination of scenarios under different configurations, enhancing the robustness of the analysis.

The result of those analysis will show if Liberty's investment approach strategy (use case 2), focusing on more than just meeting the GO165 minimum requirements (use case 1) offer more substantial long-term value by consistently maintaining fire risks at lower levels. By incorporating a variety of mitigation measures such as extensive vegetation management and the proactive replacement of conductors, the strategy realizes a lower and more stable fire risk.

When making strategic decisions, stakeholders must weigh the benefits of upfront investments against long-term operational savings and the overarching goal of risk management. Use Case 3 offers an intriguing balance by potentially reducing the need for future interventions, which could be especially compelling given its implications for risk reduction and enhanced network resilience.

The outcomes empower decision-makers with a comprehensive understanding of network conditions, enabling proactive risk management and informed decision-making for a more resilient and secure energy infrastructure.

3. Project Methodology

From a modeling standpoint, DIREXYON has organized assets hierarchically, wherein each asset type comprises multiple individual assets, each with its dedicated risk, degradation, and decision model.

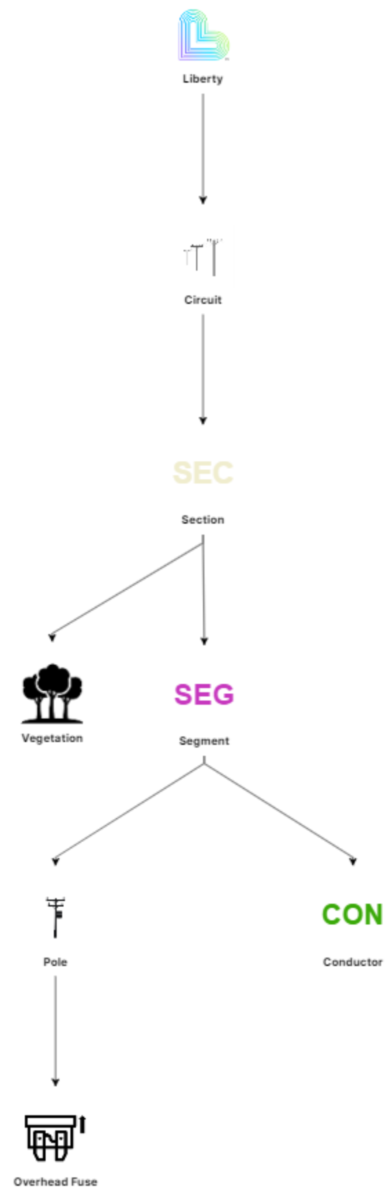


Figure 2. *Overview of Asset Hierarchy in DIREXYON*

3.1 Data Inputs

Direxyon prides itself on data transparency, ensuring that every aspect of our modeling process is clear and accessible. The following is a list of datasets and files provided by the client, broken down by asset hierarchy, which we use to build our comprehensive asset management model:

3.1.1 Liberty – Top-Level

The following inputs are used to build the Liberty top-level asset:

- CA County Boundaries from https://data.ca.gov/dataset/ca-geographic-boundaries
- 2023 spans (conductor data), provided by the client 2023_Spans.shp

A geospatial overlay is performed between the two inputs to identify the counties that intersected with conductor data. The resulting intersecting counties are then dissolved into one polygon.

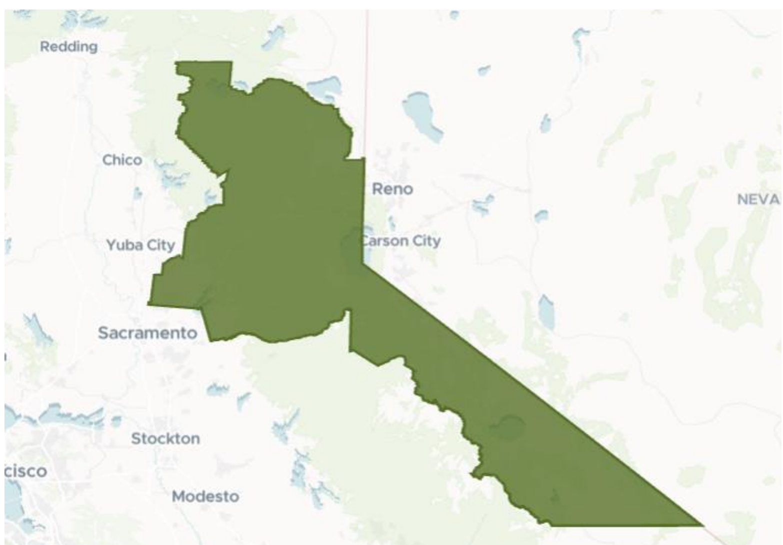


Figure 3. *Liberty Top-Level Polygon in DIREXYON*

No attributes or characteristics are included for this asset.

3.1.2 Circuit

The following inputs are used to build the Circuit asset:

- 2023 spans (conductor data), provided by the client

  2023_Spans.shp

- Customer count by circuit, provided by the client

  Customer_Count.xlsx

- Vegetation inspection cycle data, provided by the client

  VM_Inspection_and_Maintenance_2023.xlsx

  Liberty VM Detailed 3-Year Cycle Schedule

Circuit shapes are generated by dissolving and grouping conductor segments from the same circuit. The figure below provides an example for Circuit CEM41.

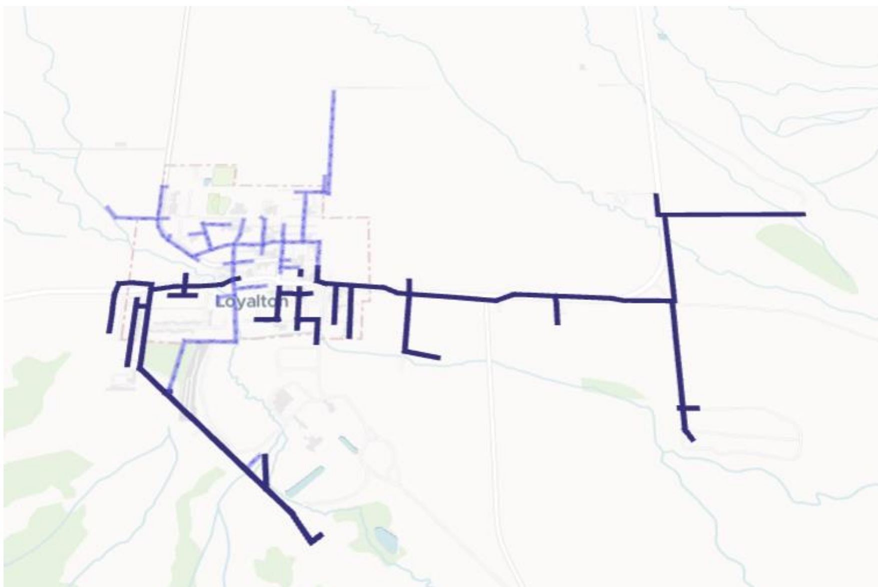


Figure 4. *Circuit CEM41, highlighted in DIREXYON*

The following attributes and characteristics are included for this asset:

Attribute Name	Description	Source
Circuit	Circuit name	2023_Spans
Customer Count	Number of customers	Customer_Count
Medical Baseline	Number of medical baseline customers	Customer_Count
Critical Facilities	Number of critical facilities	Customer_Count
Insp_Cycle_Year	Cycle schedule for inspections (years)	Liberty VM Detailed 3-Year Cycle Schedule
Maint_Cycle_Year	Cycle schedule for maintenance (years)	Liberty VM Detailed 3-Year Cycle Schedule
Last_Detailed_Inspection_Year_Veg	Last year a detailed inspection was performed	VM_Inspections_and_Maintenance_2023
Voltage	Mode voltage	2023_Spans

3.1.3 Section

The following inputs are used to build the Section asset:

- 2023 spans (conductor data), provided by the client

  2023_Spans.shp

- Zone range mapping file, provided by the client

  Vegetation_Zone_Buffers_By_Voltage.xlsx

Circuits are broken into sections and each section shapes are generated using a 200-foot buffer around the circuit segments. The resulting shapes are then dissolved to avoid overlaps. The figure below provides an example for Section 1 of Circuit CEM41.

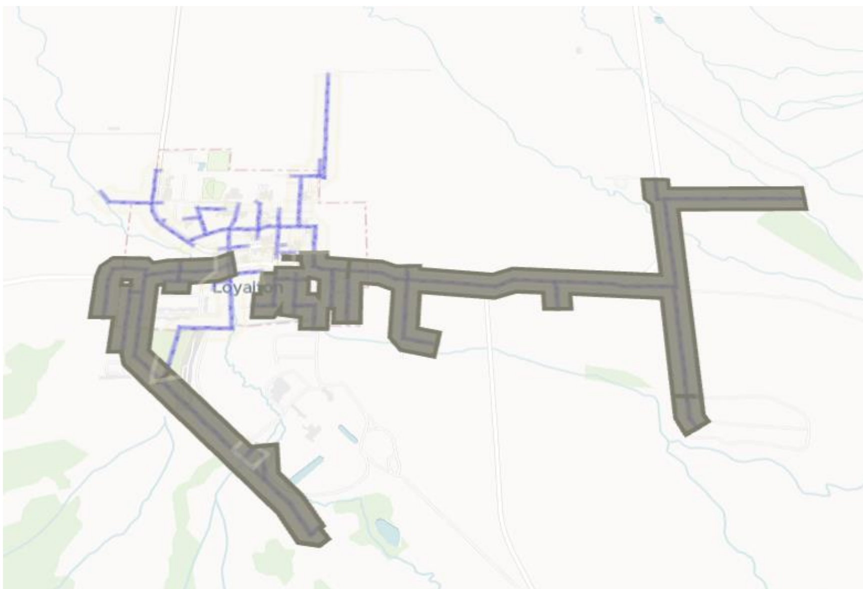


Figure 5. *Section 1 of Circuit CEM41, highlighted in DIREXYON*

No attributes or characteristics are included for this asset.

3.1.4 Vegetation

The following inputs are used to build the Vegetation asset:

- 2023 spans (conductor data), provided by the client

  2023_Spans.shp

- Zone range mapping file, provided by the client

  Vegetation_Zone_Buffers_By_Voltage.xlsx

- 2023 Structures, provided by the client

  2023_Structures.gdb

- 2021 Treetop inventory data, provided by the client

  2021 Treetop Inventory.gdb

The vegetation asset is broken into four (4) zones per section. Each zone is generated using the following buffer parameters:

Zone	Group	Buffer
1	Distribution	10
2	Distribution	50
3	Distribution	100
4	Distribution	200
1	Transmission	20
2	Transmission	50
3	Transmission	100
4	Transmission	200

The resulting shapes are dissolved to avoid overlaps. The figure below provides an example for a Zone 4 for Section 1 of Circuit CEM41.

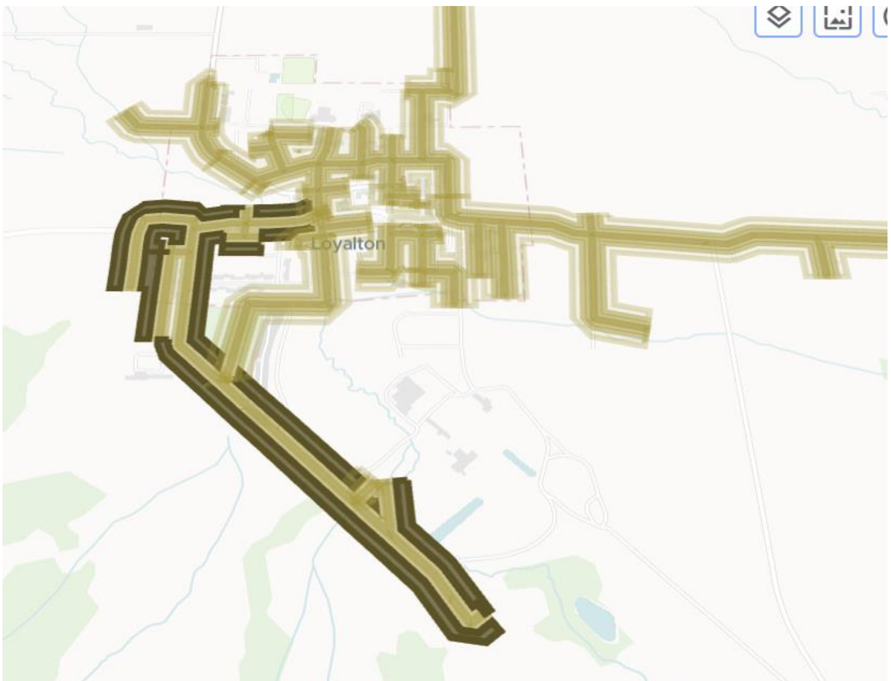


Figure 6. *A Zone-4 for Section 1 of Circuit CEM41, highlighted in DIREXYON*

The following attributes and characteristics are included for this asset:

Attribute Name	Description	Source
num_structures	Number of structures	2023_Structures
zone	Zone number	ETL process
segment_length_mi	Sum of segment length, in miles	ETL process
zone_area_sq_mi	Surface area of zone, in square miles	ETL process

3.1.5 Segment

The following inputs are used to build the Segment asset:

- Segment-level risk data, provided by Technosylva

  ConditionalRisk.shp

  POI_stats.shp

  POF_stats.shp

The figure below provides an example of a Segment in Circuit CEM41

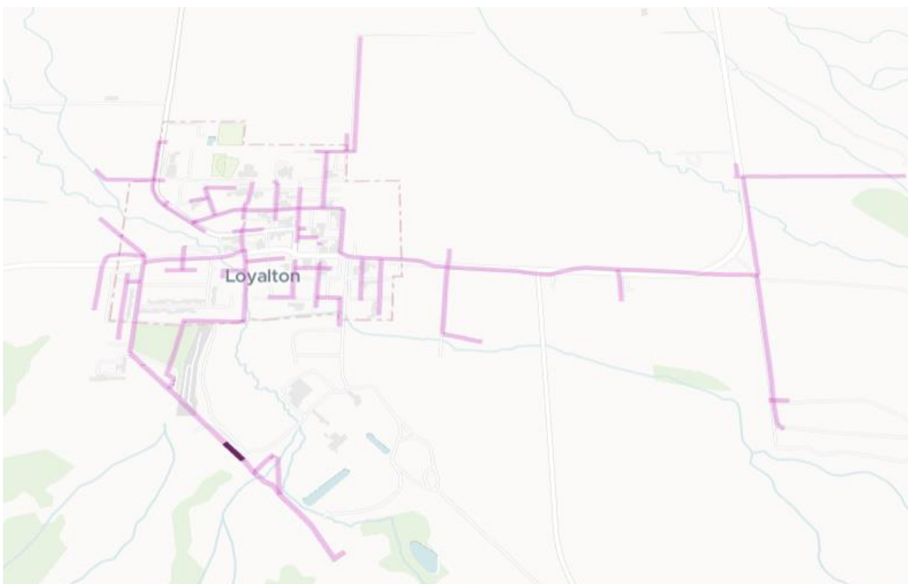


Figure 7. *A segment in Circuit CEM41, highlighted in DIREXYON*

The following attributes and characteristics are included for this asset:

Attribute Name	Description	Source
cAcrPer#	Conditional percentile acres burned	ConditionalRisk.shp
cBldPer#	Conditional percentile buildings impact	ConditionalRisk.shp
cBldDes#	Conditional percentile buildings destroyed	ConditionalRisk.shp
cFBIPer#	Conditional percentile fire behavior index	ConditionalRisk.shp
cPopPer#	Conditional percentile population impact	ConditionalRisk.shp
cFlPer#	Conditional percentile flame length	ConditionalRisk.shp
cRosPer#	Conditiona percentile rate of spread	ConditionalRisk.shp
POI#	Conditional percentile probability of ignition	POI_stats.shp
POF#	Conditional percentile probability of fire	POF_stats.shp

The # symbol represents the percentile ranges available in the dataset: 0, 20, 40, 50, 60, 80, 90, 95, 98, and 100.

3.1.6 Conductor

The following inputs are used to build the conductor asset:

- Conductor data, provided by the client

  Conductor_verification_20240307.geojson

The figure below provides an example of a conductor asset in Circuit CEM41

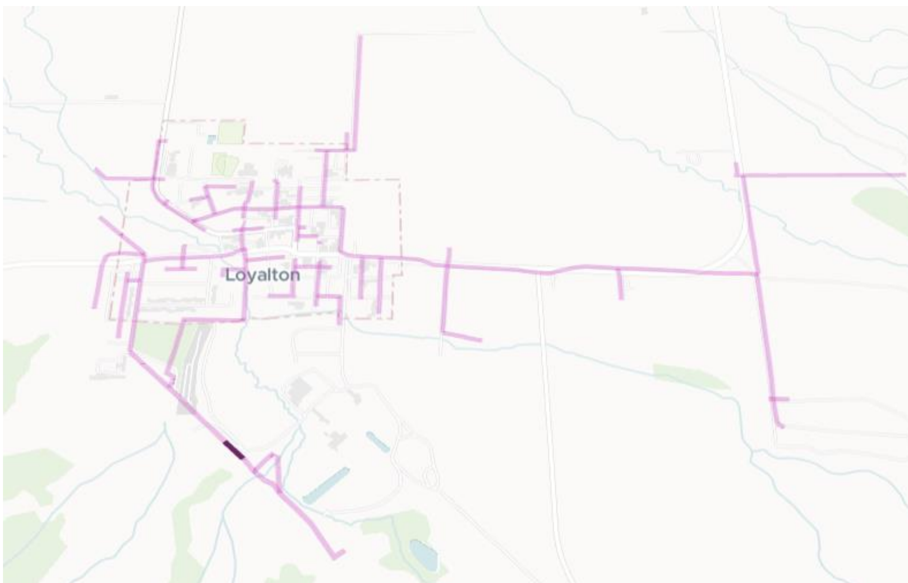


Figure 8. *A conductor in Circuit CEM41, highlighted in DIREXYON*

The following attributes and characteristics are included for this asset:

Attribute Name	Description	Source
wire_length_ft	wire length, in feet	conductor_verification_20240307.geojson
wire_size	wire size	conductor_verification_20240307.geojson
wire_material	wire material	conductor_verification_20240307.geojson
wire_type	wire type	conductor_verification_20240307.geojson
covered	covered (True/False)	conductor_verification_20240307.geojson

3.1.7 Pole

The following inputs are used to build the pole asset:

- Pole data, provided by the client

Pole_Export_20231218.gdb

- Pole inspection data, provided by the client

  2020 to 2023 Pole Inspections.csv

  Detailed_inspections_202401050845.csv

  Patrol_inspections_20240105.csv

The figure below provides an example of a pole asset in Circuit CEM41

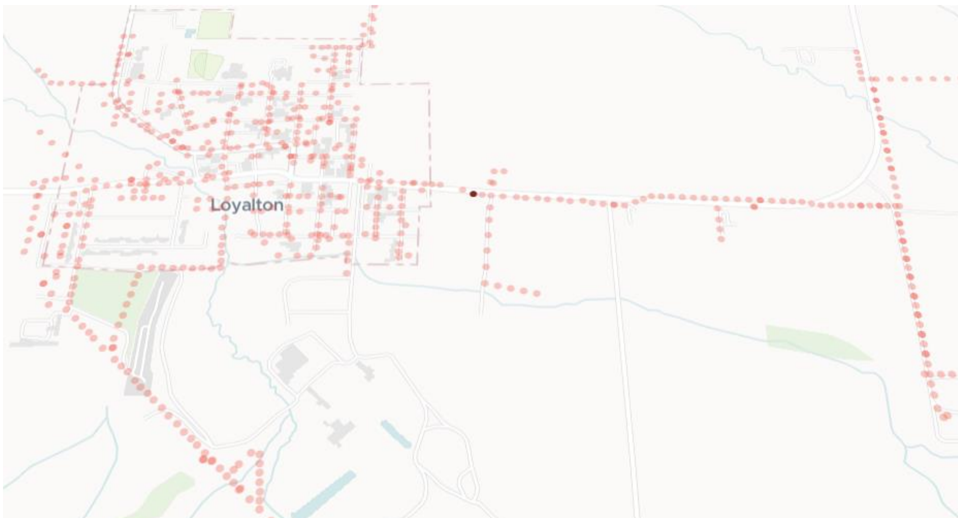


Figure 9. *A pole in Circuit CEM41, highlighted in DIREXYON*

The following attributes and characteristics are included for this asset:

Attribute Name	Description	Source
installdate	Installation date	Pole_Export_20231218.gdb
material	Material	Pole_Export_20231218.gdb
height	Height	Pole_Export_20231218.gdb
numdevices	Number of devices on pole	Pole_Export_20231218.gdb
active	Active (True/False)	Pole_Export_20231218.gdb
oh_transformer_installyear	Installation year of overhead transformer on pole	Pole_Export_20231218.gdb
poleclass	Pole class	Pole_Export_20231218.gdb
intinsp_inspect_dt	Last intrusive inspection date	intrusive_inspections.csv
detinsp_inspection_date	Last detailed inspection date	detailed_inspections_202401050845.csv
patrol_inspection_year	Last patroled inspection year	patrol_inspections_20240105.csv

3.1.8 Overhead Fuse

The following inputs are used to build the overhead fuse asset:

- Fuse data, provided by the client

  Fulcrom_GIS_Fuses_20231107.gdb

The figure below provides an example of a fuse asset in Circuit CEM41

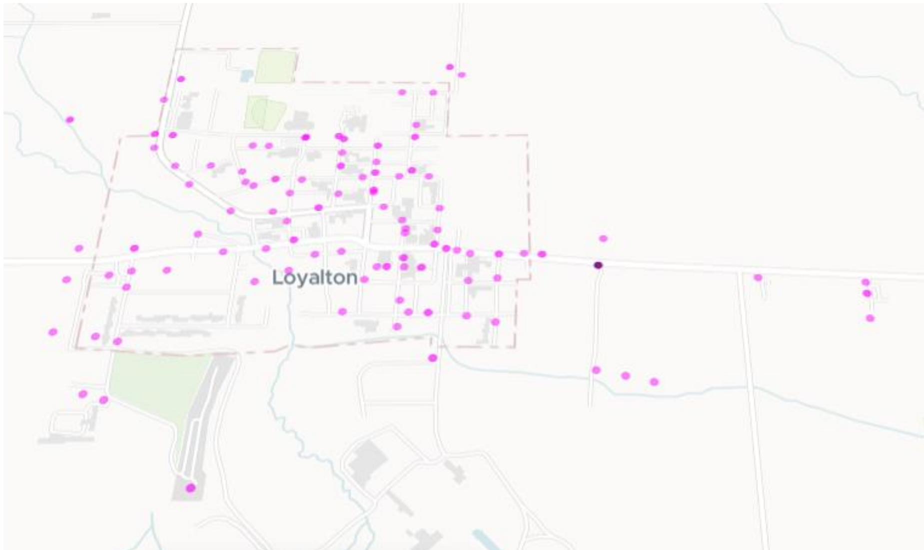


Figure 10. *A fuse in Circuit CEM41, highlighted in DIREXYON*

The following attributes and characteristics are included for this asset:

Attribute Name	Description	Source
installdate	Installation date	Fulcrom_GIS_Fuses_20231107.gdb
luefusesize	Fuse size	Fulcrom_GIS_Fuses_20231107.gdb
fusetype	Fuse type	Fulcrom_GIS_Fuses_20231107.gdb
polenumber	Pole number where fuse is attached	Fulcrom_GIS_Fuses_20231107.gdb

4. Mitigation Strategies

Liberty Utilities aims to compare various mitigation strategies using the Direxyon Solution to maximize Risk/Spent Efficiency (RSE). This involves determining which strategies achieve the highest risk reduction while minimizing expenditure. The stochastic approach provided by Monte Carlo simulations allows for multiple outcome analyses, using both average and extreme values to compare results while considering risk tolerance.

Liberty Utilities wishes to assess the impact of the following mitigation strategies, while satisfying the minimum requirements of GO.165 with added measures:

- **Proactive Replacement of Fuses**
- **Proactive Conductor Covering Strategies**
- **Implementation of Vegetation Management Strategies**

4.1 Proactive Replacement of Fuses

According to discussions with the engineering and risk teams from Liberty Utilities, some fuse types are inherently riskier than others. Currently, when a fuse fails or whenever a pole is replaced, the corresponding fuse is replaced with an ELF current limiting dropout fuse (referred to as ELF Fuse). Liberty wishes to study the impact of proactively replacing riskier fuses (T Link, Fault Tamer, Expulsion, Unknown) with ELF fuses, given a configurable proactive replacement yearly budget (set as a default placeholder value of $1,000,000).

4.2 Proactive Conductor Covering Strategies

Liberty Utilities currently replaces overhead conductors in case of engineering failure, using modern materials and modern conductor types (e.g., replacing solid copper conductors with stranded aluminum conductors). Due to the known fire risk reduction capabilities of conductor covering programs, Liberty wishes to study the impact of proactively covering bare overhead conductors to determine whether the significant investment is justified in terms of RSE.

4.3 Implementation of Vegetation Management Strategies

Vegetation growth is known as one of the main wildfire risk drivers. [8] Liberty Utilities wishes to see how implementing vegetation management strategies, harsher than those suggested by GO165, would affect wildfire risk related to their electric network and consequently how this would affect its RSE. [5]

For vegetation management, Liberty aims to understand the impact of increased inspections. More inspections lead to more work (hauling, hazard tree mitigation, pruning), which reduces the number of trees (density) and the number of trees in riskier fall-in and grow-in zones. Although this reduces risk, lower vegetation grows faster, necessitating a balance. [3]

By analyzing these strategies, Liberty Utilities seeks to optimize their mitigation efforts, ensuring the most efficient use of resources to enhance safety and reliability.

5. Risk Model

At the heart of this model lies the concept of risk, embodying adverse events, specifically fire incidents in this context. The current approach calculates risk by multiplying the probability of these adverse events by their potential consequences. Put simply, probability reflects the likelihood of these events happening, while consequence details the potential impact if the event does occur. The following chart summarizes the risk model:

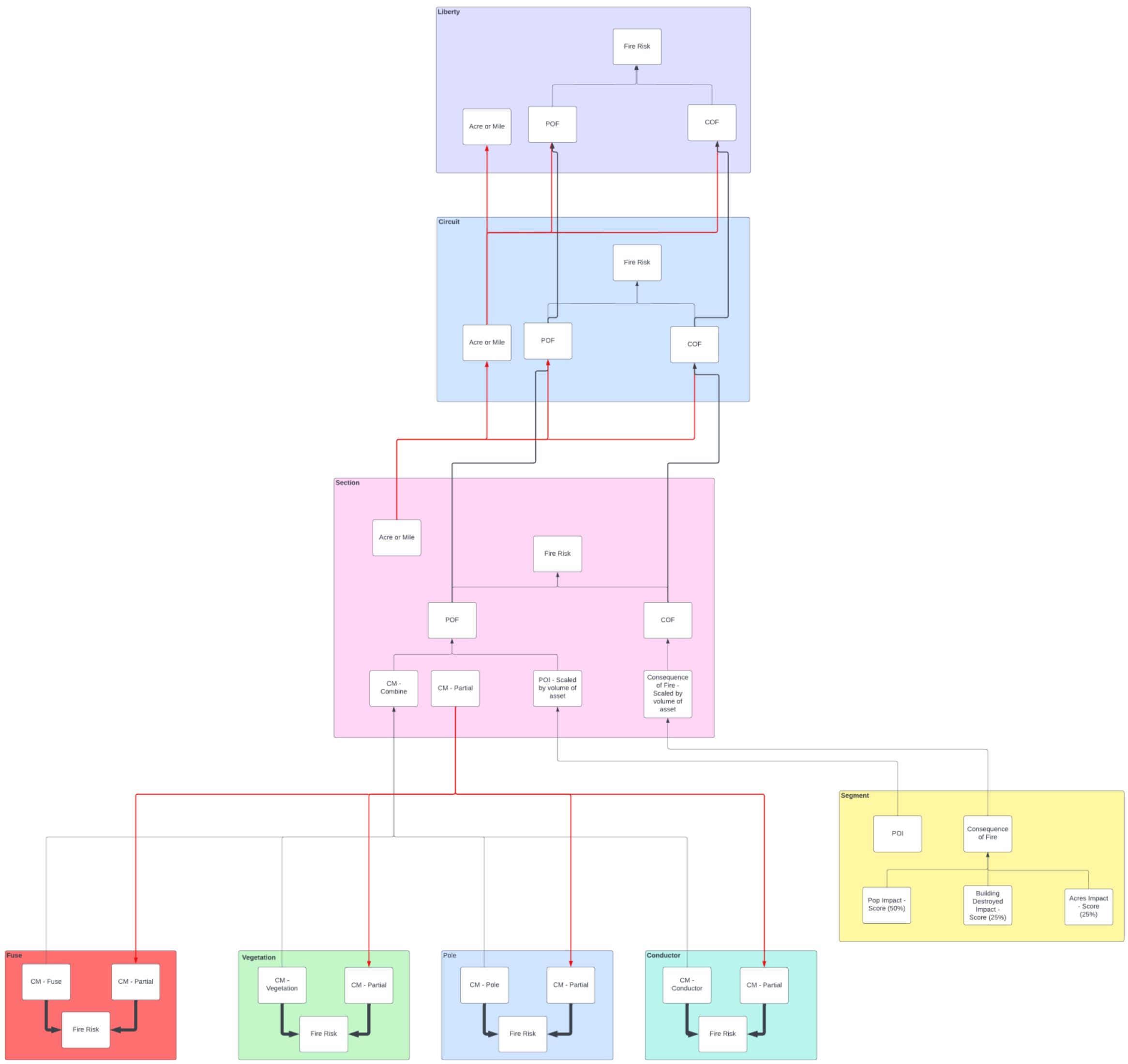


Figure 11. *Overview of the Risk Framework for Liberty Utilities in DIREXYON*

5.1 Utility Risk

Utility risk is encapsulated by the **average fire risk at the individual asset level** and the **calculated In-Service risk at the circuit level**. In collaboration with subject matter experts, it was determined with Liberty to initially allocate 50% weight to each component. This weighting is configurable and can be easily adjusted during the simulation process. The attached screenshot represents the utility risk calculations at the circuit level.

Asset Value Information for Period 2024

Characteristic [Overall Risk] calculation
End of Step

5 x 2 = 10

PoF - Overall x CoF Overall = Overall Risk

Characteristic [PoF - Overall] calculation
End of Step

ceil((0,5 x 1) + (0,5 x 9)) = 5

ceil((In-Service Risk Ratio - Old x Probability of Failure - Score) + (Fire Risk Ratio - Old x Probability of Fire - Score)) = PoF - Overall

5.2 Fire Risk

The DIREXYON Solution computes fire risk at the individual asset level, and the cumulative risk at each level contributes to the overall fire risk assessment of the entire network. Each individual asset type's fire risk comprises two components: the **probability of fire** and the **consequence of fire**, as explained below:

Asset Value Information for Period 2024

Characteristic [Fire - Risk] calculation
End of Step

9 x 1 = 9

Probability of Fire - Score x Consequence of Fire = Fire - Risk

Characteristic [Probability of Fire - Score] calculation
End of Step

min(flr(exp(2,106 x ln(10) ÷ 0,00975184));9) = 9

min(flr(exp(POI x ln(10) ÷ 0,00975184));9) = Probability of Fire - Score

5.2.1 Probability of Fire

The probability of fire gauges the likelihood of fire ignition specific to each asset type. It is calculated as the product of the Technosylva-calculated Probability of Ignition (POI) and XY condition modifiers (CMs). The attached screenshot represents the probability of fire risk calculations along with overall CM calculations for poles.

Asset Value Information for Period 2024

Characteristic [Probability of Fire - Score] calculation
End of Step

min(flr(exp(**2,106** x ln(10) ÷ 0,00975184));9) = 9

min(flr(exp(*POI* x ln(10) ÷ 0,00975184));9) = *Probability of Fire - Score*

Characteristic [POI] calculation
End of Step

2,755 x **0,7644** = 2,106

SEC - POI x ***CM - Final*** = *POI*

Characteristic [CM - Final] calculation
End of Step

0,5144 + 1 x 0,25 = 0,7644

SEC - Partial CM - Pole + *CM - Partial Only Pole* x *SEC - CM - Pole Weight* = *CM - Final*

5.2.2 XY Condition modifiers

Condition modifiers in the model illustrate the impact of asset characteristics and specific interventions on the calculated Probability of Ignition (POI) by Technosylva. Technosylva provides metrics on the initial state of the simulation, which do not account for subsequent changes made to the assets. For example, when a bare conductor is replaced with a covered conductor, the initial Technosylva value for that specific asset will no longer accurately represent the POI or the different consequences of a wildfire. Therefore, the condition modifiers represent the difference between the characteristics at the initial state of the simulation and their current value (i.e. the delta of the characteristics).

Each condition modifier ranges from 0 to 4, meaning they can either reduce the risk of a current asset to 0 (a rare instance) or increase it by up to 200%. The final condition modifier for each asset is computed by the weighted sum as shown below:

$$CM - Final = W_1 \cdot CM_1 + W_2 \cdot CM_2 + \ldots + W_n \cdot CM_n\,,$$

where CM_i and $W_i \in \{1,2,3,..,n\}$ represent the i^{th} condition modifier and its corresponding weight such that $W_1 + W_2 + \ldots + W_n = 1$. The following condition modifiers are defined at the individual asset level as detailed below:

Conductor Condition Modifiers

Conductor Material

This modifier assesses the effect of conductor material (e.g., copper or other materials) on overall fire risk. Notably, copper conductors are associated with a higher probability of igniting a fire. Consequently, substituting copper conductors with non-copper materials reduces the fire risk by 50%, while replacing non-copper materials with copper increases the risk by 100%. Please note that these percentage values are placeholders in the model and need to be adjusted with further insights from subject matter experts.

This nuanced approach enables users to quantify the potential risk mitigation or escalation associated with changes in conductor types.

Conductor Covering

This condition modifier delineates the effects of bare conductors versus covered conductors. Transitioning from bare (uncovered) to covered conductors significantly diminishes the associated fire risk. Implementing coverings on previously uncovered conductors results in a 50% reduction in fire risk. Conversely, replacing a covered conductor with a bare conductor (due to budget restrictions or inventory issues) would result in a 100% increase in fire risk. These percentage values - derived from studies by Brave et al. and Southern California Edison - serve as placeholders in the model. [2,3,5] With further insights from the client and access to historical events correlated with conductor types, adjustments can be made for a more accurate assessment.

Conductor type

This condition modifier delineates the effects of various conductor types, specifically comparing stranded and solid variants. Transitioning from solid to stranded conductors significantly reduces the associated fire risk. Consequently, implementing this change on solid conductors results in a 50% reduction in fire risk. As solid conductors represent an older technology, new conductors should not be installed in this state, and there are no situations where a conductor replacement would lead to a change from stranded to solid. Note that this percentage reduction in risk serves as a placeholder in the model. With further insights from the client and access to historical events correlated with conductor types, adjustments can be made for a more accurate assessment.

Pole Condition Modifiers

Transformer Failure

A pole linked to high-risk equipment, such as a transformer, inherently carries an elevated fire risk. This condition modifier encapsulates the effect of transformer degradation, calculated using its age as the main failure driver. For any pole without a transformer, the condition modifier should not impact the fire risk, resulting in a value of one (1). For poles with one or more transformers (with an observed maximum of four transformers), the condition modifier (CM) is calculated using the following formula:

$$CM = \exp\left(TransformerAge \cdot \left(\ln(2) \right) / \max\left(1 ; MaxTransformerAge \right) \right)$$

where Max Transformer Age is the maximum observed age in the asset network. This calculation allows the CM to increase the fire risk by up to 100% if the pole has a transformer that is the same age as the oldest transformer in the network. This approach provides a comprehensive assessment of the associated risk for a given pole.

Fuse Condition Modifiers

Fuse Failure

This modifier adjusts the fire risk based on the probability of fuse failure. If a fuse is already noted to have failed, there is a 100% increase in fire risk. Conversely, if the fuse has not yet failed, its probability of failure is observed and used to calculate the increase in fire risk, ranging from 0% to 100%. This calculation is based on the following equation:

$$CM = \exp (ProbabilityOfFuseFailure \cdot (\ln (2)))$$

This nuanced approach enables users to quantify the potential risk mitigation or escalation associated with the degradation of fuses. Please note that these percentage values are placeholders in the model and need to be adjusted with further insights from subject matter experts.

Fuse Type

Three different levels of risk were discussed with Liberty regarding the type of fuses present in their asset network. These categories are as follows: the safest (ELF and Solid Blades), the moderate (Fault Tamer and T-Link), and the riskiest fuses (Expulsion and Other). It's important to note that fuses labeled as 'Other' are considered the riskiest type due to uncertainty. If their type is not properly identified, they are assumed to pose the highest level of risk.

Transitioning from one fuse category to another, while changing or upgrading the fuse on a pole, will correspondingly alter the fire risk values of the asset and its neighbors. Transitioning from a risky fuse to a moderate one will reduce fire risk by 50%, and similarly, moving from moderate to safest will also reduce the fire risk by 50%. Consequently, going from the riskiest to the safest fuse type would decrease the fire risk to 25% of its original value. Conversely, downgrading the quality of fuses by moving from a safe fuse to a riskier one would result in a 100% increase in fire risk (safest to moderate or moderate to riskiest) or a 200% increase (safest to riskiest), depending on the final fuse type.

These percentage values serve as placeholders in the model. With further insights from the client and access to historical events correlated with conductor types, adjustments can be made for a more accurate assessment.

Vegetation Condition Modifiers

Vegetation is incorporated into the model as an integral part of the other asset types. The likelihood of fire caused by vegetation varies based on the state of trees—whether they have fall-in potential, grow-in potential, or the overall tree density. Given that vegetation interacts complexly with other components of the model, some calculations are made at different asset levels and aggregated before being passed to another asset.

Initially, the tree density condition modifier (CM) is calculated at the segment level and then aggregated to the vegetation asset level, as density needs to account for an area. Additionally, since vegetation directly impacts conductors, poles, and fuses—but does not have a one-to-one relationship with any specific asset (i.e., no trees are directly linked to a specific asset nor within a parent-child relationship)—the condition modifiers for vegetation are aggregated at the Section asset level and then propagated to the relevant child assets.

Please note that the condition modifiers values discussed below are placeholders in the model and need to be adjusted with further insights from subject matter experts.

Fall-In

Data for this metric is sourced from an ESRI Shapefile provided by the client and is calculated based on tree height and the potential distance by which a tree overstrikes an equipment. Fall-In zones are defined depending on the minimum height required for a tree to impact an asset. These zones are outlined by regulations and help manage both the vegetation management work to be done but also let's one track the vegetation growth and thus quantify its impact on risk.

The fall-in vegetation states are classified into Zone 1, Zone 2, Zone 3, Zone 4, or NA. Zone 1 represents the riskiest case where vegetation work needs to be done as soon as possible. Conversely, Zone 4 represents vegetation that is deemed safe, while NA indicates that no vegetation can be found (i.e., some work was done, and all vegetation was cut). The condition modifier values, detailed in Appendix 1A, range from a reduction of risk to 0% of its original value to a 200% risk increase.

Grow-In

Like the Fall-In condition modifier, the Grow-In metric relies on an ESRI Shapefile provided by the client, representing the likelihood of tree branches growing into power lines and causing fires. Grow-In zones are defined based on the minimum height required for vegetation to come into contact with one of Liberty Utilities' assets. These zones are outlined by regulations and the client's vegetation management team. Qualifying the vegetation asset in terms of grow-in zones helps manage both the vegetation management work to be done and allows tracking of vegetation growth, thereby quantifying its impact on risk.

The grow-in vegetation states are classified into Zone 1, Zone 2, Zone 3, Zone 4, or NA. Zone 1 represents the riskiest case where vegetation work needs to be done as soon as possible. Conversely, Zone 4 represents vegetation that is deemed safe, while NA indicates that no vegetation can be found (i.e., some work was done, and all vegetation was cut). The condition modifier values, detailed in *Appendix 1A*, range from a reduction of risk to 0% of its original value to a 200% risk increase.

Tree Density

Data for this metric comes from a combination of LiDAR data from a vegetation management data partner, and work orders provided by Liberty Utilities. Tree density is calculated at the segment asset level and then brought down to the vegetation level to calculate the final vegetation condition modifier. It is calculated at the segment level because individual trees cannot represent a density without an area. By aggregating vegetation data on a parent asset, the tree density can be modeled.

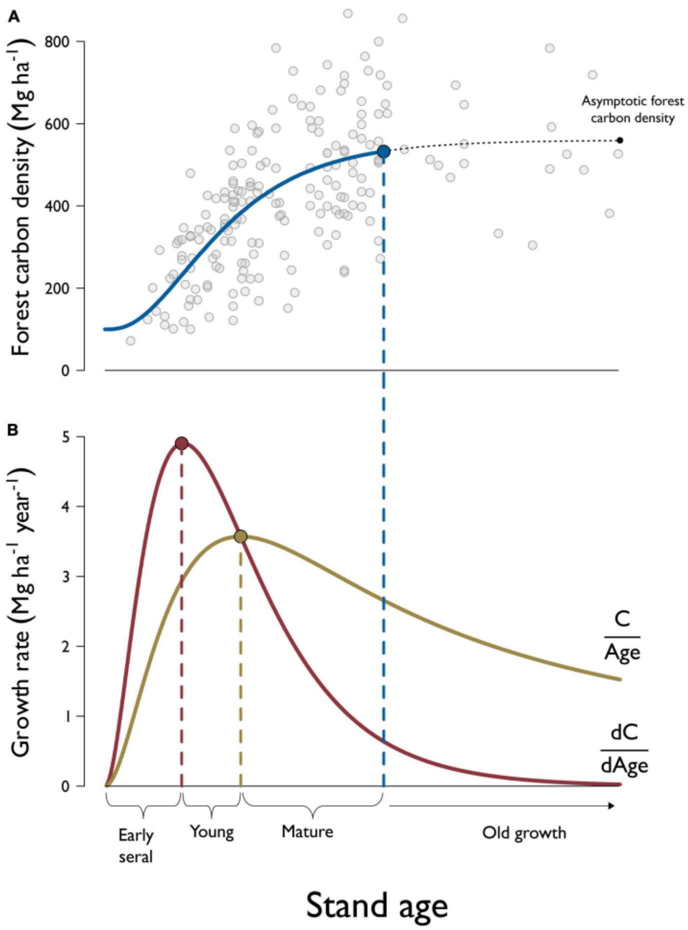


Figure 12. *Analysis of forest growth rate and carbon density based on Bernett et al. (2023).* **Panel (A)** features a scatterplot illustrating the relationship between forest carbon density—encompassing both live and dead components—and stand age. The forest carbon accumulation is estimated using a modified Chapman-Richards function. [3] **Panel (B)** shows the rate of forest carbon accumulation over time, termed the "periodic carbon increment," derived from the accumulation curve. This panel also includes the "average carbon increment" curve, calculated by dividing the total forest carbon by the stand age at each time point. This curve is utilized to model the density growth of the vegetation asset type at the section level.

Tree density fluctuates between three categories: Low, Medium, and High density. It is modeled according to growth patterns studied by Barnett et al. (2023). When transitioning from an initial tree density classified as low to medium density, or from medium to high density, the condition modifier applies a 150% increase in risk. Additionally, when transitioning from low to high density, the risk increases by 200%. Conversely, when transitioning from high to low density, the risk becomes 25% of what it originally was, and when transitioning from high to medium density (or medium to low density), the risk becomes 50% of its original value.

5.2.3 Fire Risk

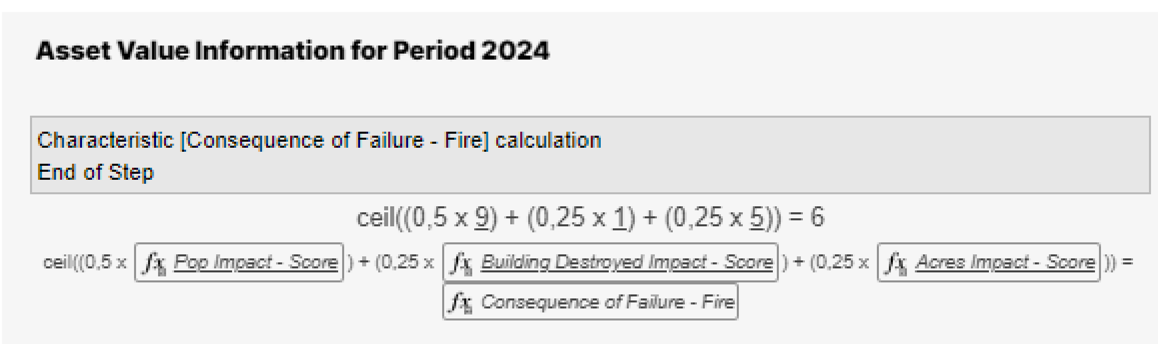
Technosylva weather sampling

Technosylva provides metrics in the form of data points, per percentile brackets, per asset. These percentiles represent the quality of the weather on a given day in a year. A zero-percentile value represents the most optimistic weather conditions regarding wildfire risks (low temperature, low wind, high humidity, etc.), whereas a 98th-percentile value represents the most pessimistic weather conditions (high temperature, high wind, low humidity, etc.). Since two assets in the same segment should experience similar weather conditions on any given day, Technosylva weather sampling (i.e., sampling a percentile value quantifying the weather for certain metrics) is conducted at the segment asset level.

Four configurations are available when running a simulation: "Best Case (10th)", "Average Case (50th)", and "Worst Case (90th)". Each configuration represents the percentile that the simulation will use to determine various Technosylva metrics used for calculating the consequence of fire (population impact, buildings destroyed, and acres burned) and the probability of fire (POI). An additional scenario labelled “Random” can also be used when launching a simulation. It samples a new value from a zero-one distribution on every period of the simulation.

Consequence of Fire

The consequence of fire values define the impact of fire on population, buildings destroyed, and acres burned. These values, determined by **Technosylva at the segment level**, remain constant across all asset types within the same segment. The mentioned consequences are grouped into safety, environmental, and finance impact with **user-defined weights.** Those weights can be easily adjusted upon running the simulation. The attached screenshot represents the calculated consequence of fire in segment level based on Technosylva data and configurable weights:



Calculating the fire risk using the adjusted probability of fire

Fire risk will be calculated at the Section asset level and then aggregated to the Circuit and Liberty asset levels for executive and decision-making purposes. To accurately compute risk in a section, the condition modifiers of all child assets are required. Pole and fuse data will be aggregated to this level using the average of all condition modifiers. In contrast, vegetation and conductor data will be aggregated by a weighted sum, using acres and span length, to emphasize asset size and density.

Subsequently, the Probability of Ignition (POI) and Consequence of Fire (COF) are aggregated using a weighted average (weighted by length) from the segment level, where the Technosylva data is imported.

Four partial Probabilities of Fire (POFs) will be created using CM_x as the condition modifier for x assets and W_x for the configurable weight for x assets:

- POF
  - $((W_v \bullet CM_v + W_p \bullet CM_p + W_f \bullet CM_f + W_c \bullet CM_c) * POI)$
- Partial POF – Conductor
  - $((W_v \bullet CM_v + W_p \bullet CM_p + W_f \bullet CM_f) \bullet POI)$
- Partial POF – Fuse
  - $((W_v \bullet CM_v + W_p \bullet CM_p + W_c \bullet CM_c) \bullet POI)$
- Partial POF – Pole
  - $((W_v \bullet CM_v + W_f \bullet CM_f + W_c \bullet CM_c) \bullet POI)$

All these POF will be used to compute the fire risk following the next formula:

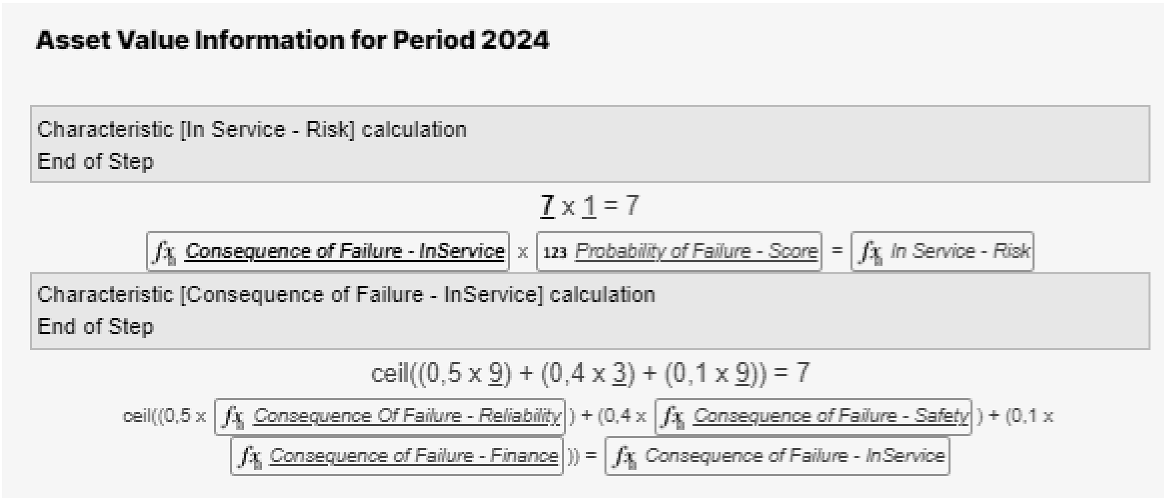
Fire Risk = POF • COF

POF and COF will be utilized as they are at the Section asset level and will be aggregated by weighted average (by miles or acres) to the Circuit and Liberty asset levels.

The partial POFs will help the user assess the risk of an asset type while considering the surrounding assets. When examining the individual asset risk level, the user will see the risk of the weighted section. However, if focusing only on the pole, the CM_p represents the condition modifier of that unique pole. This principle will be beneficial in the geographical views generated by the BI dashboard. When viewing the map widgets, users will be able to differentiate between sections and circuits without being overwhelmed by individual asset details. Additionally, when examining a specific asset, users will be able to identify which factors most significantly influence the fire risk for that asset.

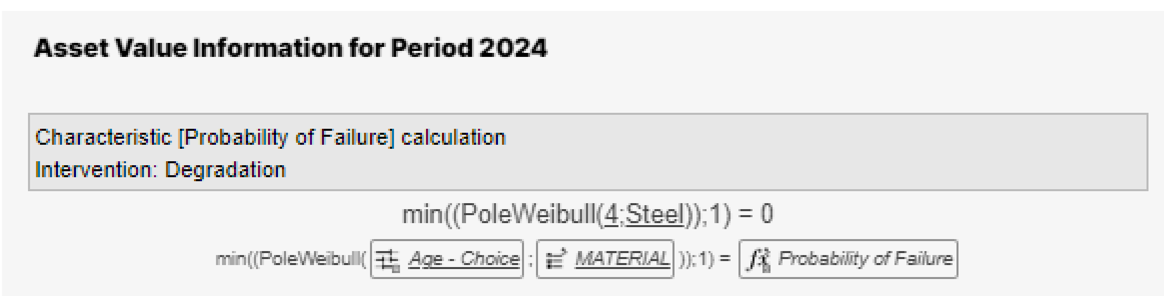
5.2.4 In-Service Risk

The DIREXYON suite computes In-Service risk at the **circuit level**, and the cumulative risk at circuit level contributes to the overall utility risk of the network. Similar to the fire risk, In Service risk comprises two components: probability of Failure and consequence of Failure, explained below:



Probability of Asset Failure

To compute the In-Service Risk, one must consider the probability of asset failure (or probability of engineering failure). Since the Pole asset is the only asset type with an age-based degradation, it is considered to be the main driver of the In-Service Risk's probability component. Based on a probability of failure, which is derived from a Weibull distribution with age and material dimensions, a probability score ranging from 1 to 9 is calculated.



In Service Consequence

In-Service Consequence values outline the repercussions of Engineering Asset Failures across distinct categories, including reliability, safety, and finance. These consequence components have been defined with customizable weights that can be easily adjusted during the simulation. Each of these categories is calculated using a weighted sum of Technosylva metrics based on the sampled weather trend used in wildfire risk calculations.

Reliability

The reliability component of the In-Service Risk is based on three main subcomponents: customer count, critical infrastructure count, and medical facility count.

1. **Customer Count:** Represents an estimate of impacted customers in the event of an outage or wildfire.
2. **Critical Infrastructure Count:** Represents the estimated impact on facilities and structures that would have critical customers' liability.
3. **Medical Facility Count:** Represents the estimated impact on medical facilities.

The weights of these subcomponents have been established through discussions with Liberty Utilities and can be adjusted as needed. The reliability component is calculated as follows:

Reliability = 0.1 • ConsequenceOfFailure-CustomerCount + 0.45 • ConsequenceOfFailure-CriticalInfrastructureCount + 0.45 • ConsequenceOfFailure-MedicalFacilityCount

Safety

The safety component of the In-Service Risk is based on Technosylva's Probability of Ignition (POI). Whenever there is an outage, part of the consequence model considers the potential for wildfire. The value for the safety component is thus determined by the weather trend sampled and the corresponding POI.

Finance

The finance component of the consequence is based on the cost required to replace the impacted asset in the event of its engineering failure. Similar to other components of the consequence, it is evaluated on a scale from 1 to 9.

Final Consequence Calculations

Each component of the consequence is defined as a score from 1 to 9. Since the In-Service consequence is also defined as a score from 1 to 9, the components are combined using a weighted sum where the total of the weights equals 1. These weights are placeholders discussed with Liberty Utilities and can be configured when launching a simulation.

6. Degradation Model

Simulations are carried out with a time step of one year. Each year, assets are therefore degraded by one year, leading to the deterioration of all age-dependent indicators (such as regulatory indicators and condition modifiers).

There is no degradation at the Liberty Asset Level, Section Asset Level, and Segment Asset Level because these assets represent aggregations of lower-level assets. Segments consist of grouped overhead conductors, poles, and overhead fuses. Sections group segments and vegetation, while the Liberty level aggregates all underlying assets. As such, any degradation observed at these higher levels is inherently a reflection of the condition modifiers and degradation of the individual lower-level assets they encompass.

6.1 Pole

The degradation of poles is modeled by three key characteristics: age, probability of failure, and probability of being restorable. The age of the pole naturally increases over time, influencing its overall condition. The probability of failure is calculated using a Weibull distribution with material and age as parameters, reflecting how the likelihood of failure grows as the pole ages. Additionally, the probability of a pole being restorable is determined using the equation:

$$P(Restorable) = min(1.3974 - 0.0183 \cdot Age, 1),$$

indicating that older poles are less likely to be restorable after a failure.

6.2 Overhead Fuse

The degradation of overhead fuses is similarly characterized by age, probability of failure, and a condition modifier for fuse failure (CM Fuse Failure). As with poles, the age of the fuse increases over time, which in turn affects its probability of failure. This probability is also modeled using a Weibull distribution, with the fuse type and age as parameters to account for different fuse characteristics. The condition modifier (CM Fuse Failure) further quantifies the risk associated with fuse failure.

6.3 Overhead Conductor

There is no degradation model for conductors in Direxyon. This means that once all conductors with a risk metric are replaced, based on the data available at the start of the simulation, no additional conductors will degrade or need replacement.

However, conductor replacement priority is determined by the Conductors Replacement Score (CRS) indicator. Ranging from 0 to 7, the CRS represents the number of critical replacement criteria met by the conductor. These criteria, defined with the help of Liberty's engineering staff, include:

1. Is there a high risk around the conductor?
2. How old are the poles supporting the conductor?
3. What is the integrity of the conductor?
4. Is the span of the conductor too long?
5. What is the material of the conductor?
6. What is the conductor size?
7. What is the conductor type?

Since there is no specific degradation component in the Overhead Conductor asset model, the CRS evolves only when related assets degrade. Given that the first two components of the CRS depend on the aggregated risk around the conductor and the age of the poles supporting the conductor, the CRS will fluctuate as the simulation progresses, thereby evolving the replacement priority.

One possible improvement could be to model breaks and outages based on the number of splices on the line using a Poisson distribution since we can have multiple breaks in one year on the same conductor. Additionally, repairing conductors means we add one or more splices to the conductor, which will then augment its Conductor Replacement Score and potentially affect its final condition modifier.

6.4 Vegetation

Unlike other asset types, vegetation does not degrade but grows as the simulation progresses. The three main components of the vegetation model are outlined as follows:

6.4.1 Grow-in

Based on the average growth observed in California by Bernett et al. (2023), the grow-in metric utilizes the vegetation growth table found in Appendix 1A. This metric uses the main species in the area to determine the species distribution across forests in the United States. [3]

6.4.2 Fall-in

Following the same growth patterns observed in the grow-in vegetation growth, the fall-in metric also uses the main species in the area to determine the species distribution across forests in the United States. This metric represents the overstrike, which refers to situations where a falling tree or its branches strike or impact electric utility infrastructure. [3]

6.4.3 Density

A percentage of growth each year is estimated using the following formula:
$y = c + a\,(1 - e^{-b \cdot STDAGE})^{d}$,

where:

- $c + a$ is the asymptotic carbon density level,
- b is the slope parameter describing the shape of the accumulation curve observed in **Figure 4**,
- d is a constant suggested to have a value of 3 by Sleeter et al. (2022) from a recent national assessment of forest carbon flux and stocks in the US' forests, [7]
- *STDAGE* is the age based on the estimated height of the three stands.

As with other vegetation metrics, density follows the growth patterns and vegetation distribution highlighted by Bernett et al. (2023). [3]

8. Cost Model

The cost estimates for pole replacement, overhead conductors, overhead fuses, and vegetation management were developed in collaboration with Liberty Utilities. These estimates are based on placeholder costs derived from work orders and existing data sets to provide initial approximations for planning and simulation purposes. It's important to note that these estimates should be refined as more data and insights become available from ongoing operations and detailed assessments.

8.1 Pole

The cost of replacing poles involves several components, with an assumption that the mode of the distributions is equal to their mean (i.e., a symmetric distribution), allowing the use of triangular distributions for some components. Below is a detailed breakdown:

- Labor Cost Component
  - Labor cost is determined by sampling a triangular distribution with the following parameters: a minimum of $1,840, a mode of $3,600, and a maximum of $5,200.
- Material Cost Component
  - Material cost is determined by sampling a triangular distribution with the following parameters: a minimum of $1,150, a mode of $2,250, and a maximum of $3,250.
- Contractor Cost Component
  - Contractor cost is determined by sampling a triangular distribution with the following parameters: a minimum of $17,020, a mode of $33,300, and a maximum of $48,100.
- Other Replacement Cost Components
  - Other replacement costs are determined by sampling a triangular distribution with the following parameters: a minimum of $1,840, a mode of $3,600, and a maximum of $5,200.
- Detailed Inspection Cost Component
  - Detailed inspection costs are determined by sampling from a continuous uniform distribution, with both the minimum and maximum values set at $97.
- Intrusive Inspection Cost Component
  - Intrusive inspection costs are determined by sampling a triangular distribution with the following parameters: a minimum of $800, a mode of $1,000, and a maximum of $1,200.
- Remedial Treatment Cost Component

    - Remedial treatment costs are determined by sampling from a continuous uniform distribution, with both the minimum and maximum values set at $833.

8.2 Overhead Fuse

The primary cost driver for overhead fuse replacement is the intervention itself. This cost is broken down into three main components: material, labor, and vehicle expenses required to access the asset.

- Material Cost Component
    - Liberty Utilities has defined an estimated material cost of $500 for overhead fuse replacements.
- Hourly Labor Cost Component
    - The estimated hourly labor cost for these replacements is $2,000, as determined by Liberty Utilities.
- Transportation (Vehicle) Cost
    - Liberty Utilities estimates the transportation cost, including vehicle expenses, at $1,000 for accessing the asset during fuse replacements.

8.3 Overhead Conductor

The costs associated with conductors are rough estimates and include the cost of poles replaced and added to the network. This approach will be reviewed with Direxyon and Liberty Utilities as more data becomes available.

- Normal replacement
    - Liberty Utilities has estimated an investment of $1,220,000 for conductor replacement. Based on work orders and discussions between Direxyon and Liberty, it has been established that 600 to 1,200 spans can be replaced annually. It is assumed that the typical mode of conductor replacement is 900 spans per year.
    - A triangular distribution with a minimum of 600, a mode of 900, and a maximum of 1,200 will be used to sample the yearly replacement capacity.
    - Costs are divided into percentages to represent labor, materials, contractor fees, overhead, other expenses, and financing costs.
- Repair

  - The repair cost is currently a placeholder and should be updated once further data and contextual information are provided by Liberty Utilities. The placeholder equation for calculating repair cost is:

    repair cost = $1 • span (ft)

- Covered conductor
  - The cost for covering overhead conductors is sampled from a continuous distribution with values ranging between $1,500,000 and $2,000,000 for conductor replacements.
  - The cost equation is therefore:

    conductor covering cost = sampled covering rate ($) • span (miles)

8.4 Vegetation

All costs for vegetation management are based on averages derived from past years' work orders provided by Liberty Utilities. Given the critical role vegetation plays in risk management, legislation mandates specific work types and schedules, which can lead to a multiplication factor being applied to the costs. If the RCD (Regulatory Compliance Directive) regulation is triggered, the cost is multiplied by 2 to account for the increased urgency and associated planning and resource requirements. Please note that costs related to grid hardening are not assigned to the vegetation budget but are instead allocated to the Capital Planning Budget.

- Hazard tree mitigation (includes the potential pruning to be done in the area)

  Hazard tree mitigation cost = $ 823.67 • Number of trees to cut

- Hauling

  Hauling cost=1 • a • b • Number of trees to cut

  Where a is a constant value of 0.6 (60%), a rule of thumb established by the industry, b is a constant value of 0.1, representing the number of tons of wood per tree and $1 is a placeholder value and should be updated with more information from Liberty Utilities.

- Pruning
  Pruning Cost = $1,986.52 per mile

9. Integrated Interventions on Assets

Integrated interventions on assets maximize efficiency by addressing multiple assets simultaneously, optimizing labor, inventory, and budget. For example, replacing a conductor often involves working on all connected assets, while pole interventions may include nearby poles and equipment like transformers. Fuse replacements are typically paired with pole work, and vegetation management is integrated into maintenance strategies to address surrounding vegetation, improving overall network reliability.

9.1 Overhead Conductor Integration

When considering assets for replacement/maintenance, the conductor is the first asset type to pass through the decision tree. That way, all the other assets can take a decision based on the conductor's decision.

The conductor is at the heart of the integration strategy. Liberty aims to reduce the risk in certain circuits by replacing old wire by creating covered conductor projects. Since conductors are subject to a lot of engineering constraints, they run through the decision tree first, thus pulling from the allocated budget first. As a result, it is important to set the capacity of covering/replacing conductor and/or budget for this asset.

When a conductor is replaced, the decision logic triggers replacement interventions on its associated poles and fuses. Moreover, when applicable, vegetation will be managed around that conductor.

9.2 Pole Integration

When a pole is replaced, we also replace any transformer mounted on it, ensuring that both assets are upgraded together for enhanced reliability and safety. Although transformers are not currently an asset type represented in the model, their inclusion in this integrated approach addresses potential vulnerabilities in the system. Additionally, if a fuse is located on the pole being replaced, the fuse is also replaced. This means that fuses are replaced not only when they fail but also during pole replacements. However, proactive fuse replacements are not included in this integrated intervention strategy.

It is important to note that, currently, pole replacements are not grouped with other poles to optimize resource usage. This is an area identified for future enhancement, where integrating the replacement of multiple poles in proximity could improve efficiency and reduce costs. Such enhancements would be considered in the next phase of the project as part of the Cost Model improvement.

9.3 Vegetation Integration

Vegetation management is a critical component of maintaining the reliability and safety of the electric network. When a pole or conductor is replaced, it indicates that an asset-related inspection has been conducted. This inspection triggers a drawing from a grid hardening distribution (based on work orders provided by Liberty Utilities). This approach ensures that any necessary vegetation work, such as hazard tree mitigation, pruning, and hauling, is identified and planned alongside the asset replacement.

Additionally, when multiple areas within the same section require vegetation maintenance, there is a significant opportunity for cost savings and efficiency gains. Thus, a 20% price reduction is applied to the total cost due to the integrated work approach. This strategy not only improves the utilization of Liberty's resources but also enhances the overall effectiveness of vegetation management.

10. Scenarios (Technosylva dependent)

To accommodate variations in weather trends, the model defines three scenarios for each use case, allowing for a comparison of optimistic, normal, and pessimistic weather conditions. The 20th percentile, 50th percentile, and 80th percentile represent the conditions for each respective scenario. This approach aids the client in making well-informed decisions by considering different levels of risk tolerance corresponding to these scenarios.

To incorporate variations in the Technosylva weather sampling and leverage better Monte Carlo simulations, an error is sampled from a triangular distribution and added to fixed percentile values. This addition allows for a more thorough understanding of potential outcomes across different scenarios, making the model more adaptable and robust in addressing uncertainties.

The minimum and maximum values of these distributions are chosen to allow for fluctuations in both the Probability of Ignition (POI) and the consequence scores of the model. They introduce variability such that when the sample values are closer to the extremes of the distribution, the scores are either lower or higher than the median score by a value of one. The specific details of these triangular distributions can be observed in Appendix 1B.

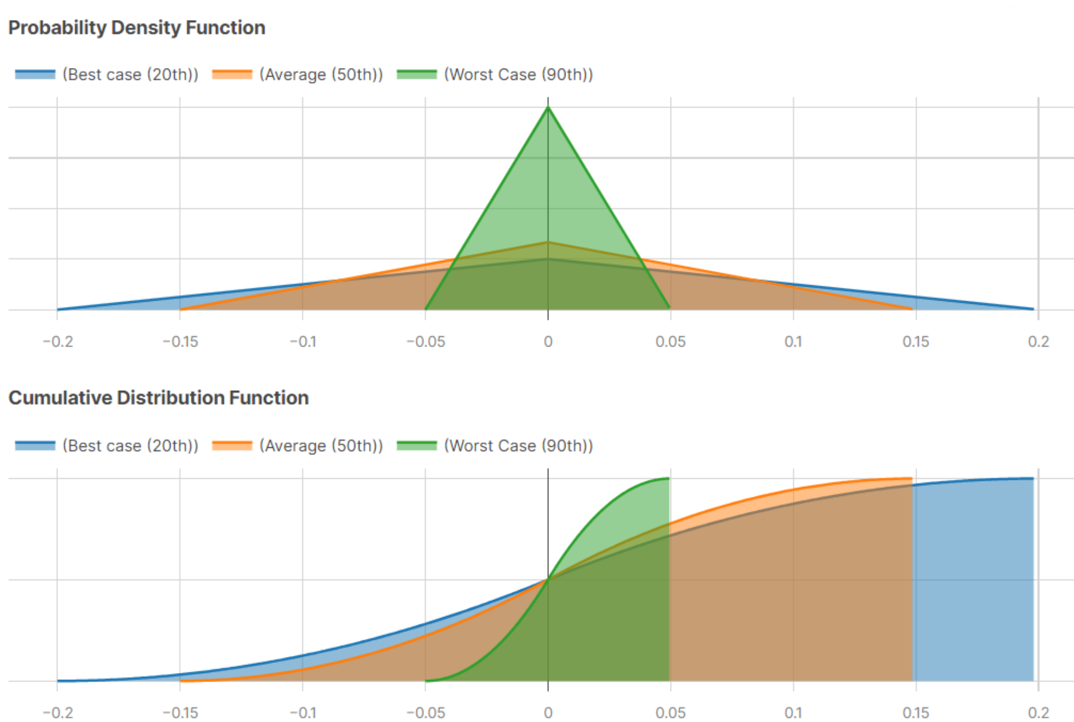


Figure 13. *Distribution of error (variation) in Technosylva weather sampling*

11. Use Cases

Three distinct use cases are crafted to drive insights in this phase of analysis, aiming to elucidate the necessary investments for meeting regulatory minimums, understand the present state of the network, anticipate its short-term and long-term evolution under the existing Liberty Utilities strategy, and explore alternative mitigation approaches. The outlined use cases are as follows:

11.1

1. GO.165 Requirements:
    - Focuses solely on meeting the minimum requirements stipulated by GO.165.
2. Current IMLB Strategy:
    - Satisfies the minimum requirements of GO.165 with added measures:
        i. Proactive replacement of fuses
        ii. Proactive conductor covering strategies
        iii. Implementation of vegetation management strategies
3. No Intervention
    - This analysis explores the consequences of not performing any interventions on the assets. By examining how the assets degrade over time without maintenance, we can better compare the benefits of different maintenance and inspection procedures on Liberty Utilities' electric network.

These use cases aim to familiarize the client with the diverse analyses and insights achievable through the DIREXYON Solution. By exploring different scenarios, we highlight the Solution's versatility in risk assessment, strategy evaluation, and decision-making, providing a concise yet comprehensive overview of its capabilities. The following will outline the step-by-step journey of one asset for each of the pole, overhead conductor, and overhead transformer asset types throughout a model simulation for each of the use cases. Each use case is simulated over 25 years and 5 iterations.

11.1 Step by step example - Current IMLB Strategies

In addition to the minimum requirements under GO165, this use case evaluates the impact of the following risk mitigation strategies:

1. Proactive replacement of fuses
2. Proactive conductor covering strategies
3. Implementation of vegetation management strategies

This use case will follow the step-by-step journey of related assets focusing on the 5th iteration of the simulation. The following linked assets are going to be studied throughout this use case: Pole (100103), Overhead Conductor (TAH5201 – 3754), Overhead Fuse (85A0B0C1-E0C6-4C10-B35F-03AE46886E0D), and corresponding vegetation areas.

11.1.1 Overhead Conductor

This use case will illustrate the step-by-step journey of the selected overhead conductor (TAH5201 - 3754) throughout the 5th iteration of the simulation, from 2025 to its replacement in 2031.

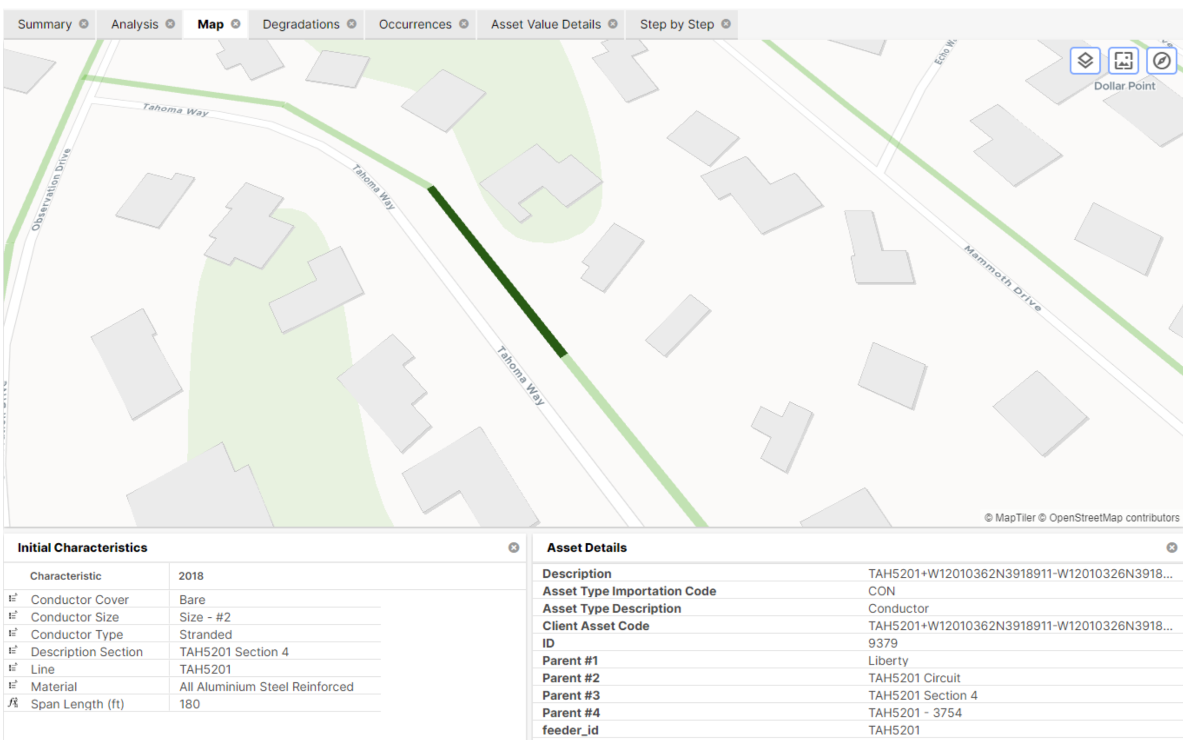


Figure 14. *Illustrates the Liberty Configuration use case, which will be studied in detail using the TAH5201 - 3754 conductor as a case study.*

Degradation

The overhead transformer is 25 years of age at the start of the simulation and will age by one year between 2023 and 2032.

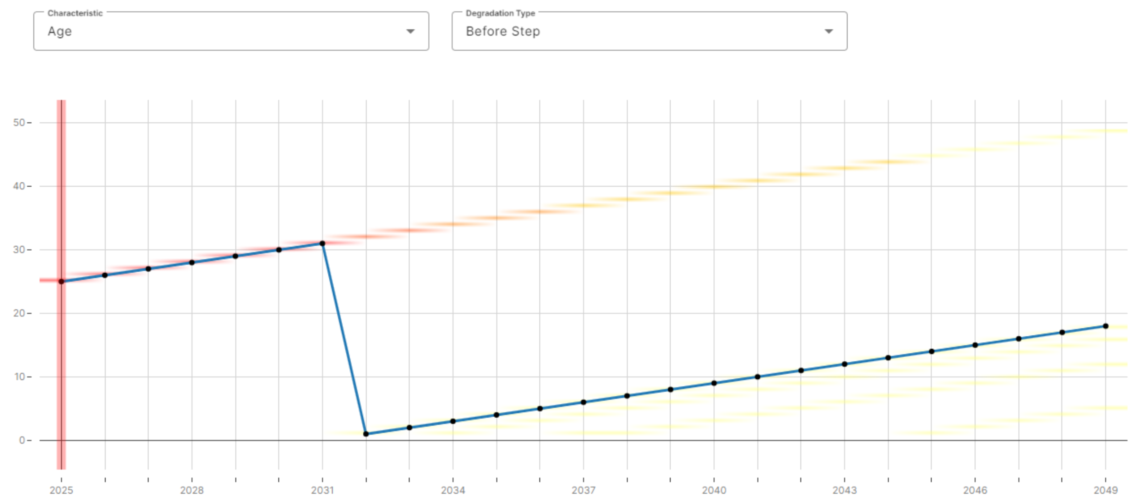


Figure 15. *Degradation of the age characteristic of the selected conductor asset over the 5th iteration of the simulation. The other colored lines represent a heat map of the degradation curves observed in the other iterations.*

The model does not indicate a failure for this asset in 2025. However, inspection cycles can be overridden at the pole level due to the imported backlog at the beginning of the simulation, and then pushed up to the circuit level. In this case, conductors must follow the inspection cycles of the former as seen in the decision tree below.

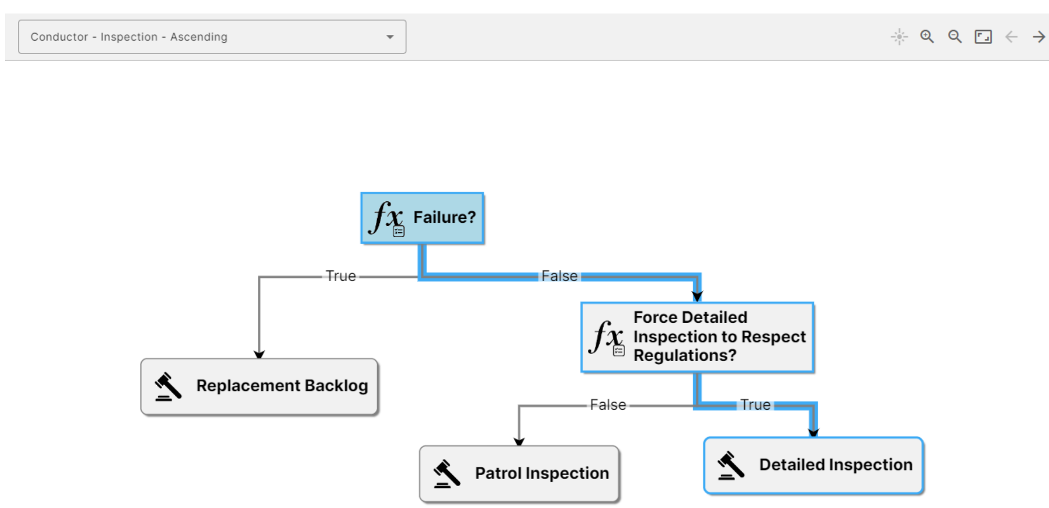


Figure 16. *Ascending Detailed Inspection decision tree of the selected conductor on year 2025 of the 5th iteration.*

Detailed Inspection

The model does not indicate a potential failure for this asset between 2026 and 2030. The detailed inspection cycle is defined at the circuit level, so the model will perform patrol inspections annually and detailed inspections as needed to align with the circuit inspection cycle.

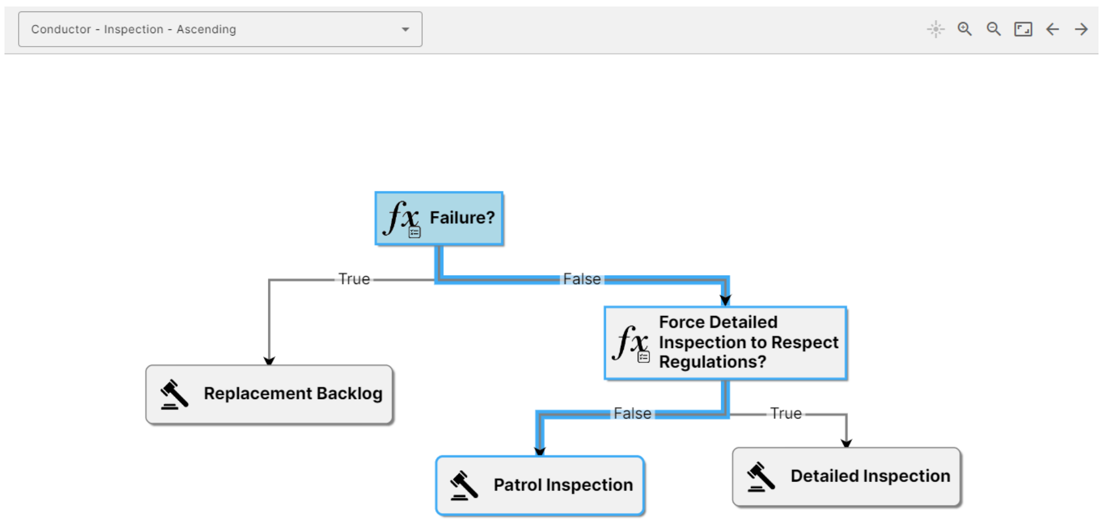


Figure 17. *Ascending Detailed Inspection decision tree of the selected conductor on years 2026 to 2028 of the 5th iteration, where a circuit detailed inspection is triggered.*

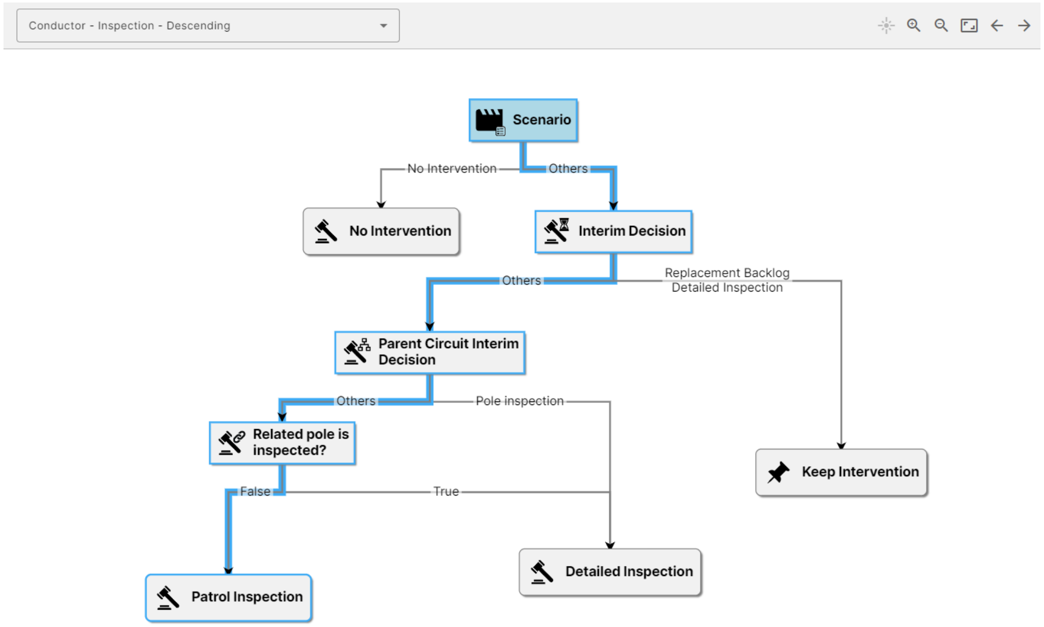


Figure 18. *Descending Detailed Inspection decision tree of the selected conductor on years 2026 to 2028 of the 5th iteration, where a circuit detailed inspection is triggered.*

Replacement

From 2023 to 2031, no interventions are planned for TAH5201 – 3754. It is a bare conductor type and although it is flagged for replacement as part of the bare to covered conductor replacement program, the replacement is on hold due to capacity constraints.

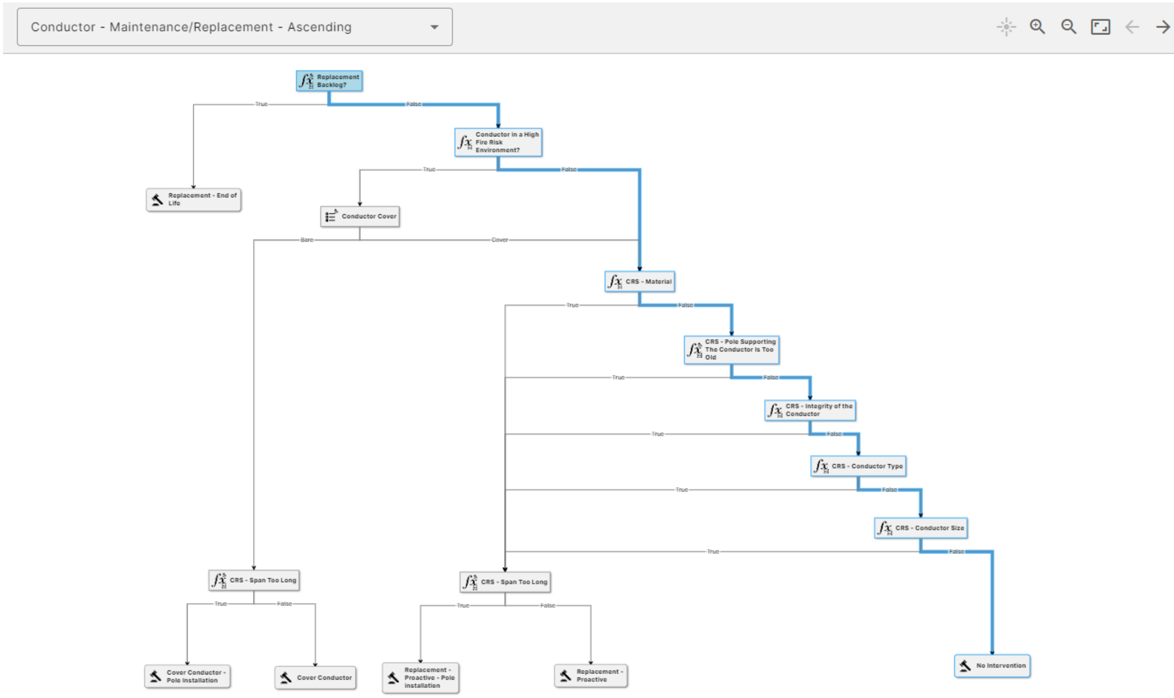


Figure 19. *Ascending Replacement decision tree of the selected conductor on year 2025 of the 5th iteration.*

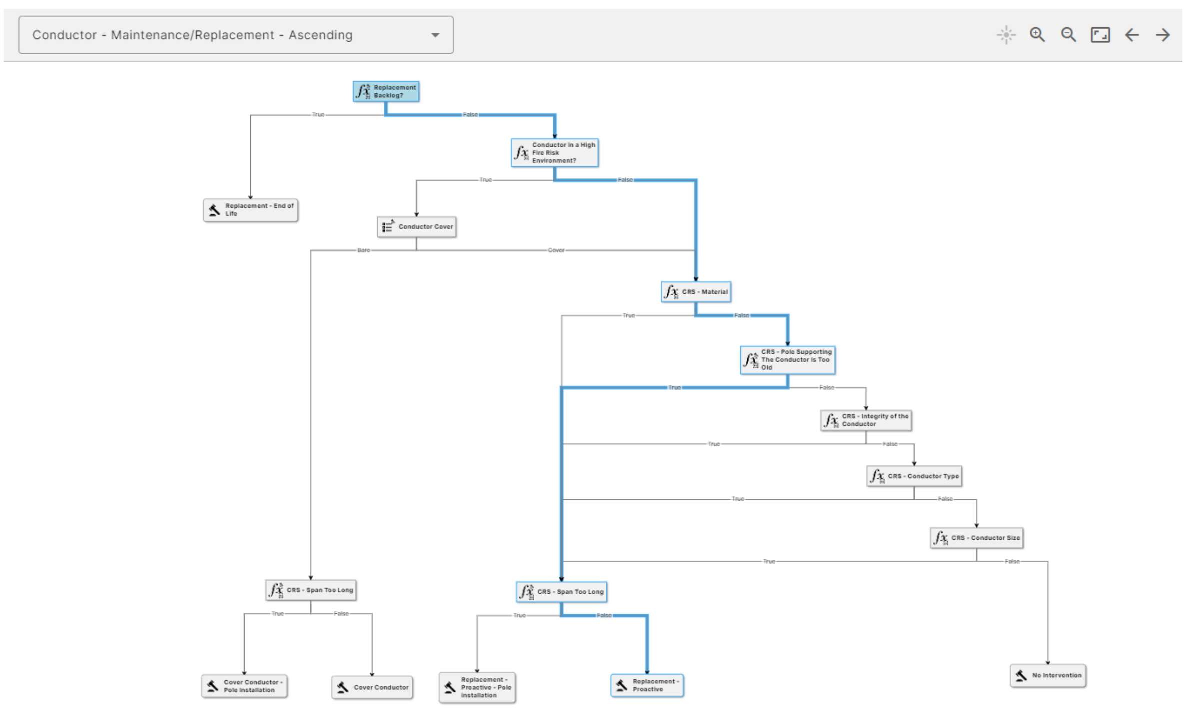


Figure 20. *Ascending Replacement decision tree of the conductor on year 2026 of the 5th iteration, where the Conductor Replacement Score of the conductor triggers a proactive replacement.*

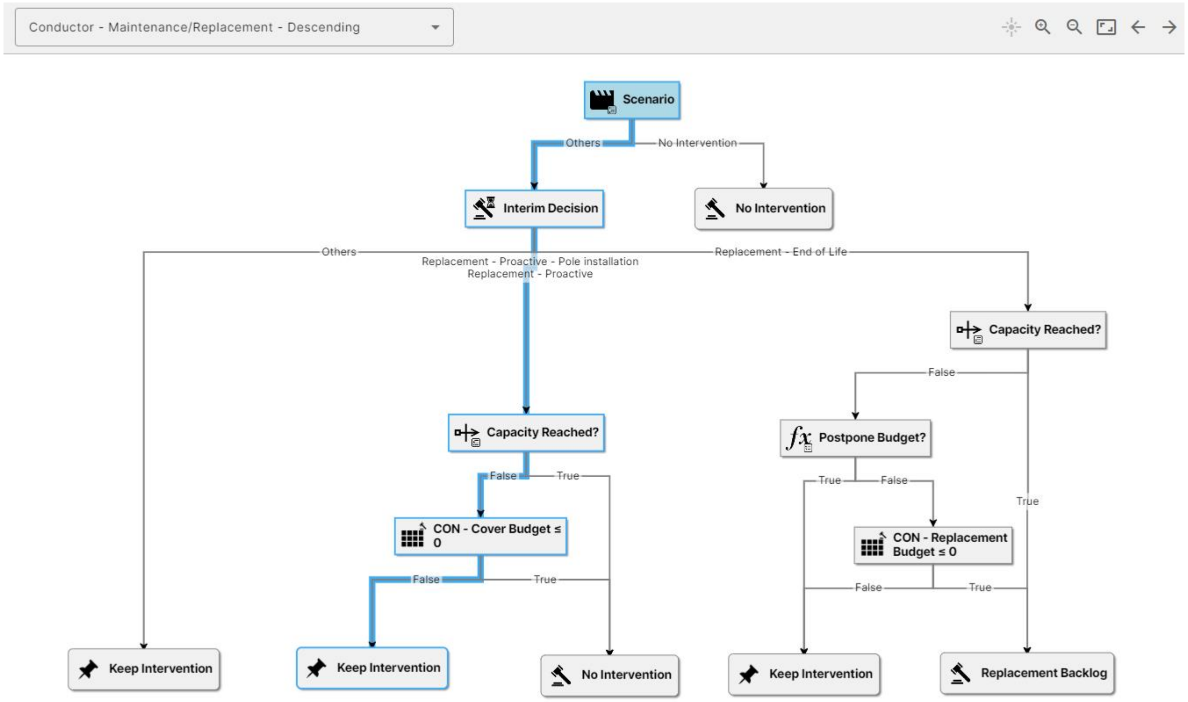


Figure 21. *Descending Replacement decision tree of the conductor on year 2026 of the 5th iteration, where the conductor covering capacity has been reached.*

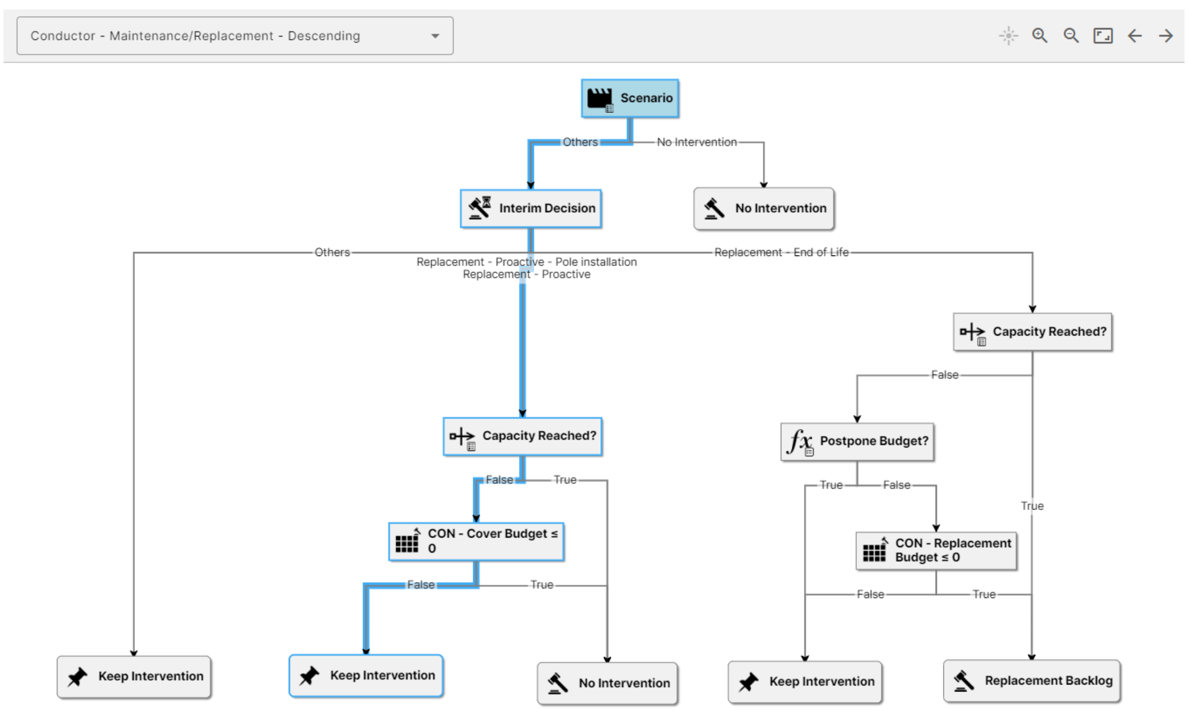


Figure 22. *Descending Replacement decision tree of the conductor on year 2031 of the 5th iteration, where the conductor covering capacity has not been reached and is therefore replaced.*

The overhead conductor replacement capacity is set at 1,000 spans per year. The prioritization order is set at the circuit level according to the Conductor Replacement Score (CRS), meaning assets within circuits with the highest average CRS will be prioritized before moving to the next circuit in the prioritization order. When the capacity reaches below 0, assets of the remaining circuits in the priority list must wait for the following year if they need to be replaced. In this instance, the overhead conductor replacement capacity fell below zero between 2025 and 2030, indicating that the selected conductor was set for replacement. In 2031, as the conductor covering capacity exceeded zero, the conductor was replaced.

The overhead conductor replacement will reset several characteristic values (age, probability of failure, installation year) as well as trigger replacement costs.

11.1.2 Poles

Let’s first start by considering our pole between the start of the simulation in 2025, to its replacement in 2031:

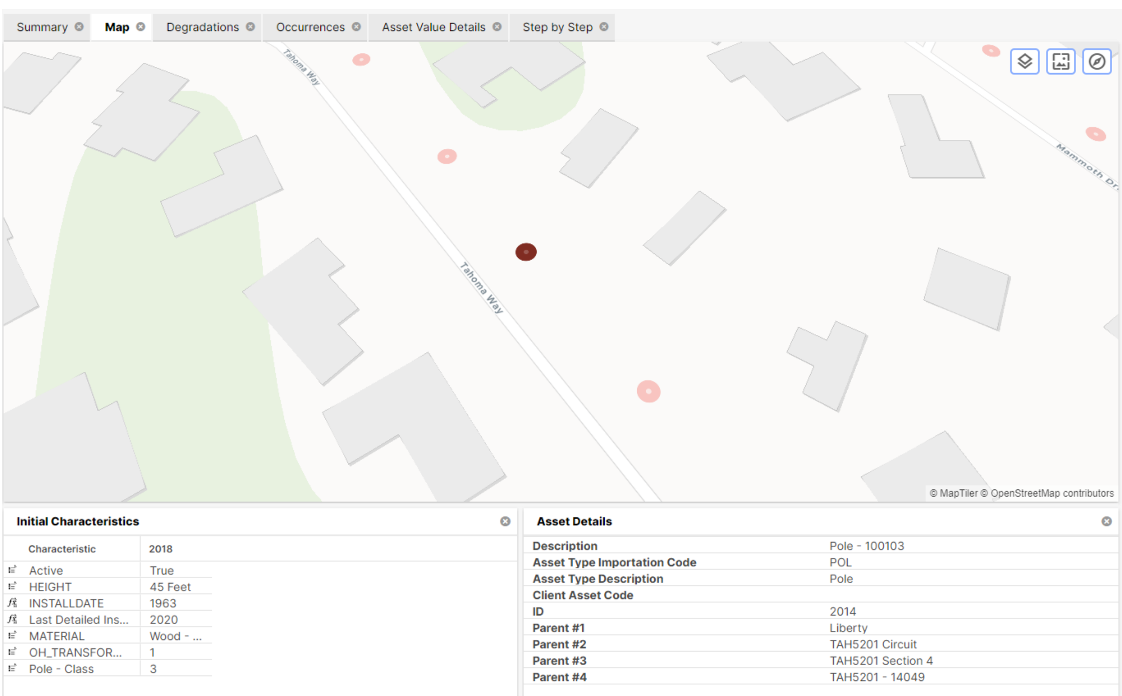


Figure 23. *Pole (100103) which will be studied to illustrate the Liberty Configuration use case.*

Degradation

The pole is 62 years old at the start of the simulation and will age yearly between 2025 and 2031.

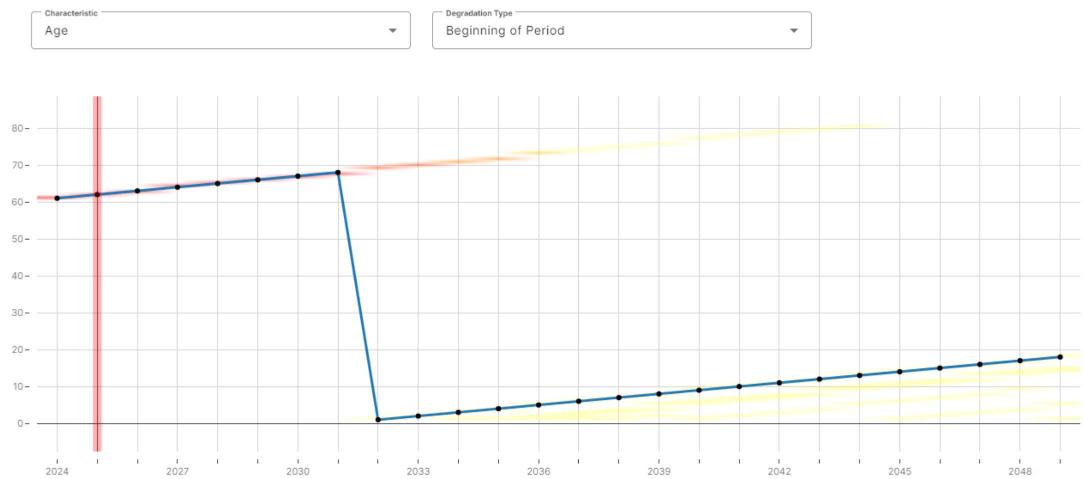


Figure 24. *Degradation of the age characteristic of the selected pole asset over the 5th iteration of the simulation (in blue). The other colored lines represent a heatmap of the degradation curves observed in the other iterations.*

The model indicates that between 2025 and 2030, there is no likelihood of failure for this asset, as shown in the decision tree below.

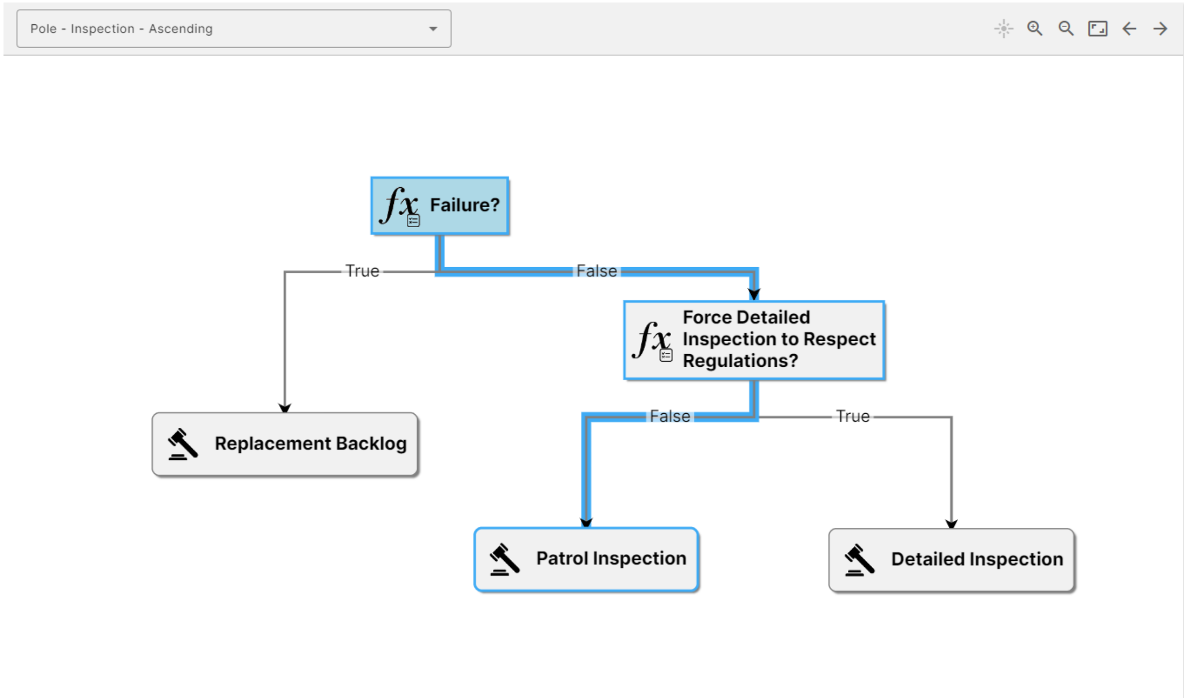


Figure 25. *Ascending Detailed Inspection decision tree of the selected pole on year 2025 of the 5th iteration.*

Detailed Inspections

Given that inspection cycle frequencies are set at the circuit level, the decision tree must validate whether the parent circuit of Pole (100103), TAH5201, is triggered for detailed inspection. As illustrated in the image above, this circuit should not be subjected to a detailed inspection in 2025.

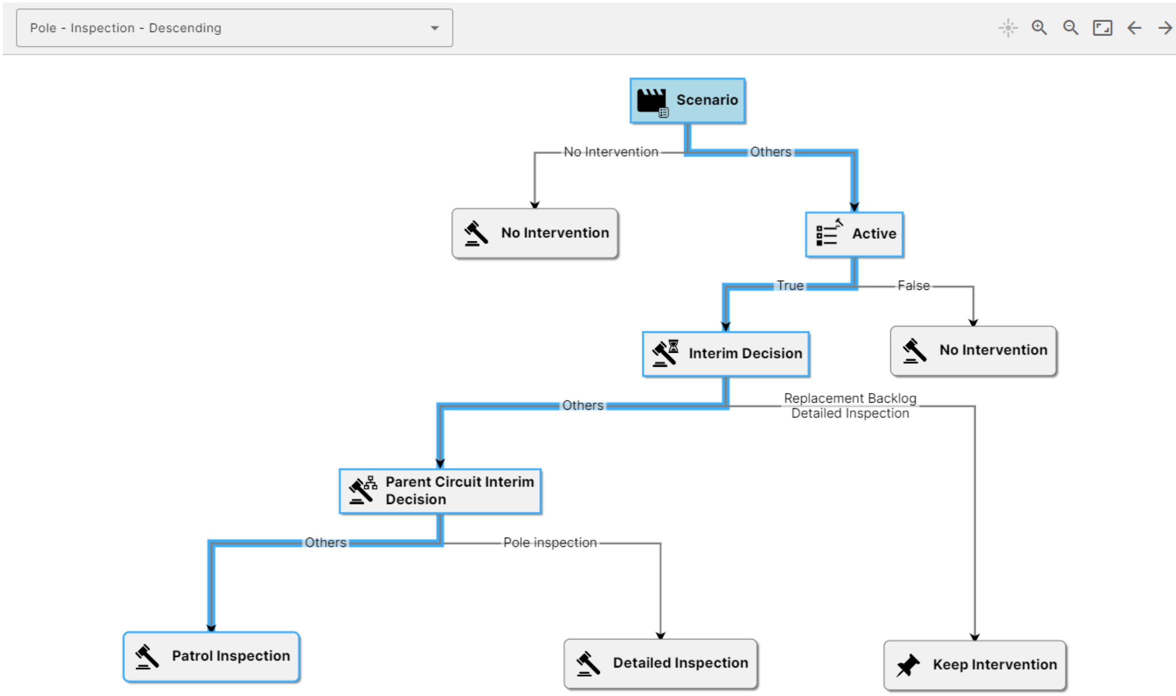


Figure 26. *Descending Detailed Inspection decision tree of the selected pole on year 2025 of the 5th iteration.*

Intrusive Inspections

The intrusive inspection cycle frequencies are set at the circuit level but can be overridden if the pole is in Liberty Utilities' backlog. In such cases, the inspection will be pushed to the parent circuit level to optimize the prioritization of interventions. In other words, if a pole is marked for intrusive inspection—for example, 10 years since its previous intrusive inspection—all other poles within that circuit that meet the criteria for intrusive inspections will be inspected. In 2025, the selected pole is triggered for intrusive inspection. As a result, all other poles within its parent circuit will be subject to the intrusive inspection decision tree. The selected pole has passed its intrusive inspection, and thus another intrusive inspection will not be needed until 2045.

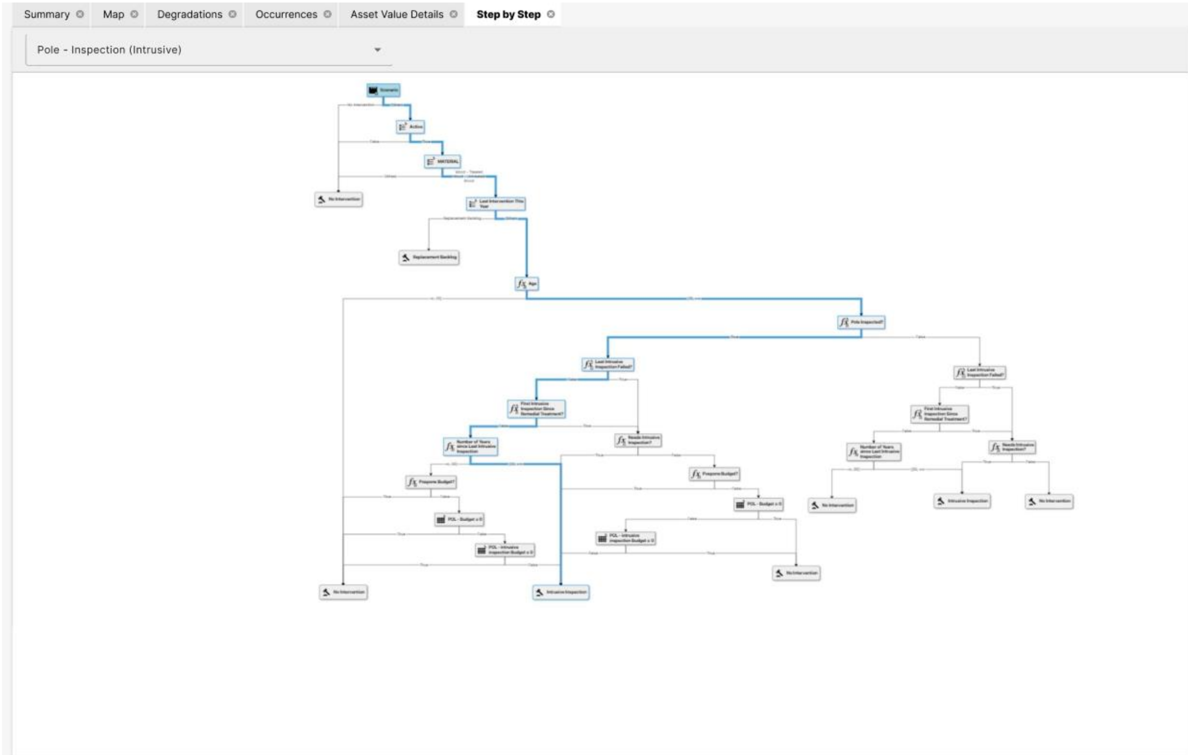


Figure 27. *Intrusive Inspection decision tree of the selected pole on year 2025 of the 5th iteration. For a higher resolution of this decision tree, please refer to the model.*

Replacement

The model does not indicate an end-of-life failure on the selected pole between 2023 and 2030. As a result, there is no need for replacement.

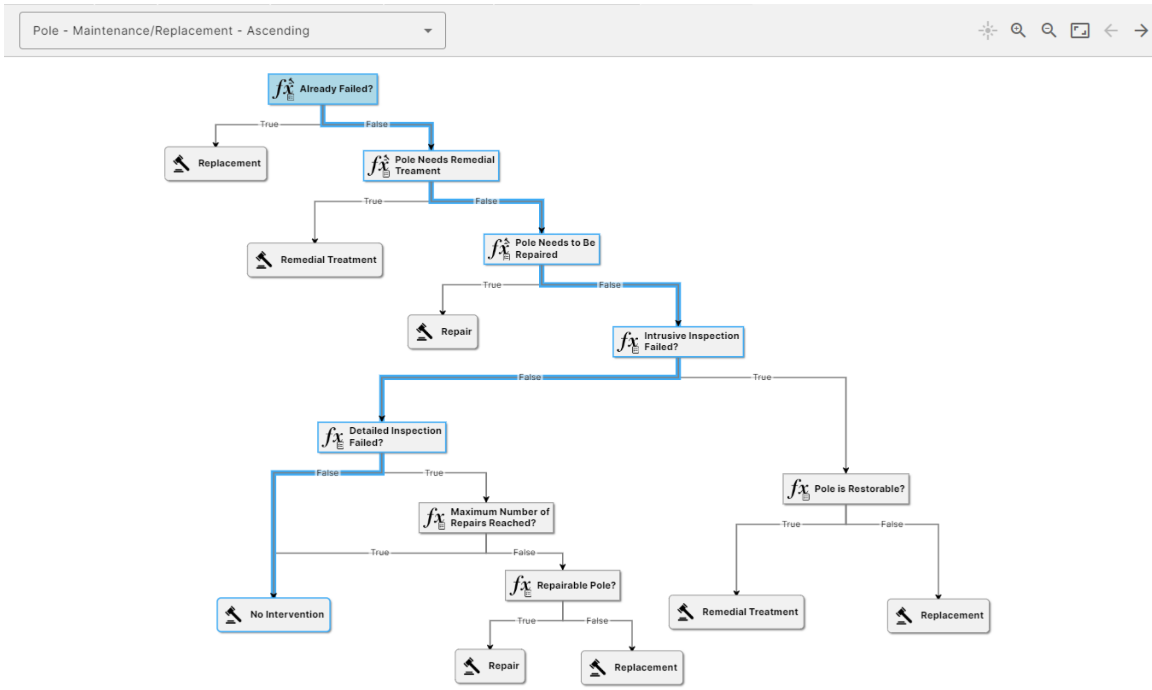


Figure 28. *Ascending Maintenance/Replacement decision tree of the selected pole on years 2025 to 2030 of the 5th iteration.*

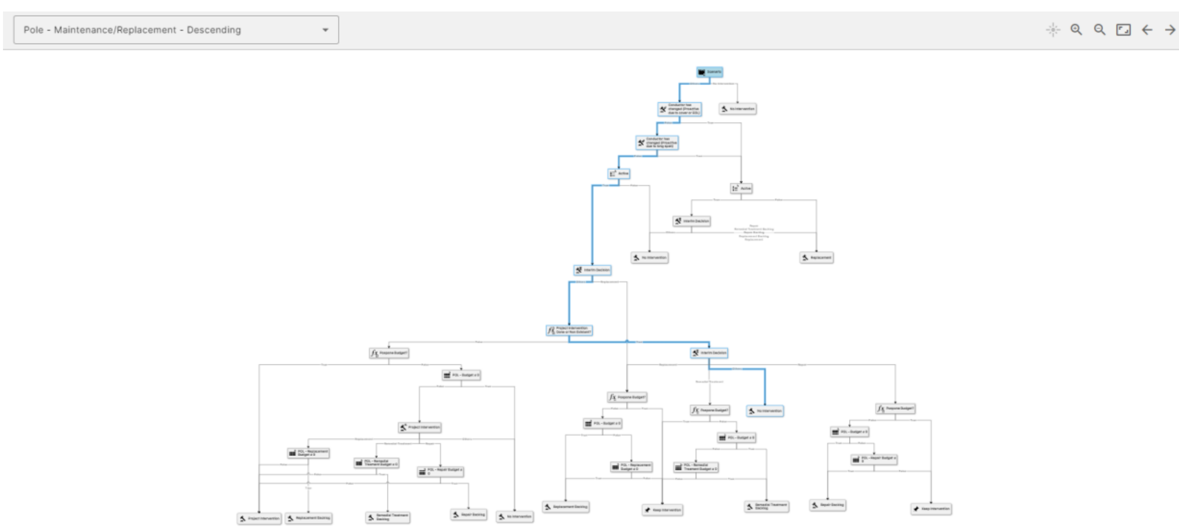


Figure 29. *Descending Maintenance/Replacement decision tree of the selected pole on years 2025 to 2030 of the 5th iteration. For a higher resolution of this decision tree, [please refer to the model](#).*

However, in 2031, the model indicates that the pole is nearing the end of its useful life. As a result, its circuit parent is triggered for a detailed inspection. This inspection leads to the decision to repair the selected pole. However, in the descending decision tree (please refer to Figure 20), it can be seen that an overhead conductor attached to said pole was also replaced due to proactive conductor covering. As a result, the pole is replaced instead of repaired.

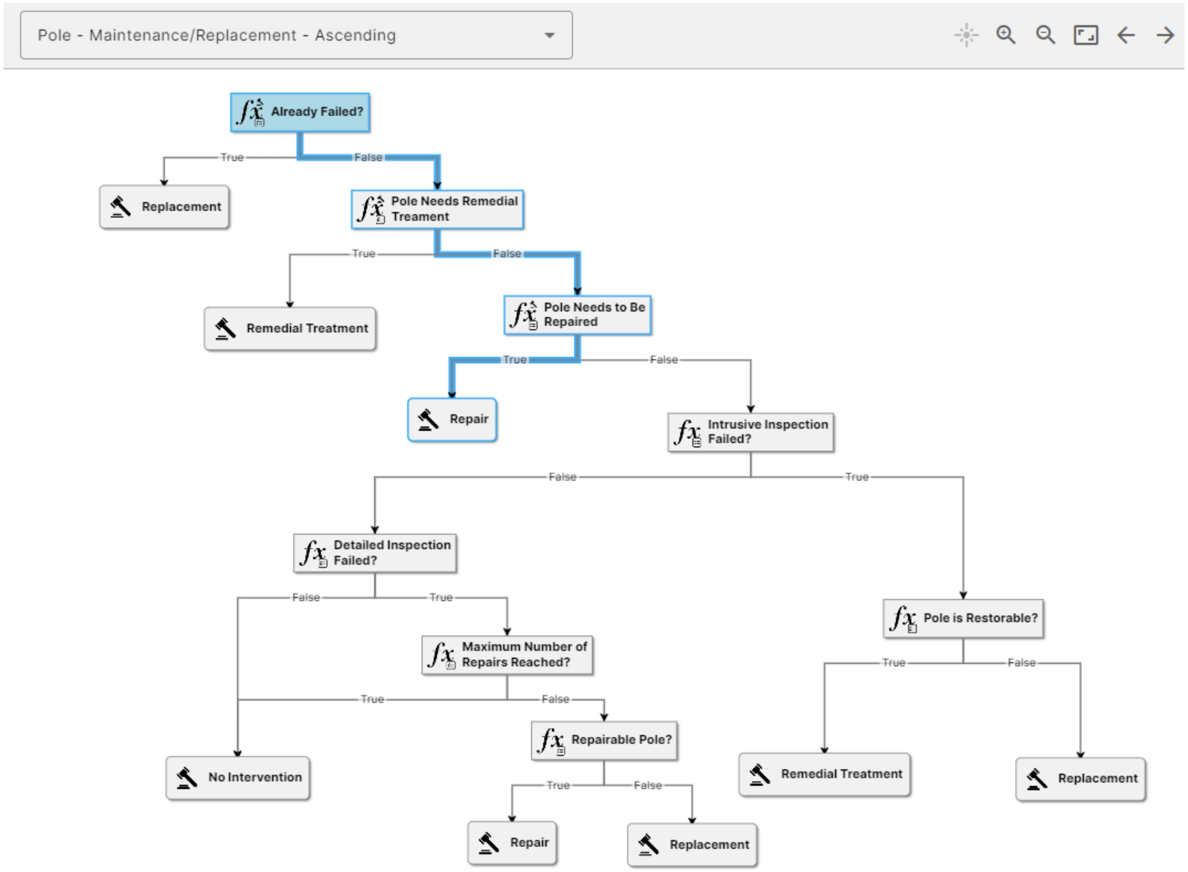


Figure 30. *Ascending Maintenance/Replacement decision tree of the selected pole on year 2031 of the 5th iteration when a pole repair/replacement is triggered.*

A budget of $3,000,000 per year has been set for the replacement of poles. The order of priority is set at the circuit level. This means that, if there is sufficient budget available, all poles flagged for replacement within an inspected circuit will be replaced before moving to the next circuit in the prioritization order. In this instance, sufficient budget was available to replace poles in TAH5201.

Note that the replacement of a pole will result in the resetting of several characteristic values, including Age, Years Since Last Detailed Inspection, and Years Since Last Intrusive Replacement. Furthermore, this process will also trigger replacement costs.

11.1.3 Overhead Fuses

This use case will illustrate the step-by-step journey of the selected Overhead Fuse (85A0B0C1-E0C6-4C10-B35F-03AE46886E0D) attached to Pole (100103) throughout the fifth iteration of the simulation, from the start of the simulation in 2025 to its replacement in 2031.

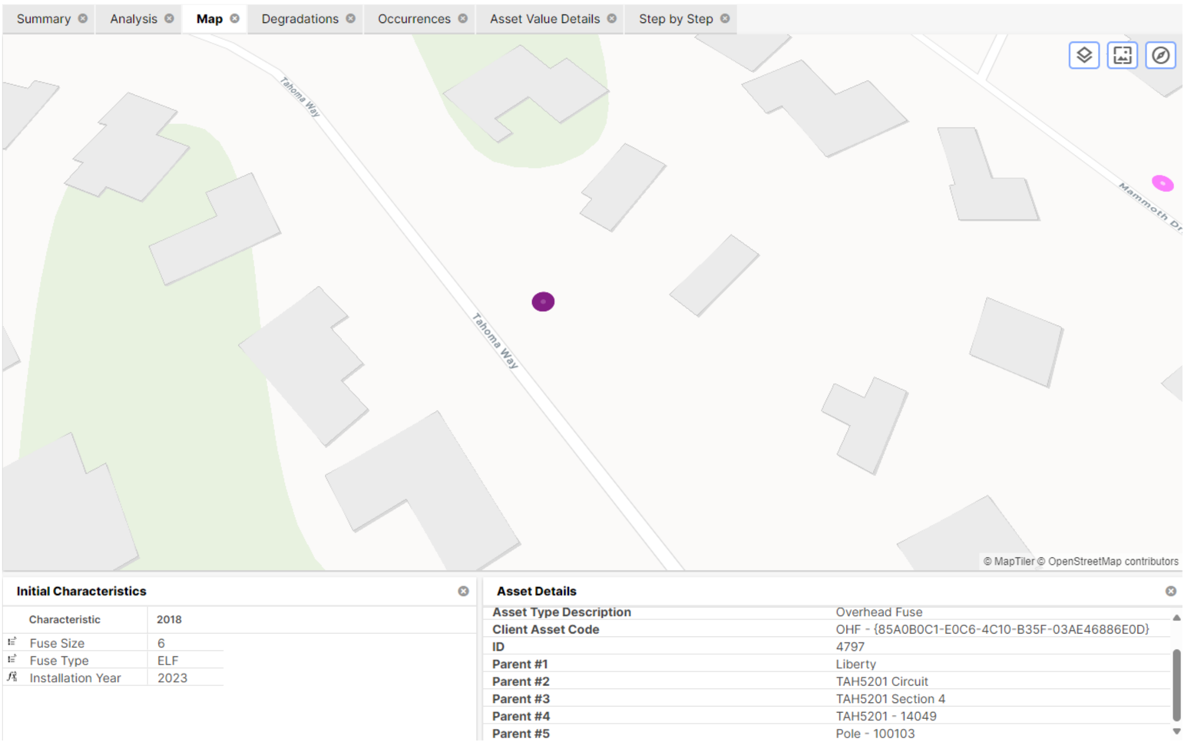


Figure 31. *Overhead Fuse (85A0B0C1-E0C6-4C10-B35F-03AE46886E0D) which will be studied to illustrate the Liberty Configuration use case.*

Degradation

The overhead fuse is one year old at the start of the simulation and will age yearly between 2025 and 2031.

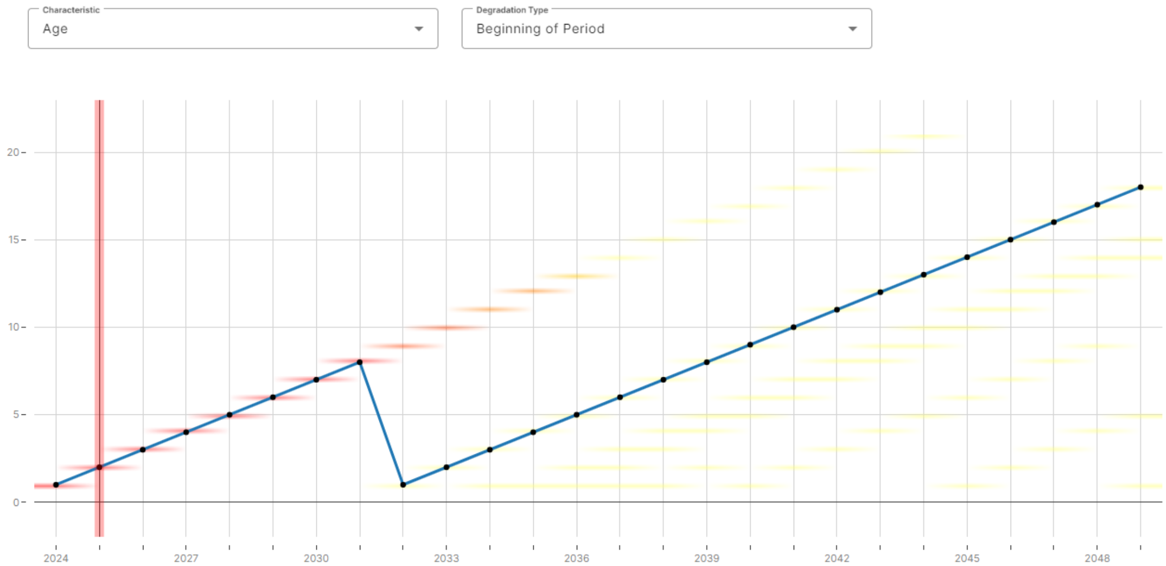


Figure 32. *Degradation of the age characteristic of the selected overhead fuse asset over the 5th iteration of the simulation (in blue). The other colored lines represent a heatmap of the degradation curves observed in the other iterations.*

The model indicates that between 2025 and 2030, there will be no failure of this asset. However, as fuses are a child asset of poles, they will be subject to the inspection cycles of the latter, as shown in the decision tree below.

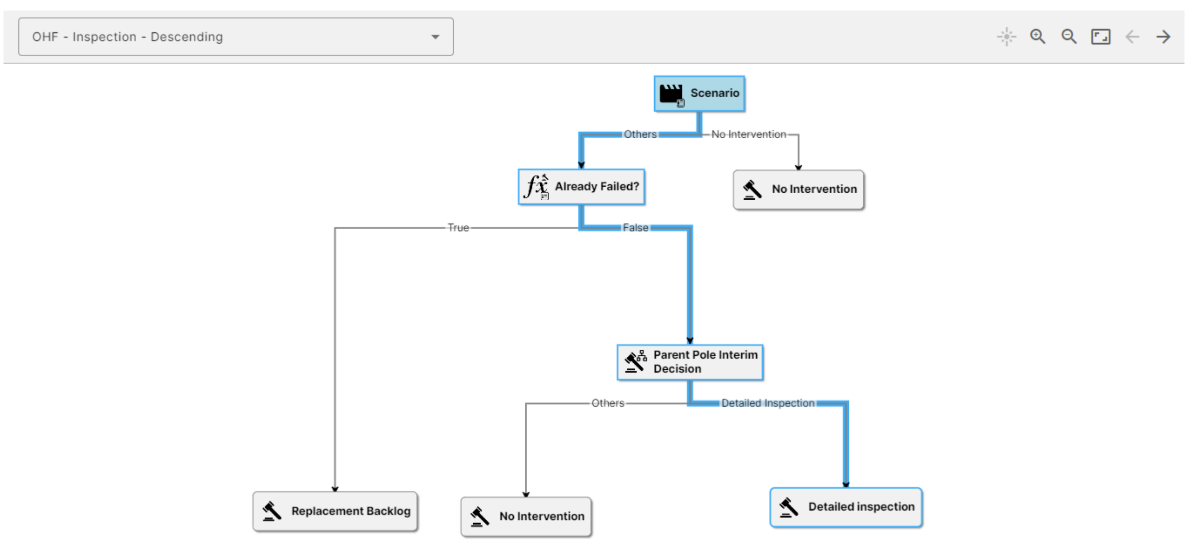


Figure 33. *Descending Inspection decision tree of the selected fuse on year 2025 of the 5th iteration.*

Replacement

From 2025 to 2030, no failures are observed on the selected overhead fuse. It is also important to note that since the simulation configuration explicitly stated that no proactive fuse replacement was to be made, the decision-making process will never reach the final decision. However, if a fuse has an engineering failure, it will trigger an End-of-Life Replacement.

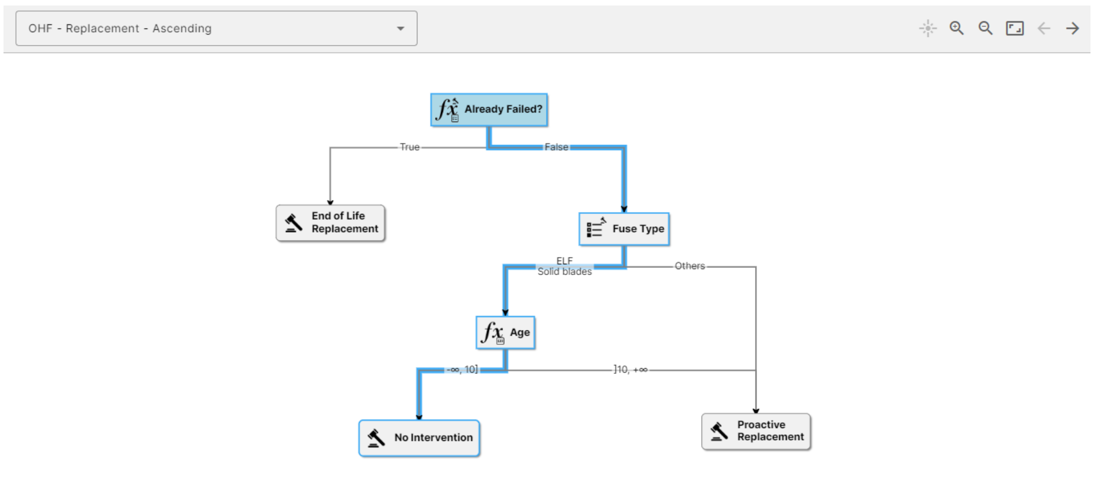


Figure 34. *Ascending Replacement decision tree of the selected fuse on years 2025 to 2030 of the 5th iteration.*

In 2031, the replacement of the fuse's parent pole will be accompanied by an integrated asset intervention, with the fuse itself being replaced proactively.

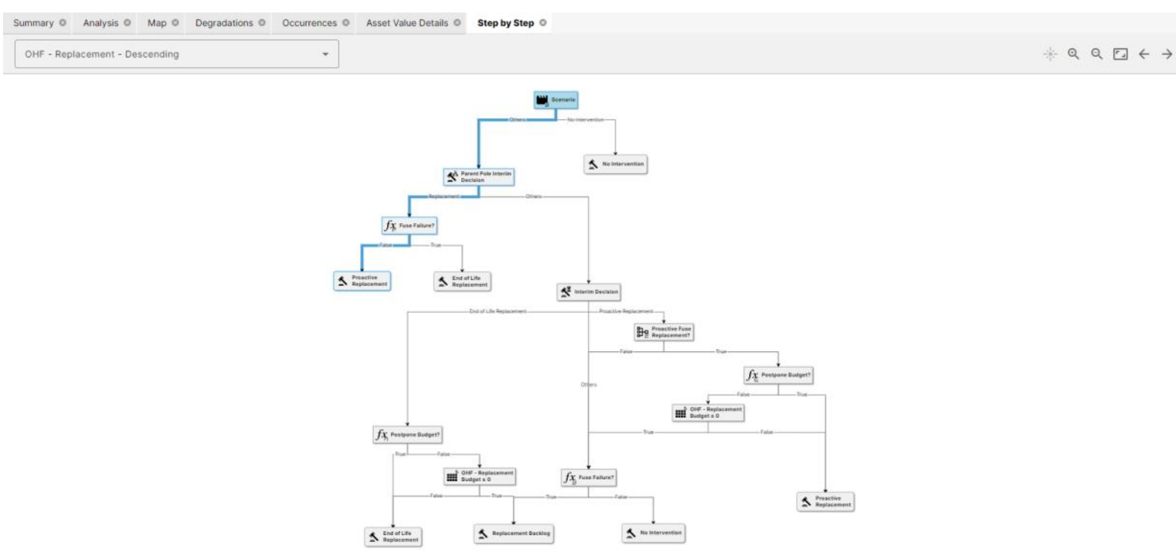
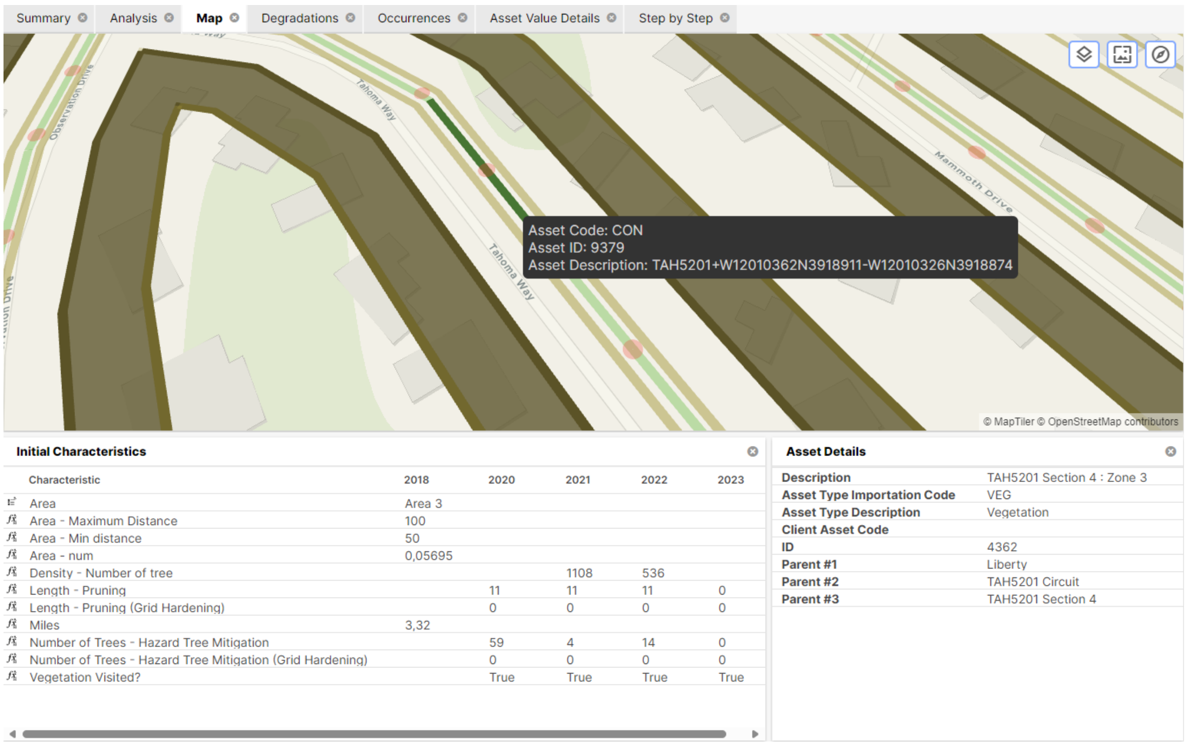


Figure 35. *Descending Replacement decision tree of the selected fuse on years 2031 of the 5th iteration. For a higher resolution of this decision tree, [please refer to the model](#).*

11.1.4 Vegetation

This use case illustrates the step-by-step evolution of the selected vegetation area (TAH5201 Section 4: Zone 3) surrounding the TAH5201 - 3754 conductor during the fifth iteration of the simulation, from the start of the simulation in 2025 to the conductor cover that occurs in 2031. Zone 3 was chosen here because Zone 1 is subject to annual regulatory work and therefore the degradation of the asset is not as interesting to illustrate the use case.



Characteristic	2018	2020	2021	2022	2023
Area	Area 3				
Area - Maximum Distance	100				
Area - Min distance	50				
Area - num	0,05695				
Density - Number of tree			1108	536	
Length - Pruning		11	11	11	0
Length - Pruning (Grid Hardening)		0	0	0	0
Miles	3,32				
Number of Trees - Hazard Tree Mitigation		59	4	14	0
Number of Trees - Hazard Tree Mitigation (Grid Hardening)		0	0	0	0
Vegetation Visited?		True	True	True	True

Description	TAH5201 Section 4 : Zone 3
Asset Type Importation Code	VEG
Asset Type Description	Vegetation
Client Asset Code	
ID	4362
Parent #1	Liberty
Parent #2	TAH5201 Circuit
Parent #3	TAH5201 Section 4

Figure 36. *Vegetation area (Section 4: Area 3), surrounding the TAH5201 - 3754 conductor, which will be studied to illustrate the Liberty Configuration use case.*

Degradation

The degradation of vegetation assets can be understood as the growth of the vegetation itself. Each year the density of trees increases and the height of the vegetation increases. To make the calculations suggested by Barnett et al [3], an estimate of the age of the trees in the area was made based on the height of the trees. The following figures illustrate the average age of the trees (estimated) in the selected area and the average number of trees per mile in the vegetation section.

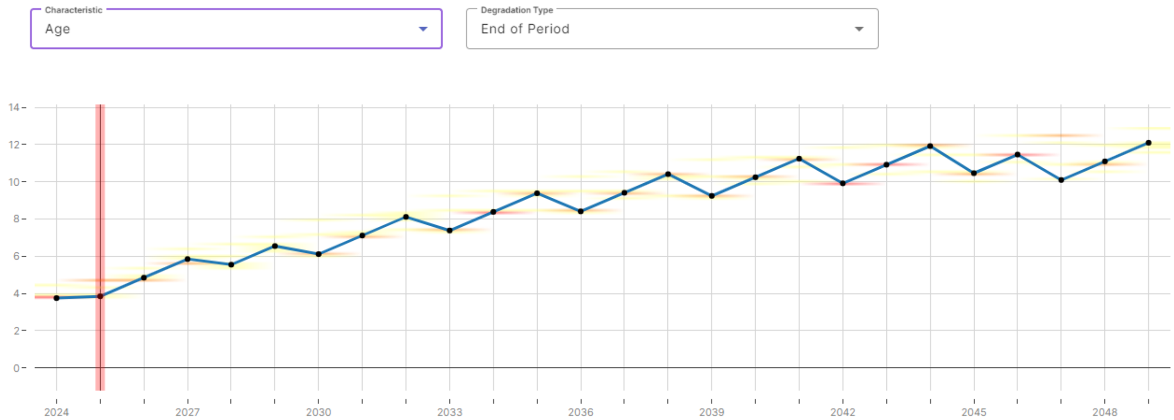


Figure 37. *Degradation of the age characteristic of the selected vegetation asset over the 5th iteration of the simulation (in blue). The other colored lines represent a heatmap of the degradation curves observed in the other iterations.*

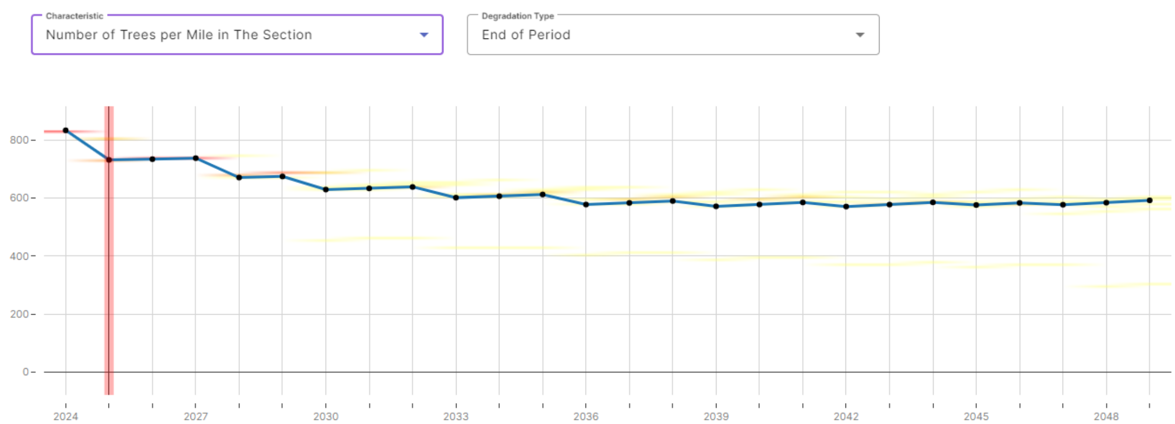


Figure 38. *Degradation of the Number of Trees per Miles in the Section characteristic of the selected vegetation asset over the 5th iteration of the simulation (in blue). The other colored lines represent a heatmap of the degradation curves observed in the other iterations.*

Grid Hardening

During the grid hardening step, we check to see if an adjacent conductor or pole has been replaced. If so, the asset-related check is triggered. Since no adjacent conductors or poles have been replaced in the first five years of the simulation, this event is not triggered.

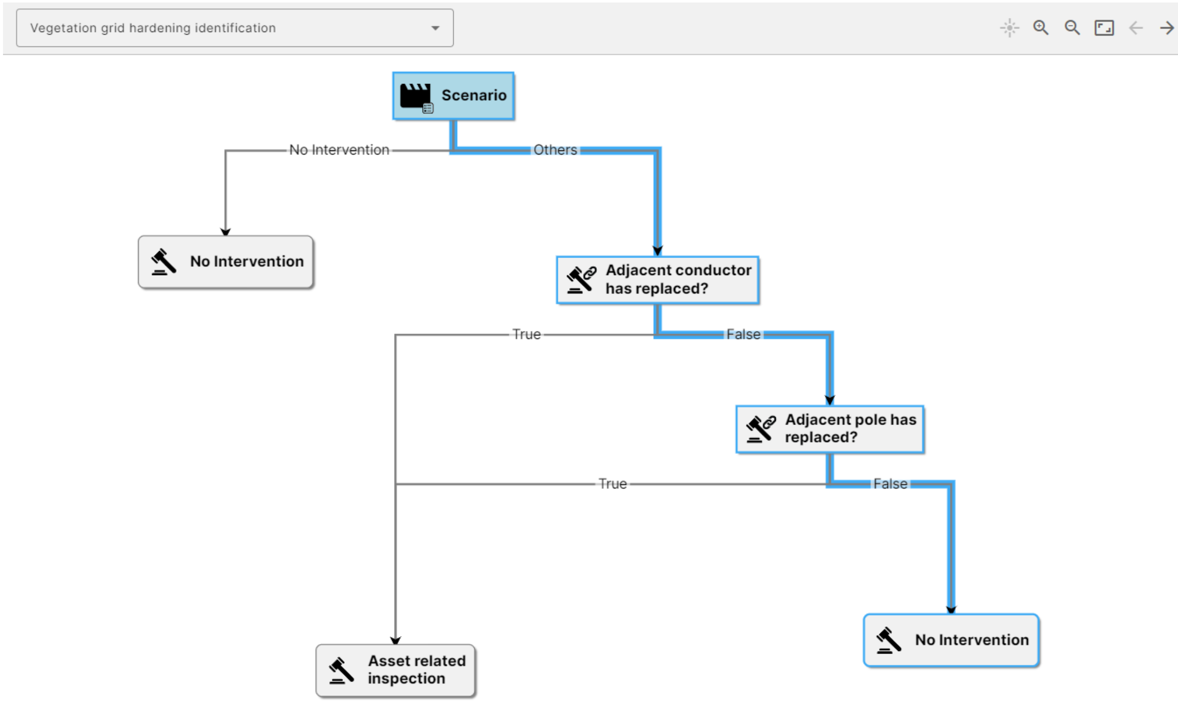


Figure 39. *Vegetation grid hardening decision tree of the selected vegetation area on years 2025 to 2030 of the 5th iteration.*

In the year 2031, when the TAH5201 - 3754 conductor is covered and its support poles are replaced, the asset-related check leaf of the decision tree is reached and, consequently, a value is sampled from a distribution built using work orders to determine the amount of additional vegetation management work to be performed in the Vegetation Management step.

Vegetation Inspection

Vegetation inspections follow an inspection cycle defined at the Liberty asset level and can be configured when running a simulation. The default cycle length is 3 years. Since the selected section has a detailed inspection scheduled for 2025, it will have another in 2028, and so on.

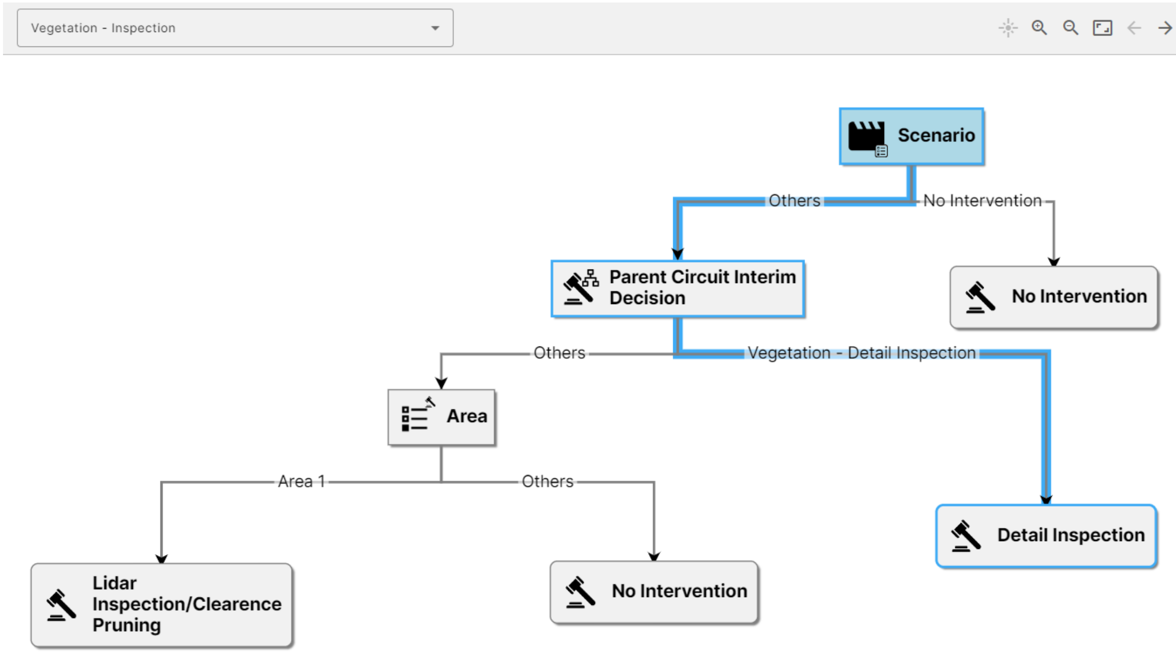


Figure 40. *Vegetation Inspection decision tree of the selected vegetation area on years 2025 of the 5th iteration.*

Vegetation Management

Vegetation management is done in two steps, first we look at the work that resulted from the vegetation inspection and the work that was sampled in the grid hardening step due to integrated asset interventions.

Then we look at the parent asset of the selected vegetation asset and perform vegetation work based on the parent section interim decision. It is important to note that when the Parent Section specifies that work must be done in an area, it also includes work to be done in areas closer to the power lines. For example, if a Section requires work to be done in Area 3, it will also require work to be done in Area 2 and Area 1.

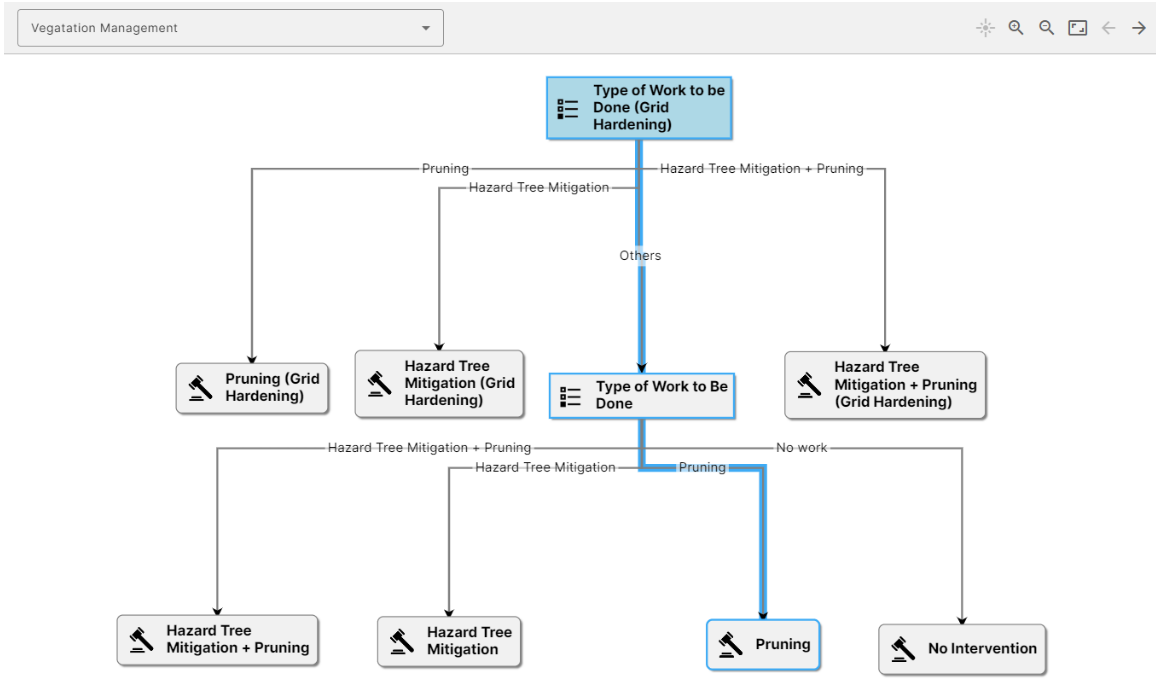


Figure 41. *Vegetation Management decision tree of the selected vegetation area on year 2031 of the 5th iteration.*

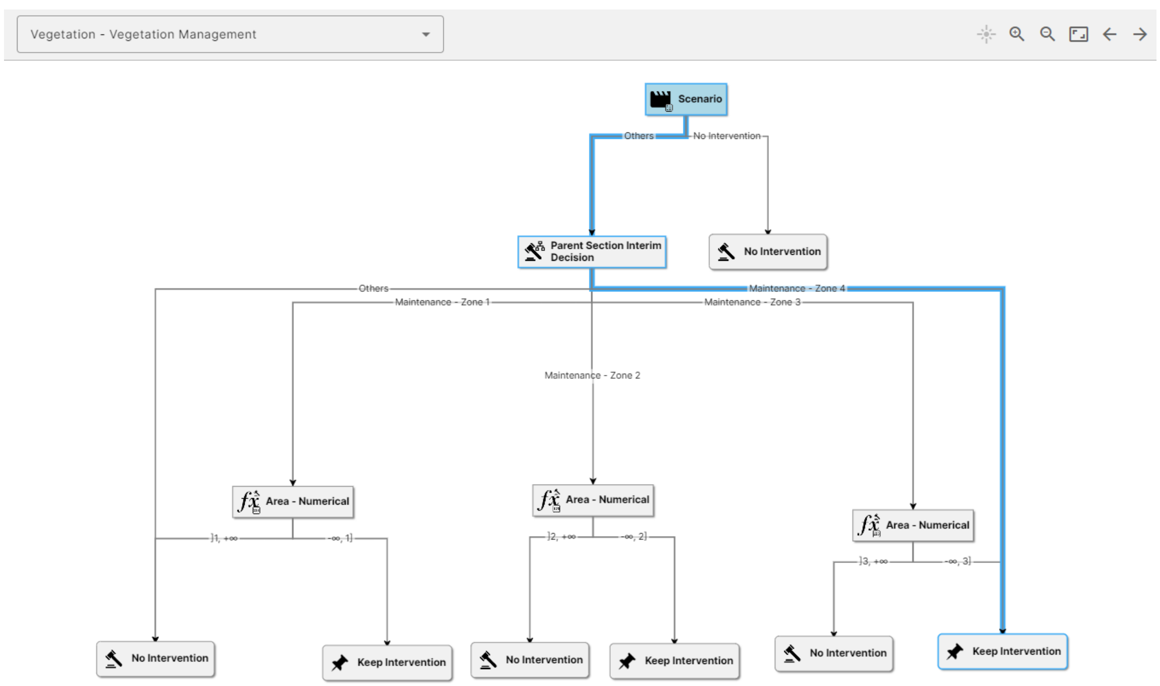


Figure 42. *Vegetation Management Descending decision tree of the selected vegetation area on year 2031 of the 5th iteration.*

12. Results

The DIREXYON suite offers complete transparency through the delivery of results in two distinct formats:

12.1 Individual Asset Level (Debug screen):

This format allows you to track the journey of each asset in each year based on each iteration, verifying the evolution of asset characteristics over time. It also enables the validation of specific interventions triggered at precise moments, providing insights into their impacts.

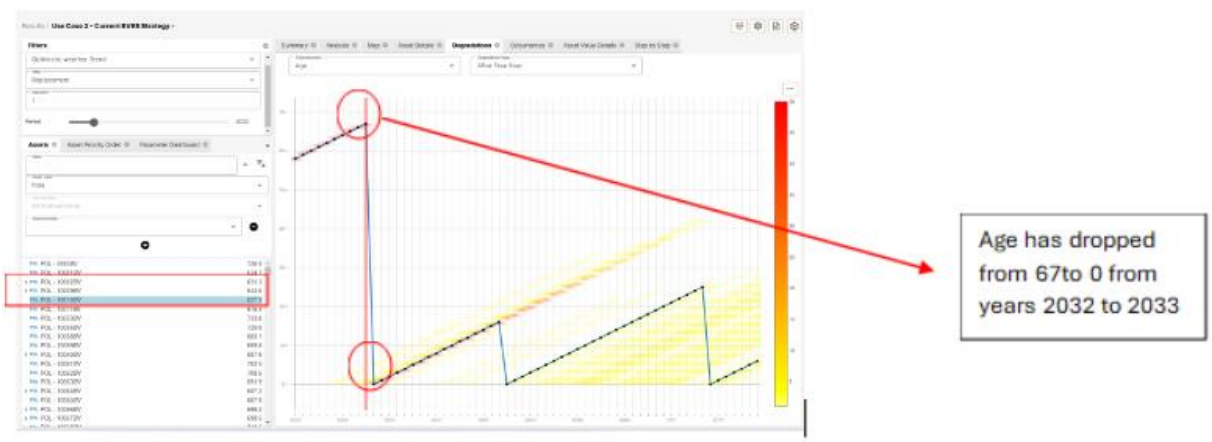


Figure 43. *Individual asset simulation details in DIREXYON*

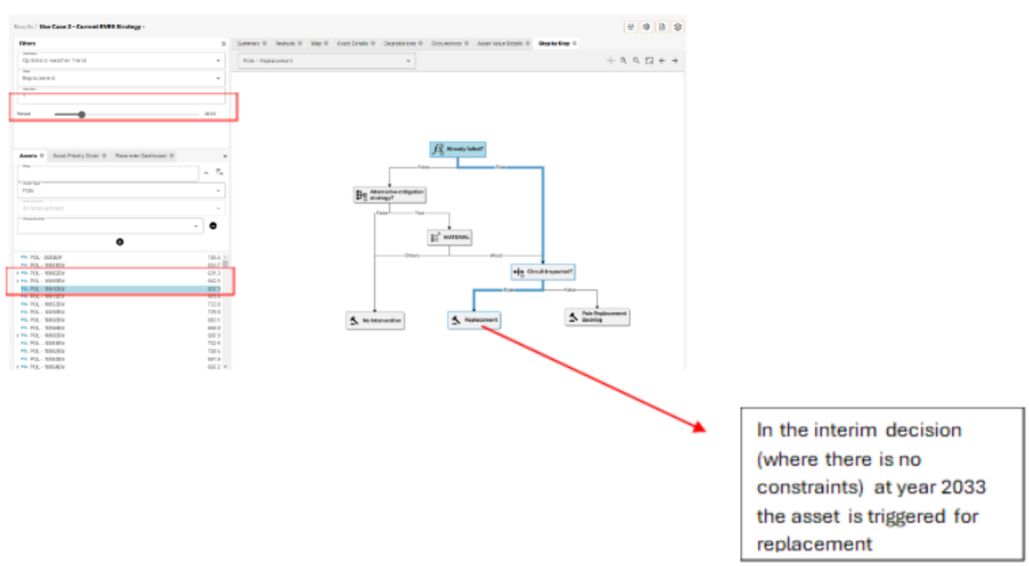


Figure 44. *Individual asset simulation step-by-step in DIREXYON*

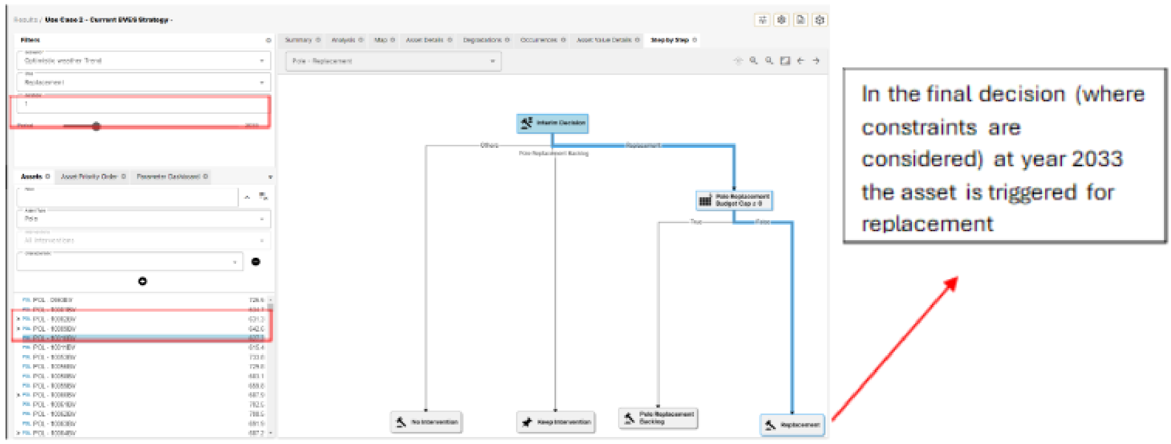


Figure 45. *Individual asset simulation step-by-step interim decision in DIREXYON*

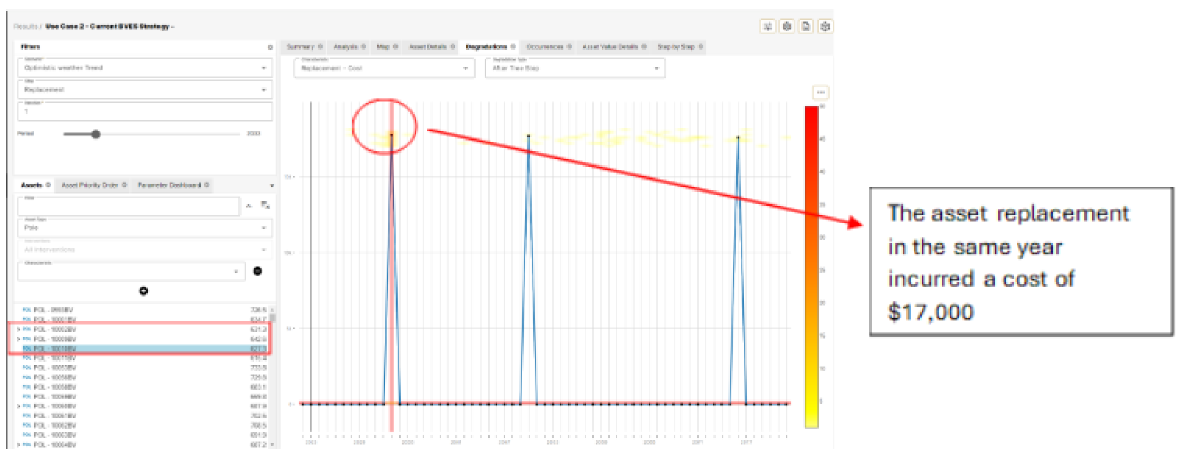


Figure 46. *Individual asset simulation details (cost) in DIREXYON*

The analysis results for an individual asset indicate that the asset will reach zero age by the year 2033. At this point, it is recommended that an intervention be initiated to address the age of the asset. Upon closer examination, the asset has indeed failed. With the available budgetary resources, the intervention involves replacing the asset in the same year. The consequences of this intervention are twofold: a triggered cost and the restoration of the asset's age, which had dropped to zero. The provided example serves as a simplified showcase of the functionality, and all specified characteristics for each individual asset can be monitored through the debug screen.

12.2 Aggregated Results (BI dashboard):

The simulation outcomes are presented in an aggregated format, offering a holistic view of the overall network condition, required investments, and other key performance indicators at a collective level. This format facilitates a comprehensive evaluation of the network's overall health and performance. The integrated dashboard within the DIREXYON suite offers versatile views, tailored to cater to various personas such as executives, asset managers, and more. These views can seamlessly switch between detailed insights and holistic overviews, providing a customized experience for different stakeholders.

12.2.1 Pole Dashboard

The Pole BI Dashboard can be accessed through [this hyperlink].

Overall Dashboard Page

This dashboard provides a comprehensive analysis of the poles during the simulation. The "Overall" page presents the fire risk of the circuit on the map of the normal simulation on a scale of 0 to 45. Additionally, you can view the condition modifier of each pole during the simulation by selecting the pole asset.

The two graphs on the right illustrate the evolution of the budget for the pole and their average condition modifier.

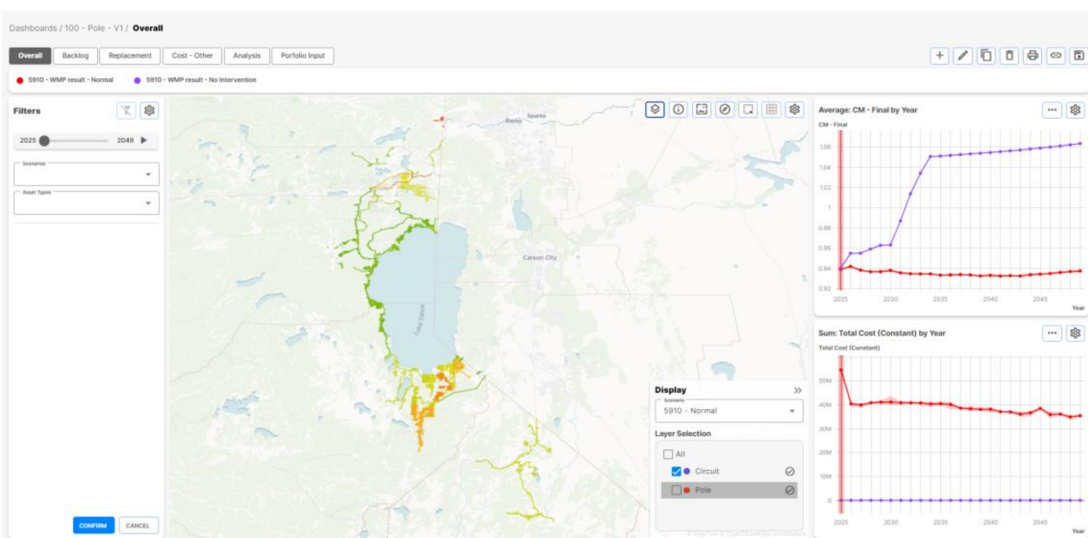


Figure 47. *Pole BI Dashboard – Overall page widgets*

Backlog

This page illustrates the evolution of the backlog for replacement, repair, and remedial treatment. These are determined by the imported backlog of the portfolio, which is provided by Liberty (except for the remedial treatment backlog). This explains why the scenario "No Intervention" has a backlog. In this case, we observe an increase in the backlog for the normal scenario due to Liberty identifying more poles for replacement than the number to be replaced annually during the inspection. Some configuration adjustments, such as adjusting the inspection cycle and budget, could address this problem directly.

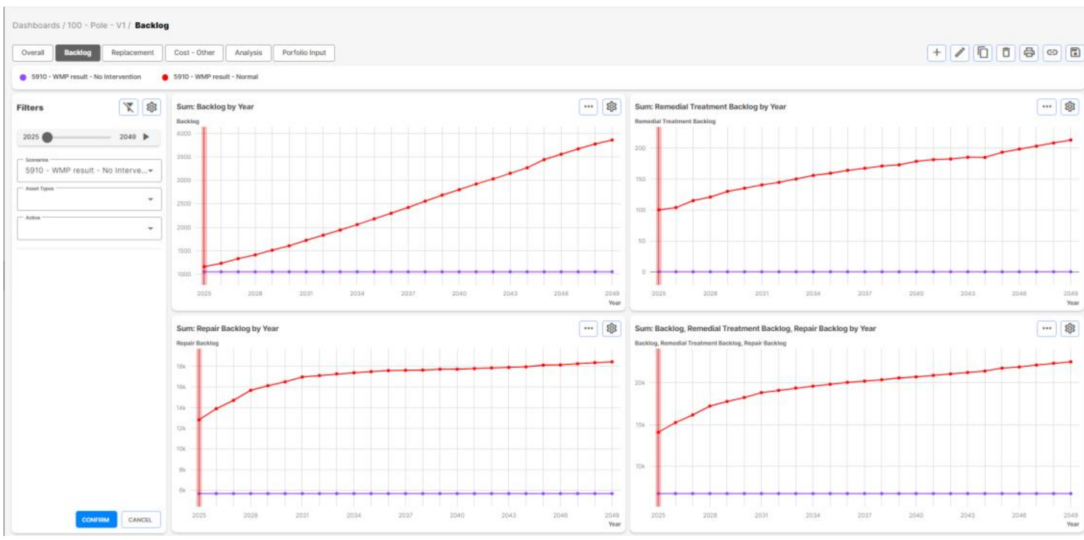


Figure 48. *Pole BI Dashboard – Backlog page widgets*

Replacement

This page illustrates the distinction between cost categories for pole replacements. The lines exhibit a consistent pattern due to the lack of granularity in the cost model. On certain pages, particularly for poles, the "Active" filter is essential to prevent the exclusion of inactive poles from the calculation of an average.

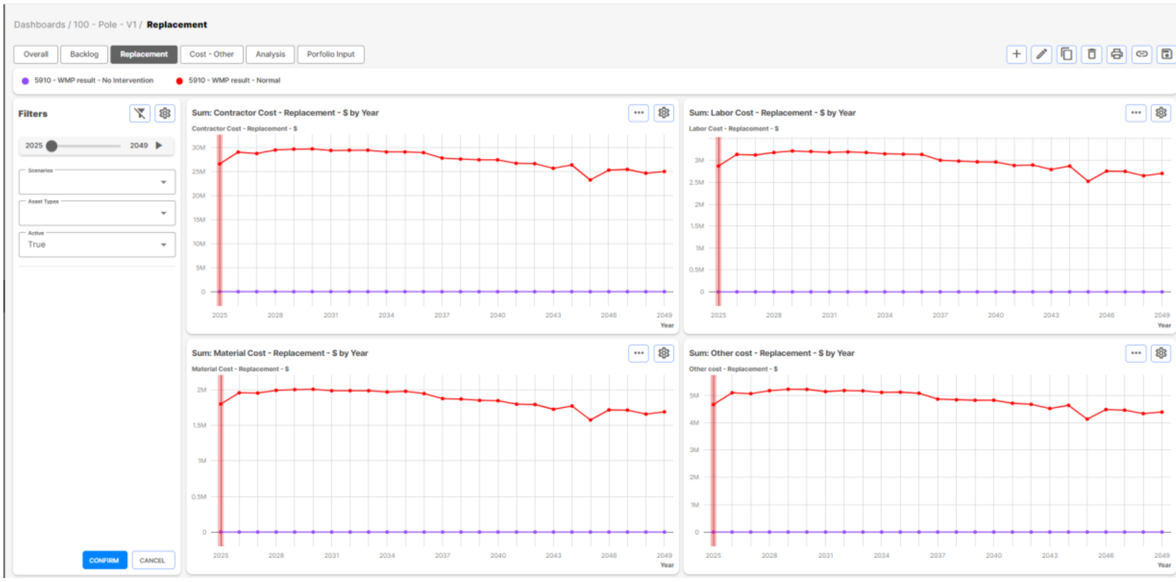


Figure 49. *Pole BI Dashboard – Replacement page widgets*

Cost - Other

This page displays the cost of inspection, repair, and remedial treatment. For instance, we can ascertain that the cost of repair and remedial treatment is $0 throughout the simulation. This is likely due to insufficient budget, as no interventions are triggered during the simulation.

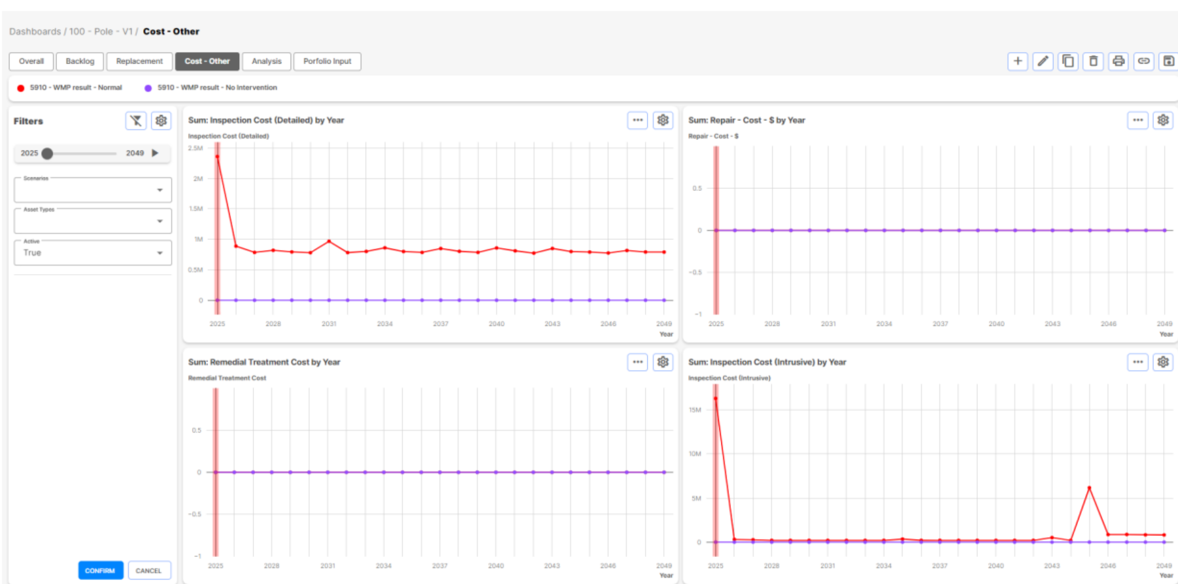


Figure 50. *Pole BI Dashboard – Cost (other) page widgets*

Analysis

This page presents various metrics, including the number of replacements per year and the evolution of risk across different metrics. The risk matrix is a 9x9 grid that provides a visual representation of risk, calculated using the product of the [1-9] POI and [1-9] COF scores. It helps determine the number of assets distributed in each cell. The risk matrix corresponds to a given year in the year filter on the left.

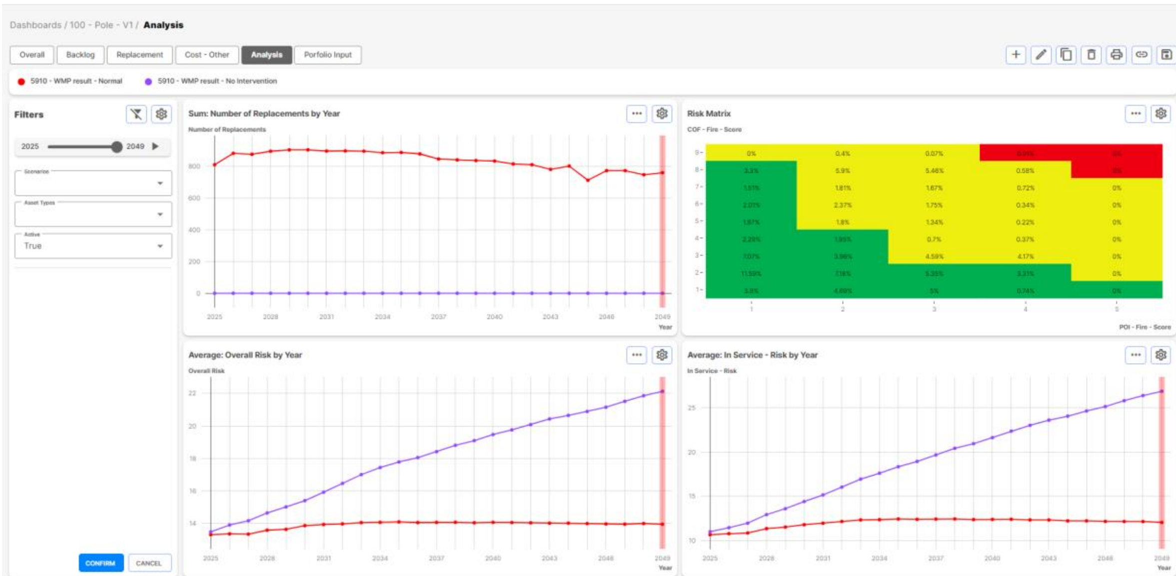


Figure 51. *Pole BI Dashboard – Analysis page widgets*

Portfolio Output

This page displays the output portfolio result and enables users to compare different configurations of the portfolio. The portfolio selects a set of intervention types, which are configurable, during the first 10 years. These types allow for the aggregation of metrics such as in-service or fire risk reduction benefits scoring after interventions have occurred. The figure below shows the evolution of the benefits over the years and the overall risk on the map. In this instance, the results demonstrate that pole replacements offer greater "in-service risk" reduction than "fire risk" reduction.

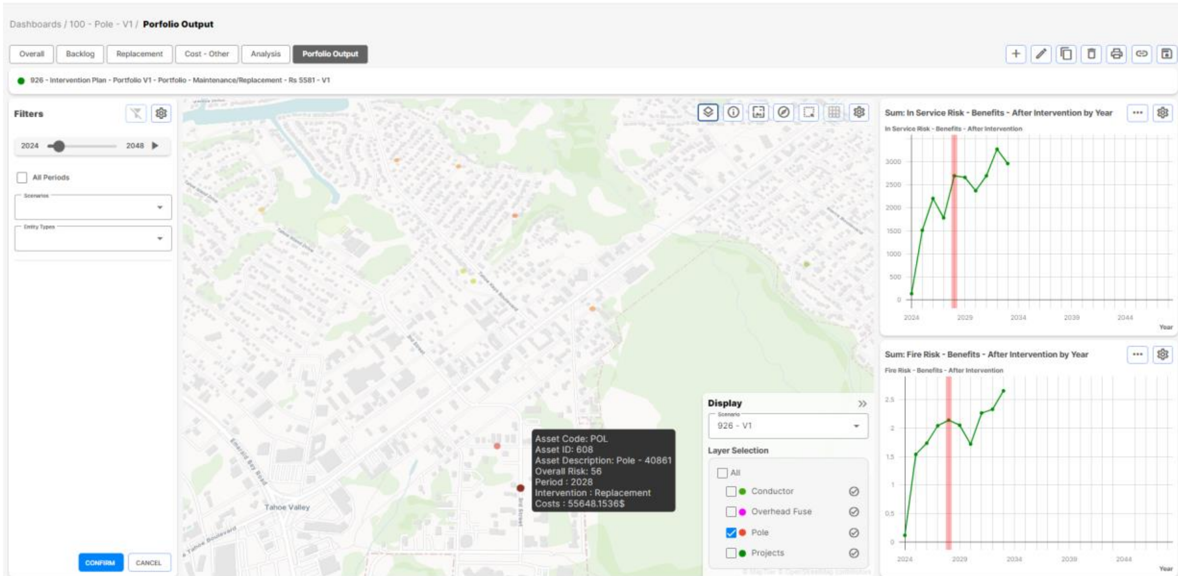


Figure 52. *Pole BI Dashboard – Portfolio output*

12.2.2 Vegetation

The Vegetation BI Dashboard can be accessed through [this hyperlink](#).

Overall

The graphs below provide an overview of the vegetation. As with poles, the figure below shows the intervention costs for this asset type and the average CM.

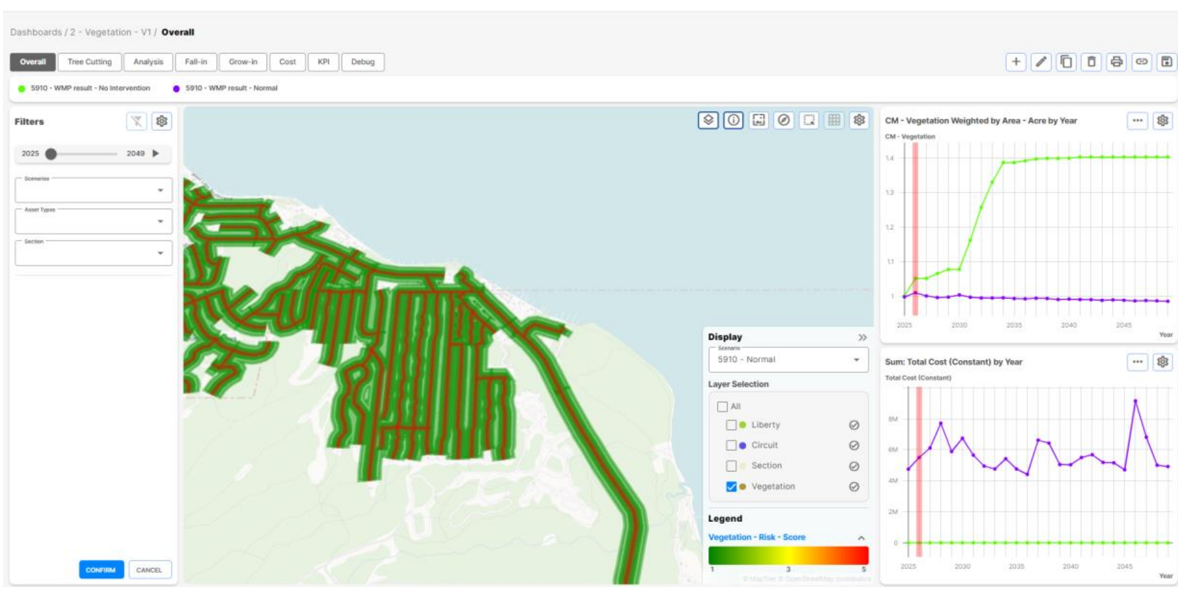


Figure 53. *Vegetation BI Dashboard – Overall page widgets*

Tree Cutting

The figure below illustrates key performance indicators (KPIs) related to vegetation interventions, including the number of trees cut, the number of miles pruned, and the total area covered for a specific intervention. It also displays key performance indicators (KPIs) for miles and acres, as shown in the graphs. Circuit-specific metrics can be displayed by applying a filter by circuit.

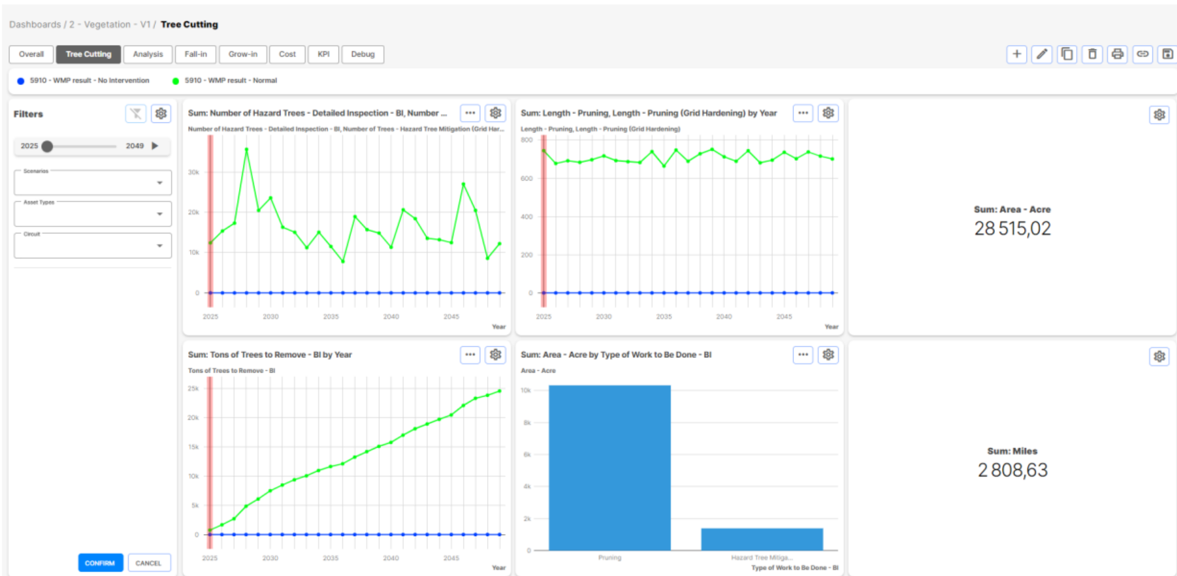


Figure 54. *Vegetation BI Dashboard – Tree cutting page widgets*

Analysis

The figure below illustrates the metrics on tree density and compares the scenario of no interventions and the scenario of interventions according to a yearly cycle. The bar graph is linked to the filter of year on the left and shows the difference between the end and the start of the simulation.

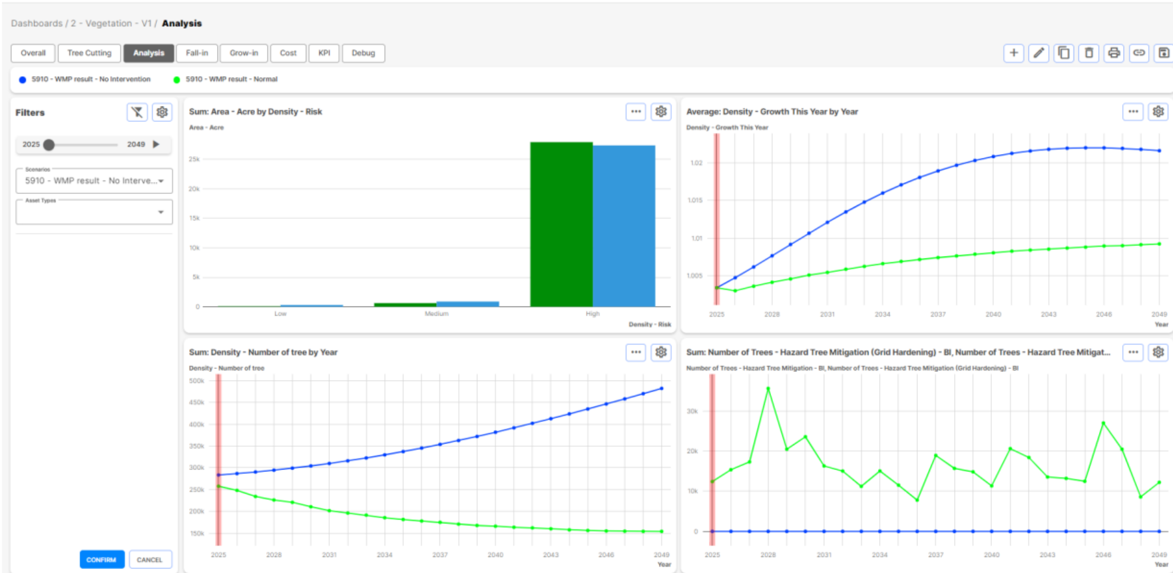


Figure 55. *Vegetation BI Dashboard – Analysis page widgets*

Cost

The figure below illustrates the distribution of costs associated with inspections and vegetation management. Filters on the left-hand side enable users to view cost metrics by intervention type.

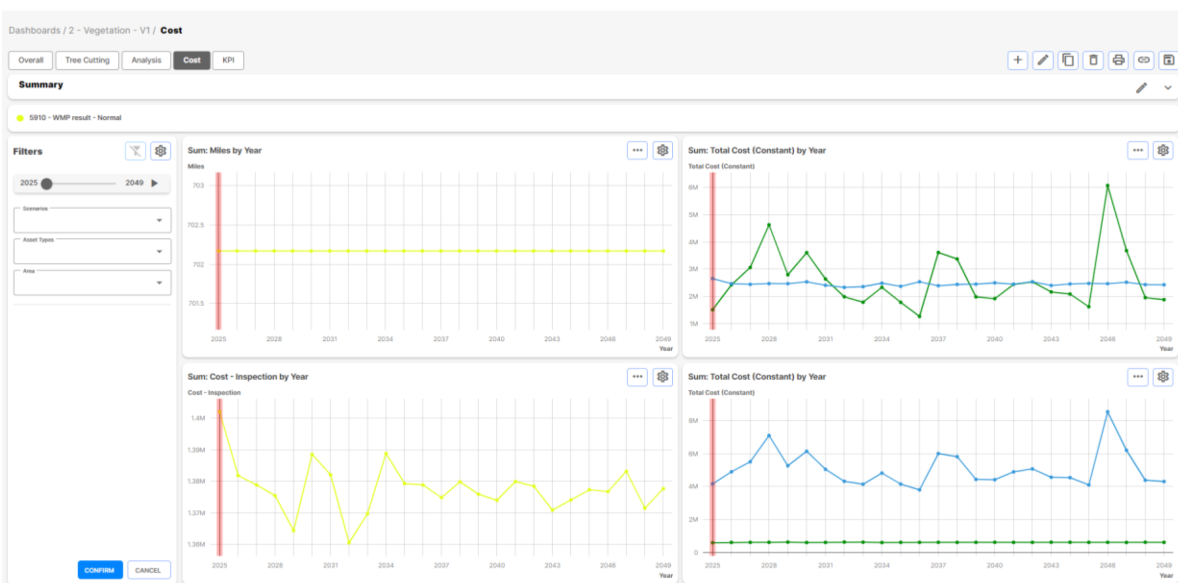


Figure 56. *Vegetation BI Dashboard – Cost page widgets*

12.2.3 Conductor

The Conductor BI Dashboard can be accessed through [this hyperlink].

Overall

This dashboard provides a comprehensive analysis of conductors during the simulation. The "Overall" page presents the fire risk of the circuit on the map of the normal simulation on a scale of 0 to 45. Additionally, you can toggle to view the condition modifier of each conductor during the simulation by selecting the conductor asset.

The two graphs on the right illustrate the evolution of the budget for conductors and their average condition modifier.

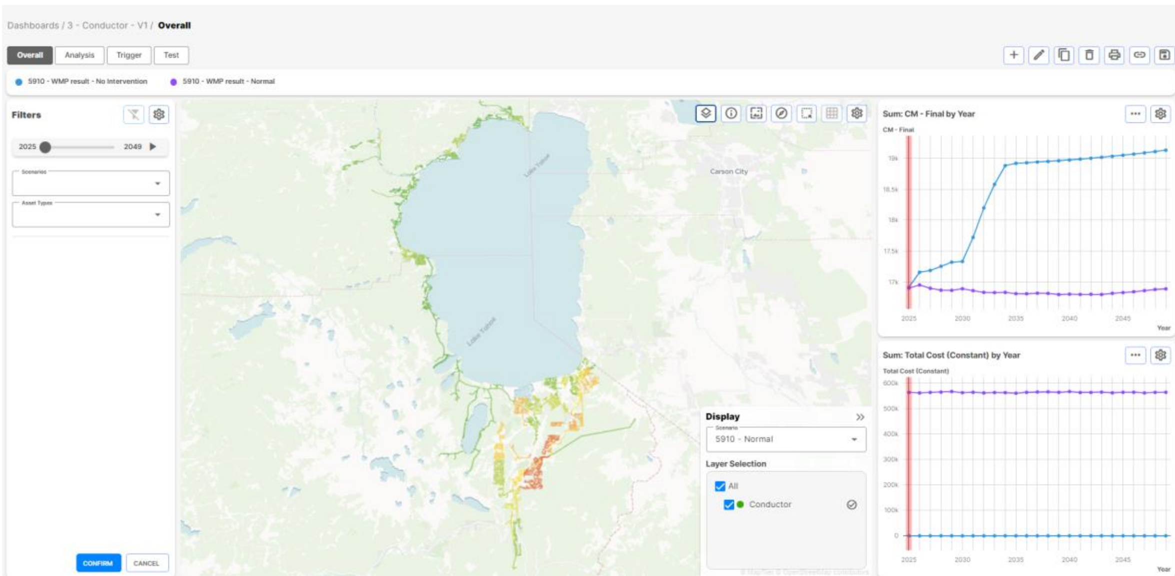


Figure 57. *Conductor BI Dashboard – Overall page widgets*

Analysis

The figure below provides information about the length of the span for various materials. Users can apply filters to display metrics according to conductor characteristics, such as conductor type. In this scenario, the covered conductor length remains consistent throughout the simulation, indicating that no budget was allocated for covered conductor replacements in the simulation configuration.

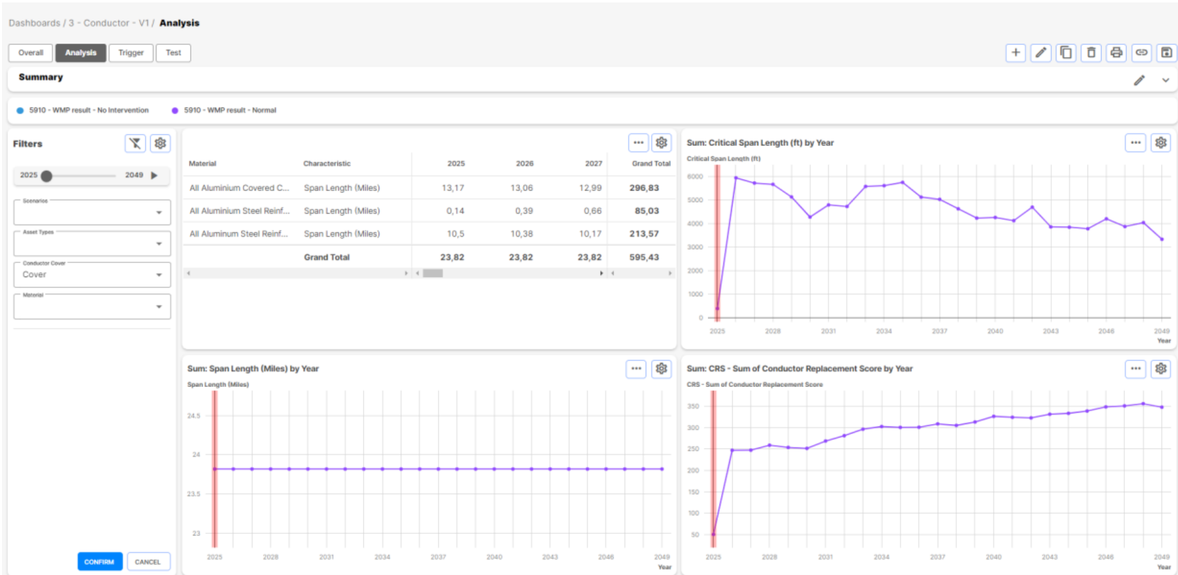


Figure 58. *Conductor BI Dashboard – Analysis page widgets*

12.2.4 BI Strategic

The BI Strategic Dashboard can be accessed through [this hyperlink](#).

Overall

This page represents the evolution of cost and risk/spend efficiency based on the reduction of fire risk in each circuit. To scale the graph correctly, the risk is multiplied by 100,000. Therefore, the ratio of fire risk reduction to cost is the risk-spend efficiency (RSE).

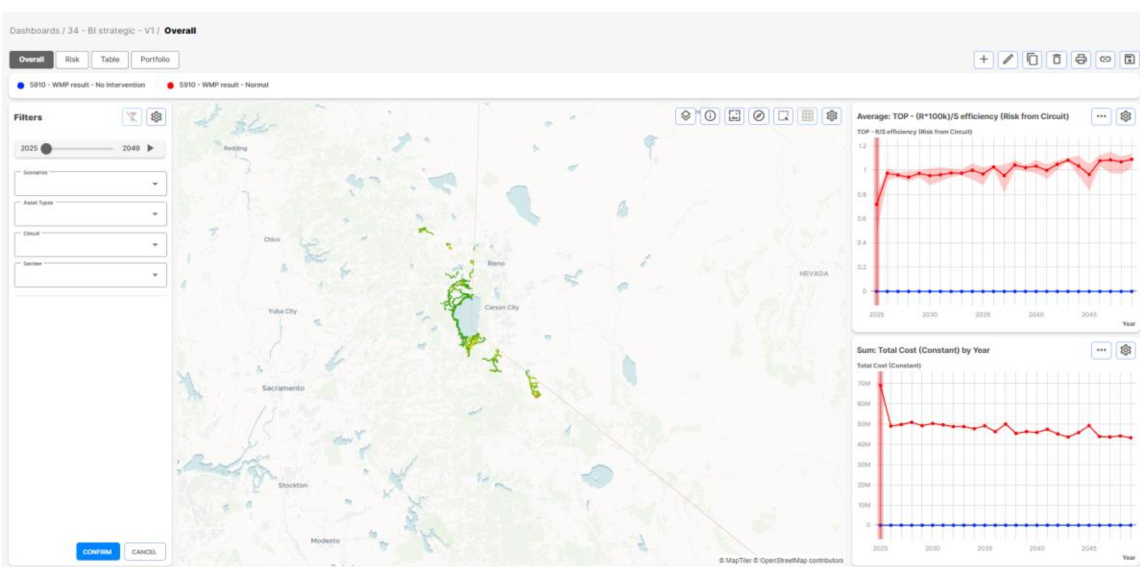


Figure 59. *BI Strategic Dashboard – Overall page widgets*

Risk

This page enables users to identify one or more circuits and observe how the condition modifiers affecting risk evolve throughout the simulation.

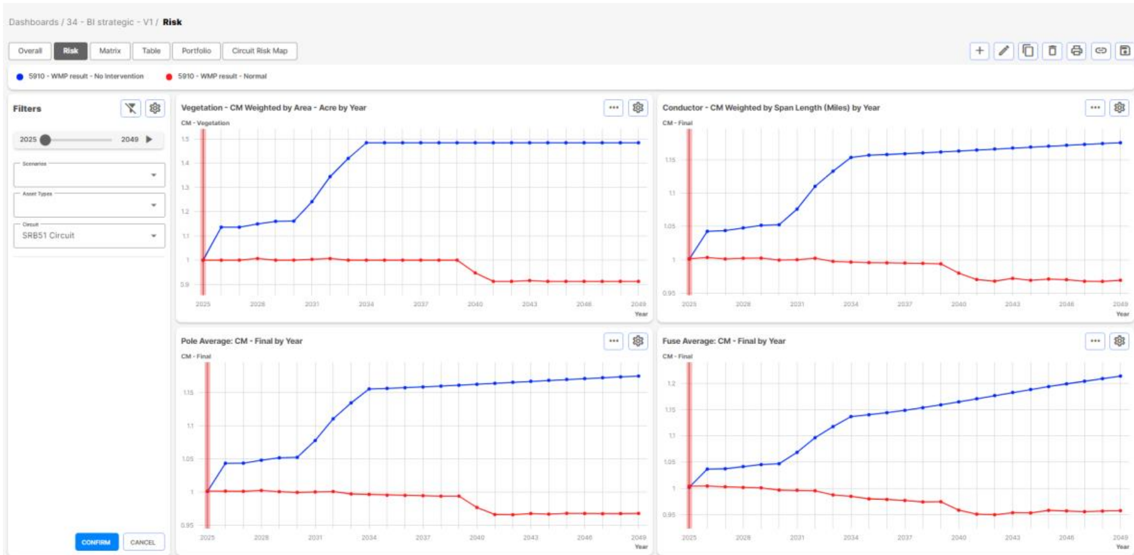


Figure 60. *BI Strategic Dashboard – Risk page widgets*

13. References

[1] *2022 WMP Update progress report*. Pacificorp. (2022).

[2] Aoyagi-Stom, C. (2018, December 20). *Covered conductor helps reduce wildfire risk*. Energized by Edison. https://energized.edison.com/stories/insulated-wires-help-reduce-wildfire-risk

[3] Barnett, K., Aplet, G. H., & Belote, R. T. (2023). Classifying, inventorying, and mapping mature and old-growth forests in the United States. *Frontiers in Forests and Global Change*, *5*. https://doi.org/10.3389/ffgc.2022.1070372

[4] Bravo, R., Pham, E., Luy, A., Rorabaugh, J., & Hutchinson, E. (2020). 12kV covered conductor testing. *2020 IEEE/PES Transmission and Distribution Conference and Exposition (T&D)*. https://doi.org/10.1109/td39804.2020.9300013

[5] *CPUC general orders*. California Public Utilities Commission. (2024). https://www.cpuc.ca.gov/Home/Proceedings-and-Rulemaking/CPUC-general-orders

[6] Luy, A. (2020, December 14). *Covered conductor: A wildfire mitigation solution*. T&D World. https://www.tdworld.com/wildfire/article/21146172/covered-conductor-a-wildfire-mitigation-solution

[7] Sleeter, B. M., Frid, L., Rayfield, B., Daniel, C., Zhu, Z., & Marvin, D. C. (2022). Operational assessment tool for forest carbon dynamics for the United States: A new spatially explicit approach linking the lucas and CBM-CFS3 models. *Carbon Balance and Management*, *17*(1). https://doi.org/10.1186/s13021-022-00201-1

[8] *Wildfire mitigation reference guide*. North American Electric Reliability Corporation. (2021, January). https://nerc.com/comm/RSTC/Documents/Wildfire Mitigation Reference Guide_January_2021.pdf

14. Appendix 1 – Tables and Charts

14.A. Zone based condition modifier for vegetation (grow-in and fall-in)

Initial Vegetation Zone	Current Vegetation Zone	Condition Modifier Value
Zone 1	Zone 1	1
Zone 1	Zone 2	0,75
Zone 1	Zone 3	0,5
Zone 1	Zone 4	0,25
Zone 1	NA	0
Zone 2	Zone 1	1,25
Zone 2	Zone 2	1
Zone 2	Zone 3	0,75
Zone 2	Zone 4	0,5
Zone 2	NA	0,25
Zone 3	Zone 1	1,5
Zone 3	Zone 2	1,25
Zone 3	Zone 3	1
Zone 3	Zone 4	0,75
Zone 3	NA	0,5
Zone 4	Zone 1	1,75
Zone 4	Zone 2	1,5
Zone 4	Zone 3	1,25
Zone 4	Zone 4	1
Zone 4	NA	0,75
NA	Zone 1	2
NA	Zone 2	1,75
NA	Zone 3	1,5
NA	Zone 4	1,25
NA	NA	1

14.B Weather Scenario – Triangular Distribution Parameters

Scenario	Minimum	Mode	Maximum
Random	0	0	0
Optimistic (20th Percentile)	-0.2	0	0.2
Normal (50th Percentile)	-0.15	0	0.15
Pessimistic (90th Percentile)	-0.05	0	0.05

14.C Vegetation Growth – Triangular Distribution Parameters

Tree Species	Minimum	Mode	Maximum
Jeffrey Pine	2	2.5	3
Lodgepole Pine	0.25	0.375	0.5
Quaking Aspen	2	2.5	3
White Fir	1	1.25	1.5
Other Wester Soft-woods	0.771	1.6405	2.1325

14.D GO165 Inspection Cycle Requirements

	Patrol		Detailed		Intrusive	
	Rural	Urban	Rural	Urban	Rural	Urban
Overhead Conductors	1	2	5	5	---	---
Wood Poles under 15 years	1	2	x	x	---	---
Wood Poles under 15 years which have not been subject to intrusive inspection	1	2	x	x	---	---
Wood Poles under 15 years which passed intrusive inspection	1	2	x	x	10	10
Overhead Transformers	1	2	5	5	---	---

Source: GO 95 128 & 165 Seminar (CPUC Utilities Safety and Reliability Branch) [5]

Reax Engineering, Inc.
Job # 21-1045

Wildfire Probability, Consequence, and Risk Modeling

Prepared for Liberty Utilities

April 14, 2021

Approved by:

Chris Lautenberger, PhD, PE

Document Revision History

Job #	Job Name	Client
21-1045	Wildfire Probability, Consequence, and Risk Modeling	Liberty Utilities

Revision #	Date	Description	
Rev 0	April 14, 2021	Initial draft.	
		Prepared by: Chris Lautenberger, PhD, PE	**Approved by:** Chris Lautenberger, PhD, PE
		Prepared by:	**Approved by:**
		Prepared by:	**Approved by:**
		Prepared by:	**Approved by:**
		Prepared by:	**Approved by:**

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		50th	60th	70th	80th	90th	95th	97th	98th	99th	99.9th
Transmission	111 - 120 KV (Meyers-Buckeye)	484.4	649.8	843.3	1083.1	1465.8	1854.1	2115.0	2302.7	2603.3	3434.0
	608 - 60kV (Hirschdale Line Tie)	77.8	126.5	190.8	294.0	454.4	593.1	669.9	739.9	869.3	1513.2
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	608 - 60kV (Truckee-North Truckee-I-80)	126.3	174.6	250.2	364.1	497.7	606.2	705.7	810.0	1019.0	1728.9
	160 - 120 KV (Round Hill-Cal Border)	243.7	304.5	368.3	468.1	613.4	746.6	843.5	943.6	1131.3	1588.1
	629 - 60kV (Squaw Valley-Tahoe City)	194.6	231.7	276.0	337.8	430.8	510.8	567.1	610.5	692.5	1052.8
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	669 - 60kV (Northstar-Kings Beach)	141.2	208.2	285.6	373.0	548.9	723.2	838.2	929.2	1114.0	1839.0
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	625 - 60kV (Tahoe City-Kings Beach)	83.8	114.8	162.1	245.5	363.4	524.6	644.3	726.6	850.4	1226.1

1.0 INTRODUCTION

Reax Engineering Inc. (Reax) has been retained by Liberty Utilities (Calpeco Electric) LLC (hereafter, Liberty) to conduct a wildfire probability/consequence analysis across its service territory. This report documents that work and is organized as follows:

- Section 2.0: Historical outage data were analyzed to quantify outage probability as a function of environmental variables, primarily wind gust.
- Section 3.0: The outage probability model in the previous step was used to estimate ignition rates.
- Section 4.0: Fire modeling methodology and inputs that were used to quantify consequences of ignitions that occur in proximity to overhead electric lines is explained.
- Section 5.0: Fire modeling outputs are explained and instructions for accessing underlying GIS data are provided.
- Section 6.0: Limitations of these modeling efforts are explained.

2.0 ESTIMATING OUTAGE RATES

To facilitate correlation of outage occurrence rates with wind and weather conditions within its service territory, Liberty Utilities provided Reax with outage data comprising approximately 1,300 forced outage records from 2017 to 2021. This data included approximately 1,300 individual outage records, with outage time and coordinates (latitude & longitude) of the operating device for each outage. The location of the operating device is unlikely to be the same as the location of the initiating event (*e.g.*, vegetation contact).

These data were analyzed to quantify outage rates (outages / line mi / hr) as a function of wind gust and temperature. Weather conditions at the location and time of each outage were determined from the Real Time Mesoscale Analysis (RTMA) dataset [1] which provides hourly estimates of sensible weather variables on a 2.5 km grid for the Continental US.

Although using RTMA data to determine weather conditions at the time and location of each outage is straightforward, additional steps are necessary to correlate outage occurrence rate (outages / line mi / hr) with environmental variables. The primary steps are:

1. Establish discrete wind gust / temperature bins and count the number of outages that occur in each discrete bin using RTMA data,
2. Determine the length of overhead conductor (in line miles) for each RTMA grid cell,
3. Determine the number of line mile-hours that Liberty's overhead lines spent in each wind gust / temperature bin over the period for which outage data are available (2017-2021),
4. Calculate outage rate for each bin as outages (Step 1) divided by line mile-hours (Step 3),
5. Develop a correlation that provides an estimate of outage rate (outages / line mi / hr) as a function of wind gust and temperature.

2.1.1 Step 1: Outage occurrence in discrete wind gust & temperature bins

Temperature was binned in 2 °F increments and wind gust was binned in 2 mph increments. The number of outages in each 2 °F × 2 mph bin was determined from RTMA data. This is shown graphically in Figure 1 where the colors correspond to the logarithm of the number of outages in each wind gust / temperature bin.

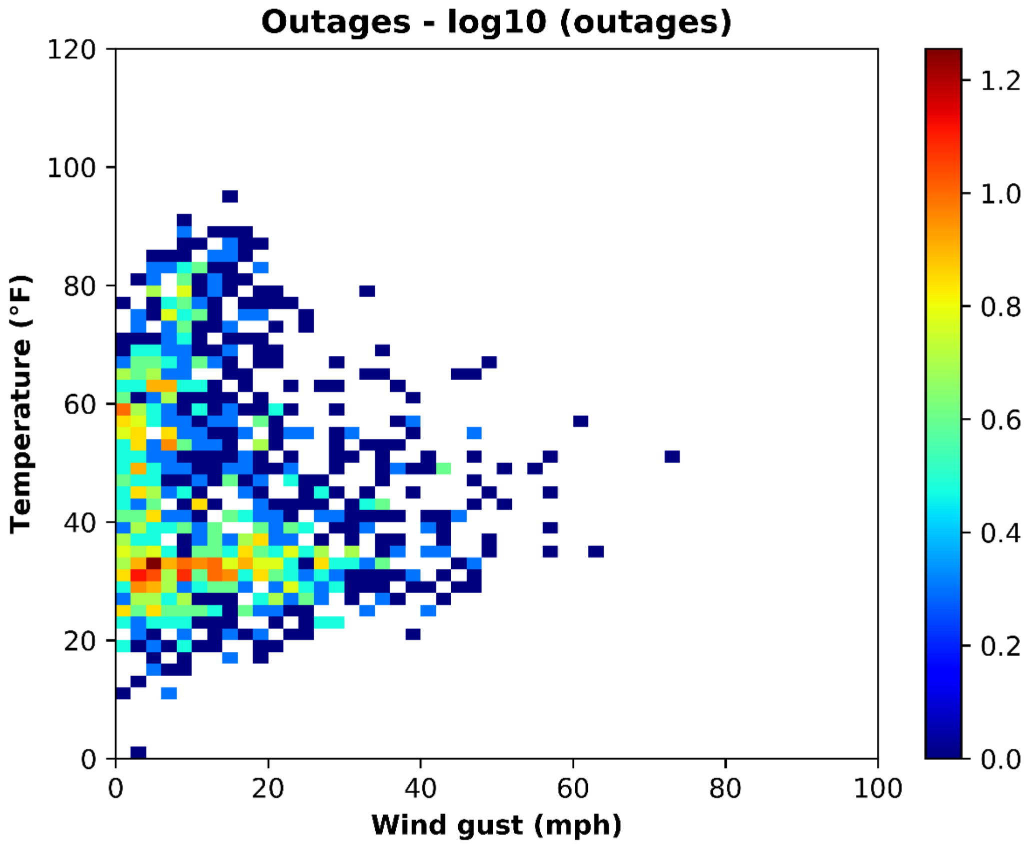


Figure 1. Outages ($\log_{10}$ color ramp) per discrete RTMA temperature & wind gust bin.

2.1.2 Step 2: Overhead line miles density on RTMA grid

The length of conductor in each 2.5 km RTMA grid cell was determined. Figure 2 shows the length of conductor (line mi) for overhead conductors, including transmission, primary distribution, and secondary distribution.

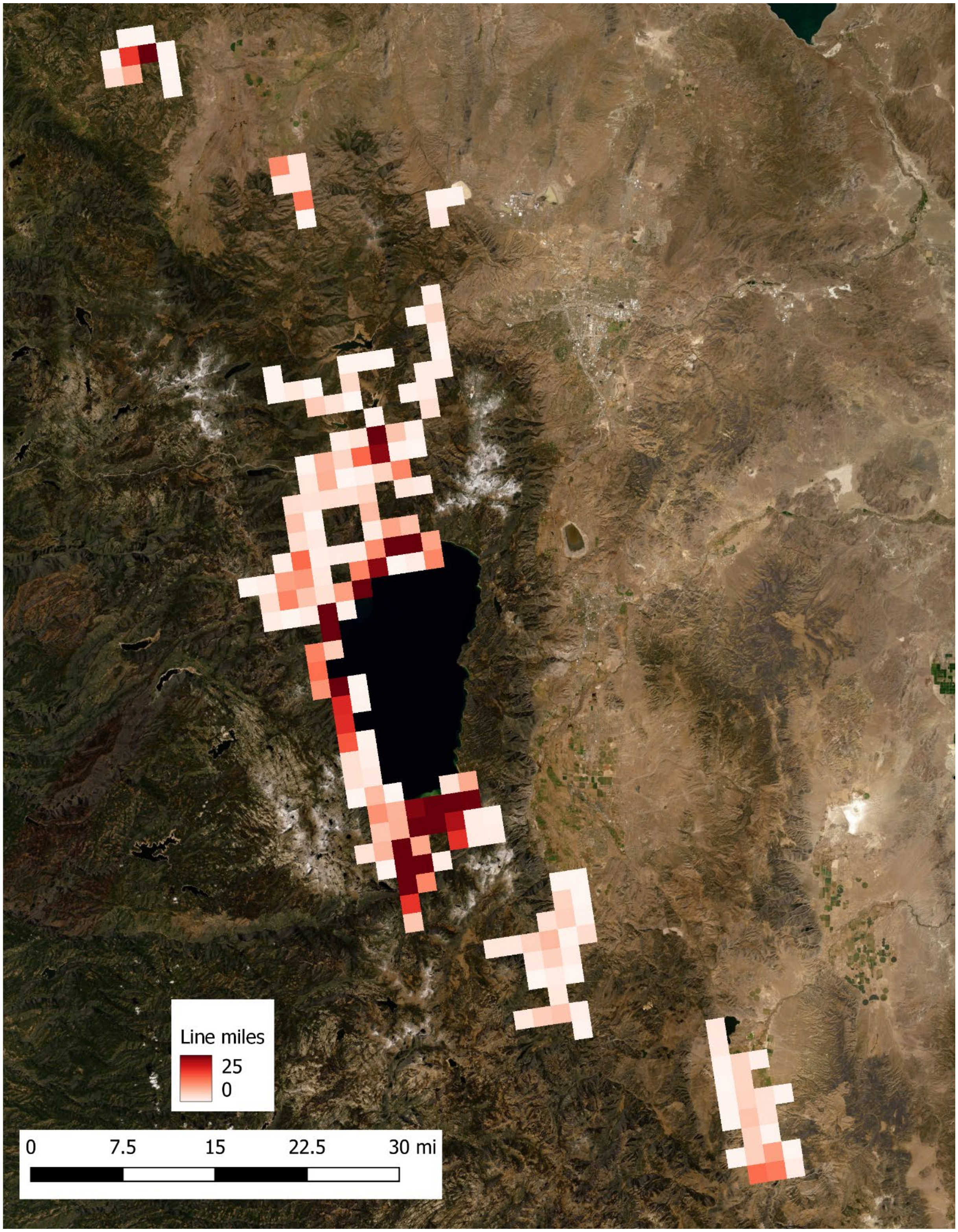


Figure 2. Line miles per RTMA grid cell.

2.1.3 Step 3: Line mile hours per bin

The conductor density map in Figure 2 was used to determine the number of line mile hours that Liberty's overhead electrical system spends in discrete temperature / wind gust bins. Instead of counting outages per bin as in Step 1, line mile-hours per bin is summed. This was done by looping temporally over the RTMA climatology and, for each grid cell containing overhead electrical infrastructure, determining the corresponding 2 °F × 2 mph bin. The number of line mile-hours in that bin was then incremented by the number of line mile-hours in the RTMA grid cell. This was repeated for each hour from 2017 – 2021, and the result is shown graphically in Figure 3. Note that as with outage counts (Figure 1), a logarithmic color scale is used.

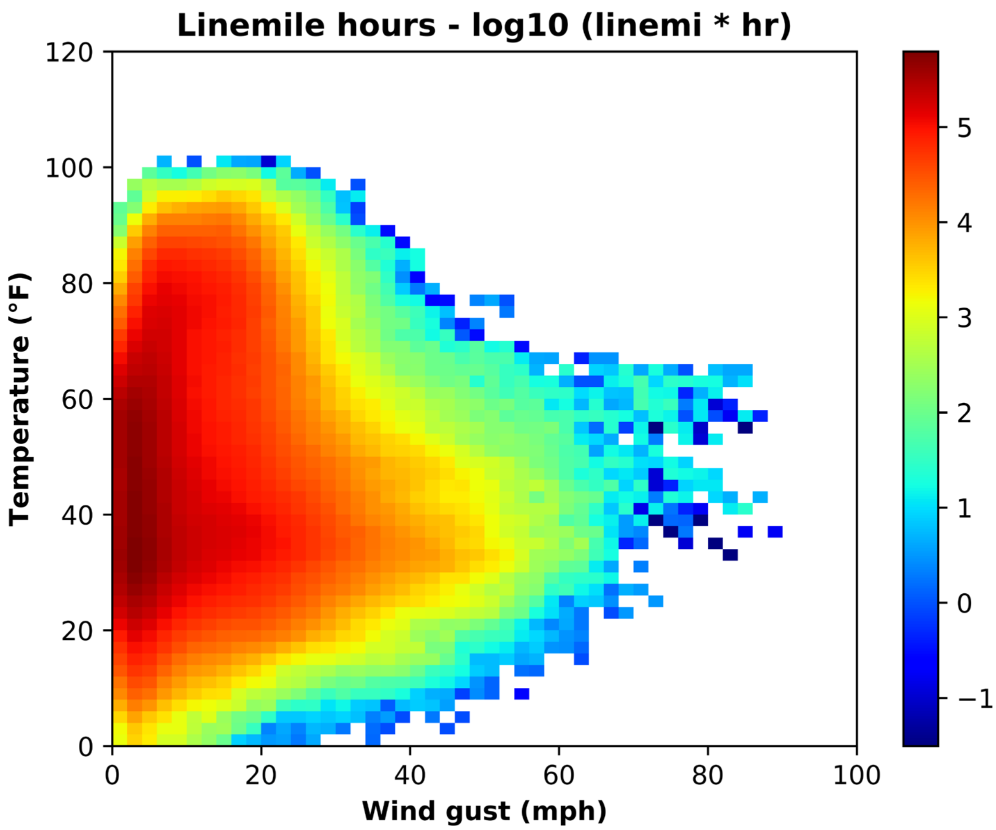


Figure 3. Line mile-hours (log_{10} color ramp) per temperature & wind gust bin.

2.1.4 Step 4: Outages per line mile hour per temperature & wind gust bin

With outages (Step 1) and line mile-hours (Step 3) now determined for each wind gust and temperature bin, outages per line mile per hour was calculated by dividing the matrix from Step 1 (outages) by the matrix from Step 3 (line mile hours). The result is shown graphically in Figure 4.

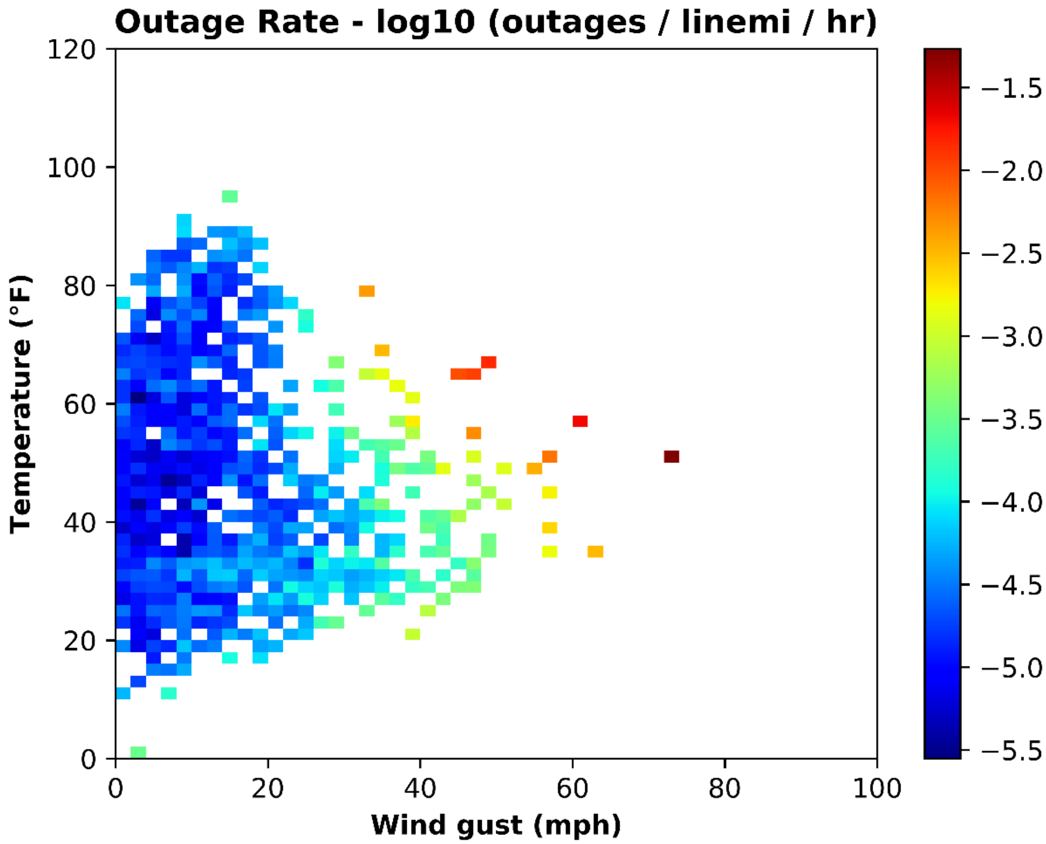


Figure 4. Outages ($\log_{10}$ color ramp) per line mile per hour.

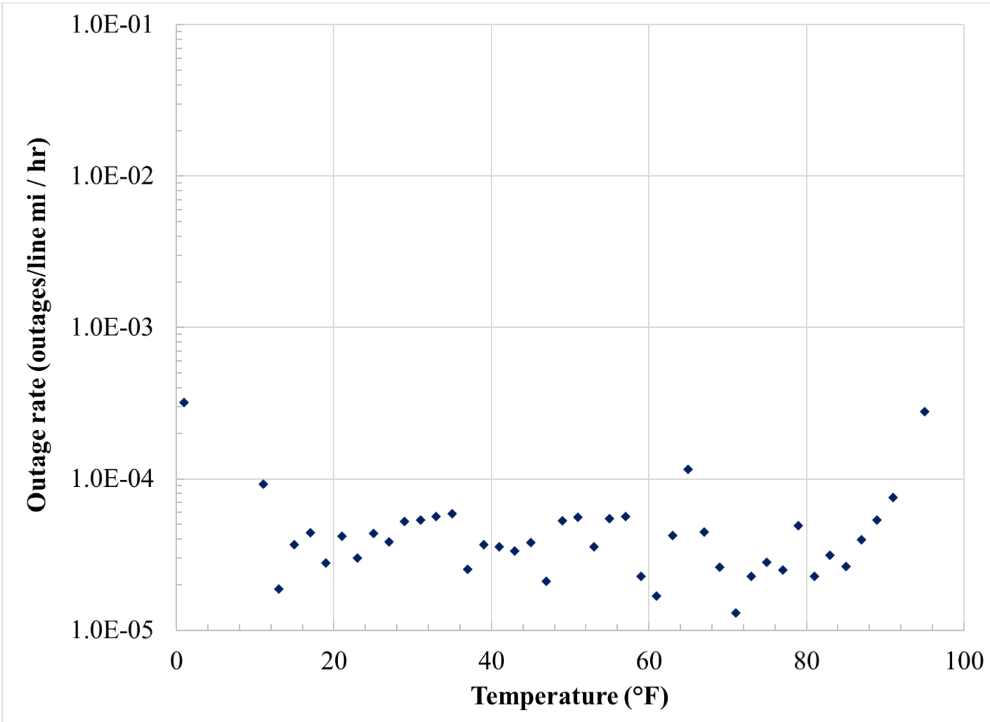
2.1.5 Step 5: Correlation of outages / line mile / hour with temperature & wind gust

The data shown in Figure 4 were used to correlate outage rate as a function of wind gust and temperature. The effect of wind gust and temperature on outage occurrence rate were first examined separately by plotting outage rate as a function of temperature independent of wind gust (Figure 5a) and as a function of wind gust independent of temperature (Figure 5b).

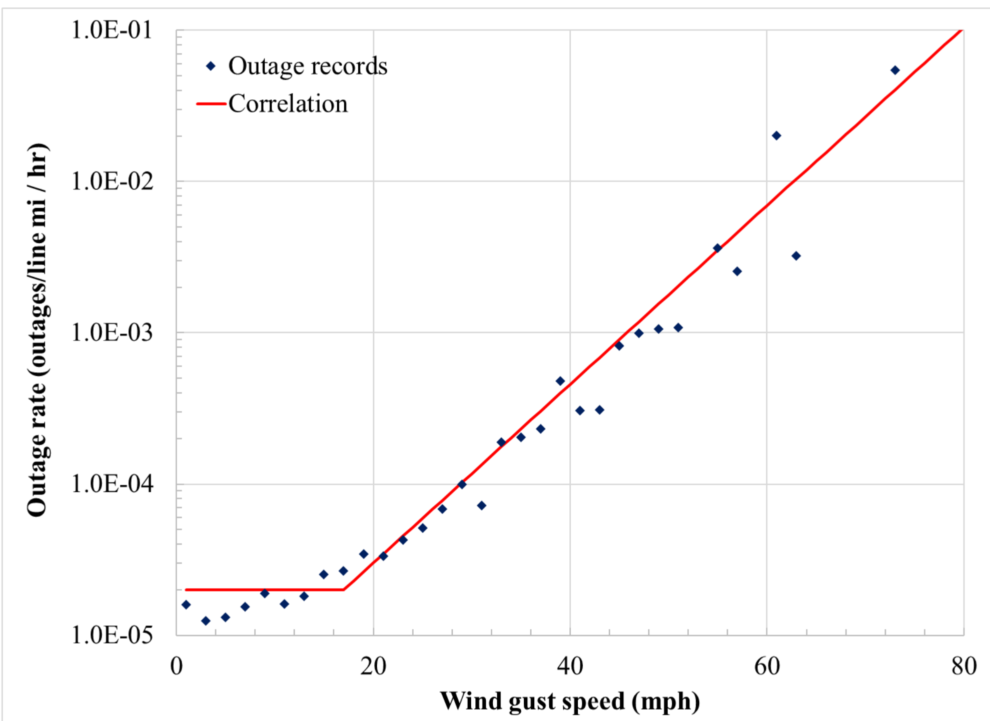
Figure 5a shows that outage occurrence rate is a weak function of temperature. Conversely, outage occurrence rate is a strong function of wind gust speed, varying by over three orders of magnitude between 20 mph and 70 mph. The data in Figure 5b are well-fit by Equation 1 where OR is outage rate and u_g is wind gust in mph:

$$\log_{10} \mathrm{OR} \approx \max\left(-4.7,\ 0.059 \times u_g - 5.7\right) \tag{1}$$

The red line labeled "Correlation" in Figure 5b is a graphical representation of Equation 1.



(a)



(b)

Figure 5. Outage occurrence rate as a function of (a) Temperature independent of wind gust, and (b) Wind gust independent of temperature.

Although Equation 1 should provide a reasonable estimate of outage rate as a function of wind gust, several limitations of the analysis are noted:

1. Wind conditions at the reported outage location may not be the same as the location where the outage-initiating event occurred since the precise location of the latter is typically unknown,
2. Presence or absence of canopy has a real-world effect on outage rate but does not factor into Equation 1 since canopy cover and canopy height are not known at the location of the outage-initiating event,
3. Although subtransmission / transmission lines are more resilient than distribution lines, circuit voltage is not considered in Equation 1,
4. System configuration (reclosing / one-shot / fast trip) and presence of covered conductor do not factor into Equation 1.

3.0 ESTIMATING IGNITION RATE

The preceding analysis provides a means to estimate outage rates as a function of environmental factors (wind gust). Due to Liberty's small number of CPUC-reportable ignitions, there is an insufficient number of data points to correlate Liberty's ignition data in the same way that outage data was correlated. For this reason, several assumptions were made to estimate relative ignition rates as a function of environmental factors:

1. Given a receptive fuel bed with zero fine dead fuel moisture content, ignition rate is proportional to forced outage rate, and
2. Given a forced outage, the probability that the outage causes an ignition is proportional to National Fire Danger Rating System (NFDRS) ignition probability [2].

Under these assumptions, ignition rate (ignitions / line mi / hr) can be estimated from Equation 2:

$$\mathrm{IR} = F \times P_{ign} \times \mathrm{OR} \qquad (2)$$

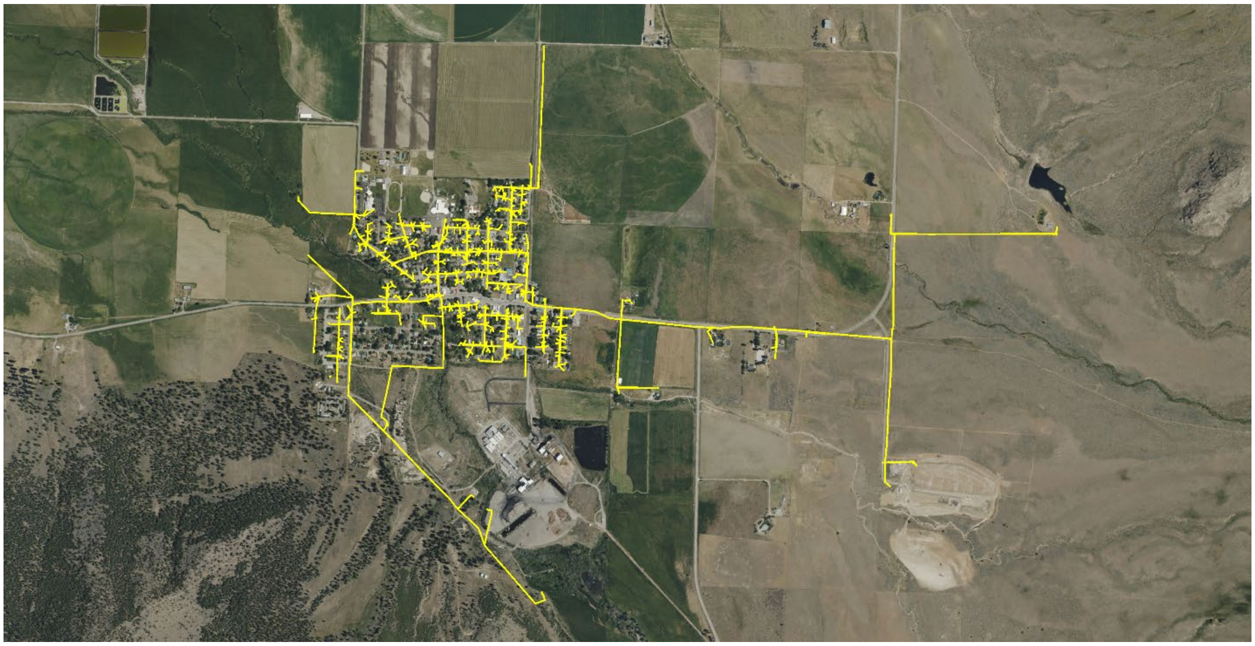
where F is the ignition-to-outage ratio for a receptive fuel bed with negligible moisture content and temperature > 80 °F, and P_{ign} is NFDRS ignition probability given a receptive fuel bed's actual moisture content and temperature. A rough estimate of F is $10^{-2} < F < 10^{-1}$. P_{ign} (NFDRS ignition probability) is a function of fine dead fuel moisture content and fuel bed temperature as shown in Table 1. Note that fine fuel moisture content is a function of relative humidity and temperature.

Table 1. NFDRS ignition probability [3].

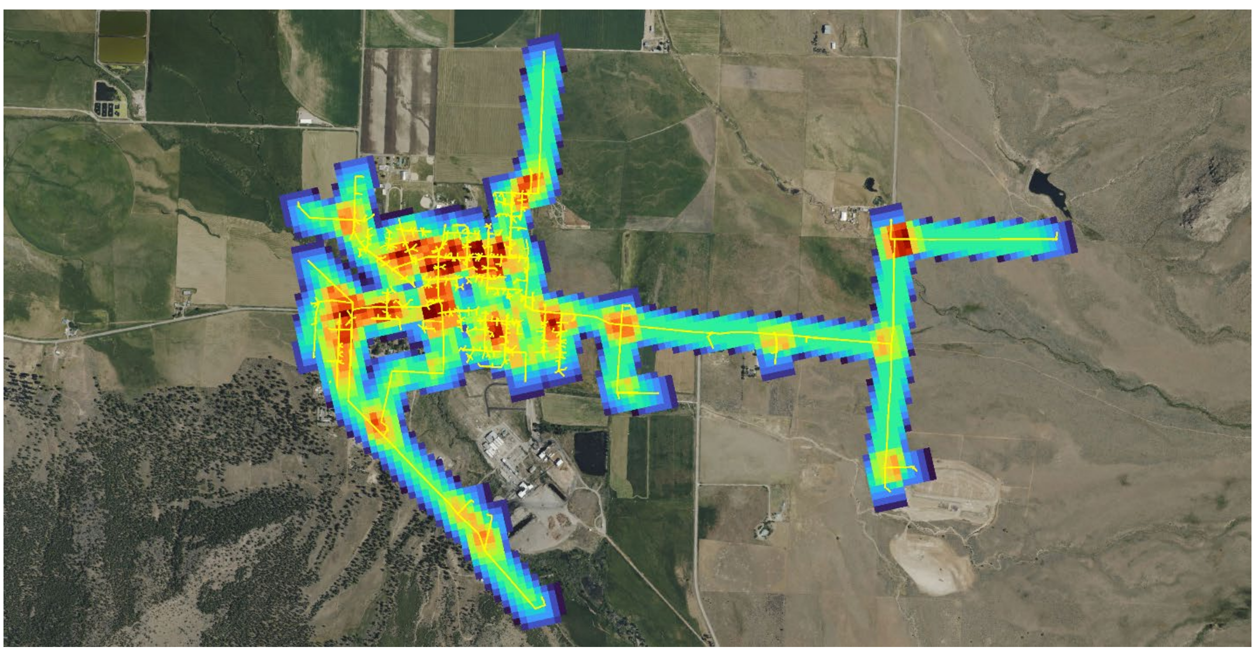
Fuel	*Fine Fuel Moisture Content (%)*														
Temp (F)	*1.5*	*2.0*	*2.5*	*3.0*	*4.0*	*5.0*	*6.0*	*7-8*	*9-10*	*11-12*	*13-16*	*17-20*	*21-25*	*26-30*	*>30*
30-39	87	80	74	69	59	51	43	34	25	17	10	4	1	0	0
40-49	89	83	77	71	61	53	45	36	26	18	11	5	1	0	0
50-59	92	85	79	73	63	54	47	37	27	20	11	5	2	0	0
60-69	94	88	81	76	65	56	49	39	29	21	12	6	2	0	0
70-79	97	90	84	78	68	59	51	41	30	22	13	6	2	0	0
80-89	100	93	87	81	70	61	53	42	31	23	14	7	2	1	0
90-99	100	96	90	84	73	63	55	44	33	24	15	7	3	1	0
100-109	100	99	93	86	75	66	57	46	35	26	16	8	3	1	0
110-119	100	100	96	89	78	68	59	48	36	27	17	9	3	1	0
120-129	100	100	99	93	81	71	62	51	38	29	18	9	4	1	0
130-139	100	100	100	96	84	74	65	53	40	30	20	10	4	1	0
140-149	100	100	100	99	87	77	67	55	42	32	21	11	5	2	0
150-159	100	100	100	100	90	80	70	58	45	34	22	12	5	2	0

Equation 2 provides an estimate of ignition rate (ignitions / length / hr) as a function of wind gust speed, relative humidity, and temperature since the latter two factors influence P_{ign}. This estimate can in turn be used to estimate spatiotemporal ignition probability (ignitions / area / hr) by multiplying ignition rate by overhead network density (length / area).

To accomplish this, overhead conductor length (transmission, primary distribution, and secondary distribution) per unit area was calculated on the same 30 m grid that is later used for fire spread modeling. A 5 × 5 smoothing filter was used to smooth these conductor densities into adjacent grid cells since ignitions may not occur directly under powerlines. As an example, overhead conductors in part of Liberty's service territory are shown in Figure 6a, and conductor length per unit area after smoothing is shown in Figure 6b.



(a)



(b)

Figure 6. Liberty Utilities overhead electrical system (a) Conductors; (b) Density (mi/mi^2).

4.0 FIRE RISK MODELING METHODOLOGY & INPUTS

The outage-based ignition model developed in Section 3.0 provides probability of ignition as a function of overhead network density, wind gust, relative humidity, and temperature. For fire risk modeling purposes, it is coupled to the wildfire spread model Eulerian Level set Model of FIRE spread (ELMFIRE) [4-5] with inputs provided as follows:

- Current (2021) climatology/weather: National Oceanic and Atmosperic Adminsitration (NOAA) National Centers for Environmental Prediction (NCEP) Real Time Mesoscale Analysis (RTMA) [1]. This dataset provides hourly gridded fields of temperature, relative humidity, wind speed, and direction at 2.5 km resolution from 2011 – current. Since wind gust data are most reliable after 2016, a 6-year block spanning 2016-2021 was used in the modeling.
- Future (2050) climatology/weather: Dynamically downscaled Weather Research and Forecasting (WRF) initialized with global climate models from the 6th Coupled Model Intercomparison Project (CMIP6) [6]. This provides hourly gridded fields of temperature, relative humidity, wind speed, and wind direction at 3 km resolution. A 6-year temporal block from years 2048 – 2053 was selected for analysis.
- Fuel & topography: Pyrologix 2021 California Fuelscape prepared for USFS Region 5 [7]. This dataset provides surface and canopy fuel layers and topography at 30 m resolution. No adjustments are made for 2050 conditions. Due to several 2021 fires in Liberty's service territory that are not reflected in this dataset, models will be re-run later this year when the 2022 California Fuelscape data become available.
- Structures: Microsoft building footprint dataset [8]. No adjustments are made for 2050 conditions.

Fire risk modeling proceeds by incrementally looping over each hour in the climatology data (RTMA for 2021, downscaled WRF for 2050):

1. Spatial variations in ignition rate (ignitions / line mi / hr) are calculated from wind gust, fine dead fuel moisture, and temperature (Equation 2).
2. Spatial variations in ignition rate per unit area (ignitions / area / hr) are calculated by multiplying conductor length per unit area (*e.g.*, Figure 6b) by ignition rate per line mile per hr from Step 1.
3. Total number of ignitions is determined by spatially integrating ignition rate per unit area and multiplying by a large-scale factor which is equivalent to modeling ignition patterns over tens of thousands of years.
4. The number of ignitions determined in Step 3 are distributed across the landscape in a pattern that is proportional to the ignition density surface from Step 2.
5. For each ignition location, fire spread is modeled for 24 hours.
6. At the end of 24 hours, total fire area, timber impacts, and number of impacted structures are recorded for the ignition location, and the next ignition is processed.

Approximately 4.5 million ignitions were modeled under 2021 conditions, and approximately 7.9 million ignitions under 2050 conditions.

5.0 FIRE RISK MODEL OUTPUTS AND GIS DATA

Fire size, timber impacts, and number of impacted structures were recorded in a shapefile for each of the ~12.5 million modeled ignitions. Sample data (modeled fire area by ignition point, log scale, 2021 climatology) are shown in Figure 7.

Kernel density estimation, with ignition points weighted by area/structures/timber, was used to distill the millions of modeled ignitions into rasterized risk heat maps. An example depicting potential structure impacts near Truckee is shown in Figure 8. Warmer colors correspond to higher relative risk (probability of ignition multiplied by structure impacts) and cooler colors correspond to lower relative risk. Since secondary overhead lines are included in the ignition density surface, areas with a high density of secondary overhead may show up as hot spots. An additional analysis with only primary overhead lines used for modeling ignition density may give slightly different results.

Zonal statistics were generated for each circuit to summarize fire model outputs at the circuit level. For each circuit, structure impacts, fire area, and timber impacts were tabulated at the following percentiles: 50, 60, 70, 80, 90, 95, 97, 98, 99, 99.9. For example, 50th percentile fire area is the median modeled fire size for a particular circuit. A data excerpt showing modeled fire size by circuit is given in Table 2. Zonal statistics can be generated for other polygons (PSPS zones, risk polygons, etc.) at Liberty's request.

Underlying GIS data can be downloaded from the following link:

https://www.dropbox.com/s/pkesozab7vmj4z2/2022-04-14_reax_liberty_fire_risk_data.zip?dl=1

Included in the gis directory in the .zip archive is a brief data dictionary that explains the data.

Table 2. Data excerpt – modeled fire size by circuit at different percentiles.

	Circuit	Fire area (acres) by percentile									
		50th	60th	70th	80th	90th	95th	97th	98th	99th	99.9th
Transmission	111 - 120 KV (Meyers-Buckeye)	484.4	649.8	843.3	1083.1	1465.8	1854.1	2115.0	2302.7	2603.3	3434.0
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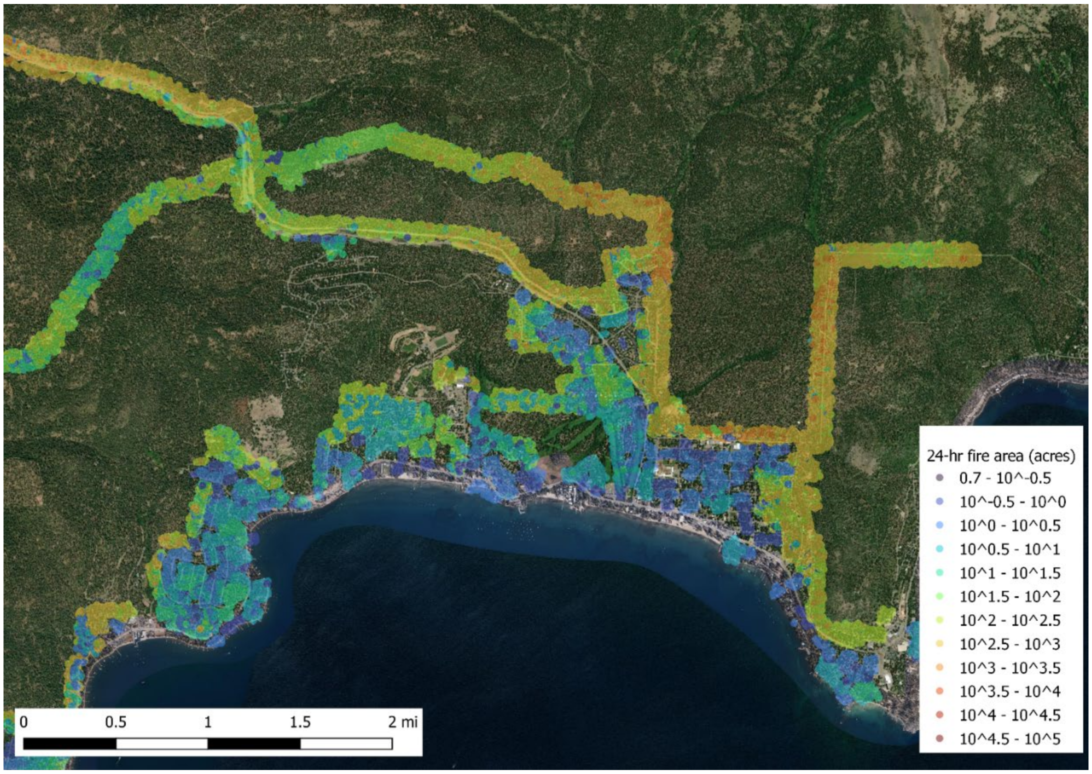


Figure 7. Sample data showing modeled fire area (log scale) near Kings Beach, CA.

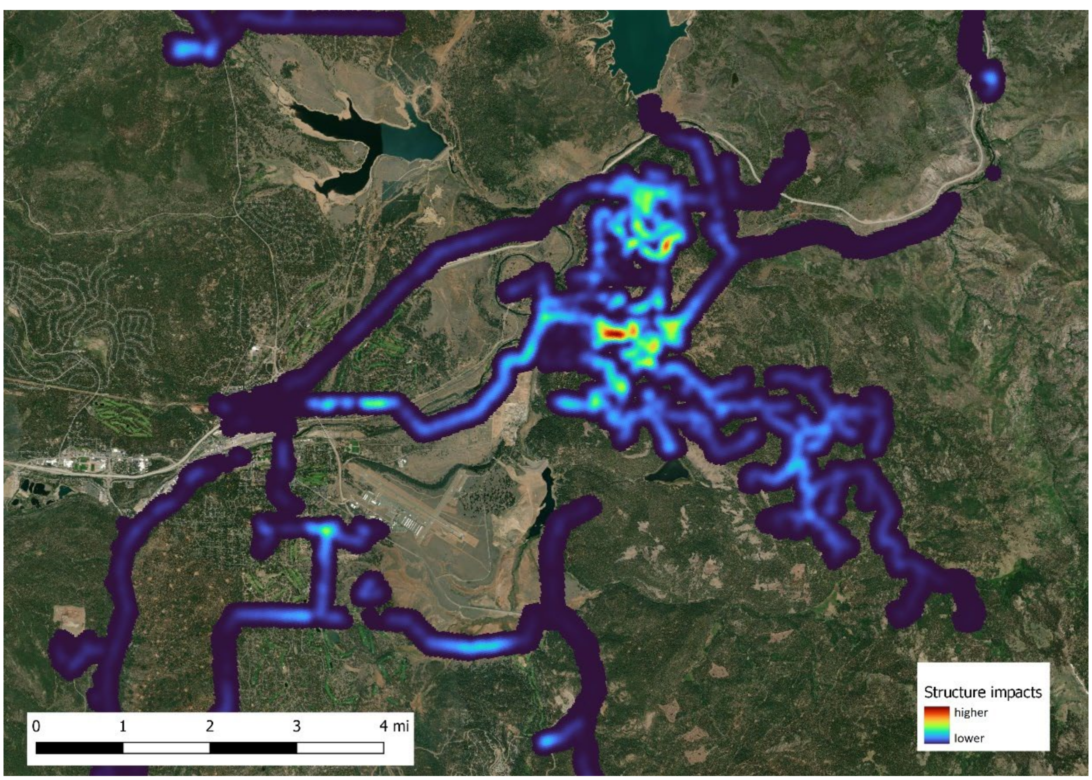


Figure 8. Sample structure impacts "heat map" generated via kernel density estimation.

6.0 CONCLUDING REMARKS

Although this work is based on the best currently available fire modeling technology and input data, several inherent limitations are noted:

1. Ignition probability was modeled from empirical outage data; differences in system operation (reclosing, fast trip), maintenance, vegetation management, *etc*. were not accounted for.
2. Insufficient outage data were available to account for differences between outage rates on distribution and subtransmission/transmission lines.
3. Fires were modeled as unsuppressed for a duration of 24-hours because operational fire models cannot currently reliably model fire suppression.
4. Fire spread through urban/built up areas that are marked as nonburnable in underlying fuel inputs is not modeled. Impacted structure values were tallied as the number of structures within a modeled fire perimeter and do not necessarily correspond to damaged or destroyed structures. Factors that affect structure vulnerability (*e.g.*, roof and exterior wall construction, defensible space, *etc*.) were not addressed.
5. There is considerable uncertainty around future climate conditions and the modeled future climate data is based on a single near-worst-case climate scenario. Climate-adjusted determinist fire spread modeling is an active research area.
6. For future/2050 climate-adjusted modeling, fuels and structure footprints were kept constant at the current/2021 baseline.

7.0 REFERENCES

[1] https://www.nco.ncep.noaa.gov/pmb/products/rtma/

[2] Bradshaw, L.S., Deeming, J.E., Burgan, R.E., and Cohen, J.D., "The 1978 National Fire-Danger Rating System: Technical Documentation," United States Department of Agriculture Forest Service, Intermountain Forest and Range Experiment Station, General Technical Report INT-169, 1983.

[3] Schroeder, M.J., "Ignition probability," USDA Forest Service. Fort Collins, CO. RMRS unpublished report, 1969.

[4] Lautenberger, C., "Wildland Fire Modeling with an Eulerian Level Set Method and Automated Calibration," *Fire Safety Journal* **62**: 289-298 (2013).

[5] Lautenberger, C., "Mapping Areas at Elevated Risk of Large-Scale Structure Loss Using Monte Carlo Simulation and Wildland Fire Modeling," Fire Safety Journal 91: 768-775 (2017).

[6] https://registry.opendata.aws/wrf-cmip6/

[7] http://pyrologix.com/wp-content/uploads/2021/06/CAL_FuelscapeReport.pdf

[8] https://github.com/microsoft/USBuildingFootprints

Liberty Fire Potential Index (“FPI”)

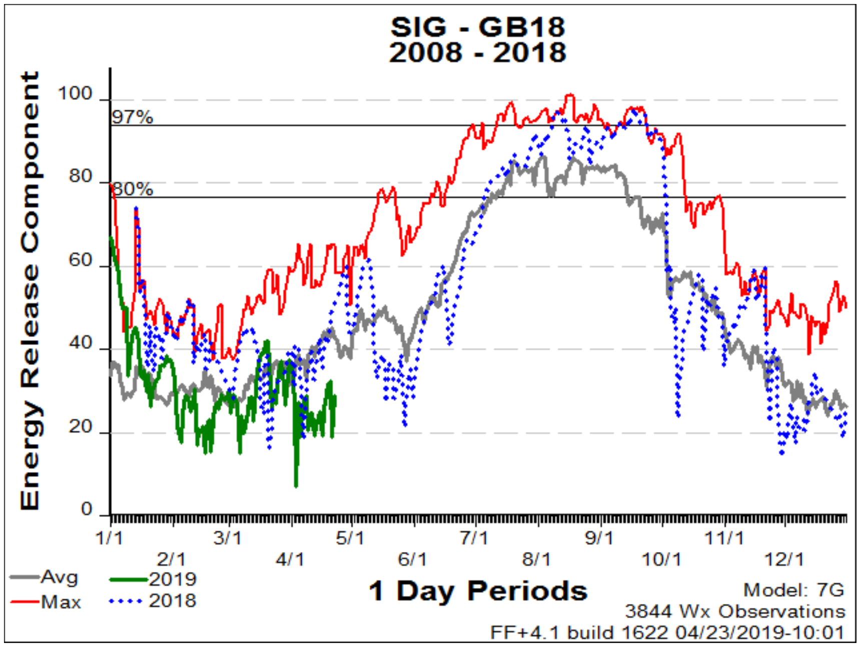
Purpose of model - The FPI is intended to communicate daily localized wildfire potential using easily understood classifications (low, medium, high, very high, and extreme) to forecast wildfire potential for the next week.

Relevant terms - Burning Index (“BI”) - An estimate of the potential difficulty of fire containment as it relates to the flame length at the head of the fire; Energy Release Component (“ERC”) - The computed total heat release per unit area (Btu/ft2) within the flaming front at the head of a moving fire; National Fire Danger Rating System (“NFDRS”) - the United States’ fire danger rating system intended to quantify fire threat and relative severity of burning conditions.

Data elements - As described in the methodology section below, Liberty’s FPI is calculated from two NFDRS indices. The first index, ERC, quantifies intermediate to long-term dryness. The second index, BI, quantifies its proportion to flame length of a head fire and is directly related to fire suppression effectiveness and difficulty of fire containment.

ERC is calculated from Remote Automated Weather Station (“RAWS”) observations as part of the NFDRS. A given ERC value is 4% of the energy per unit area, in units of Btu/ft2, that would be released during a fire. Therefore, multiplying an ERC value by 25 gives the number of Btu per square foot that would be released in the flaming front of a fire. ERC depends on live and dead fuel loading by size class (as characterized by an NFDRS fuel model), as well as fuel moisture content of live and dead fuels. In addition to dependence on fuel loading assigned to each fuel model, ERC varies due to changes in moisture content of both live and dead fuels, which are, in turn, dependent on prior precipitation, relative humidity, and temperature. Figure 1 below shows a representative yearly variation in ERC in the Western U.S. Because ERC depends on fuel loading/fuel model at each RAWS, absolute ERC values are usually converted to percentiles to facilitate comparison of seasonal ERC trends between RAWS stations with different fuel models.

Figure 1: Representative Yearly Variation in ERC in the Western US



BI is conventionally interpreted as head fire flame length, in feet, multiplied by 10. For example, a BI of 80 corresponds to a head fire flame length of approximately eight feet. BI is more sensitive to short-term fluctuations in environmental conditions, particularly wind, than ERC.

Methodology assumptions and limitations - For fire danger rating purposes, ERC and BI are often normalized against historical weather conditions so they can be reported as percentiles, which may provide a better indication of fire danger than absolute values. For the purposes of calculating Liberty's FPI, ERC and BI percentile forecasts are obtained from the U.S. Forest Service ("USFS") Wildland Fire Assessment System ("WFAS") (https://wfas.net).

Modeling methodology - A 2019 USFS study demonstrated that a simple fire danger index that combines ERC and BI percentiles is strongly correlated with historical fire occurrence and ultimate fire size. Analysis of historical fire records (Figure 2) has shown that 13% of new fires and 33% of eventual burned area occurred when fires were ignited when ERC and BI were both above 90th percentile. Similarly, 28% of new fire reports and 57% of eventual acres burned occurred when both indices were above 80th percentile. Leveraging these findings, Liberty's FPI is calculated by converting ERC and BI percentiles obtained from the USFS WFAS into FPI adjectives using Figure 3.

Figure 2: New fire reports (a) and eventual acres burned (b) as a function of ERC and BI percentiles. Color scales indicate the amount of fire activity observed in each joint bin and the percentages indicate the proportion of fire activity observed in each joint bin

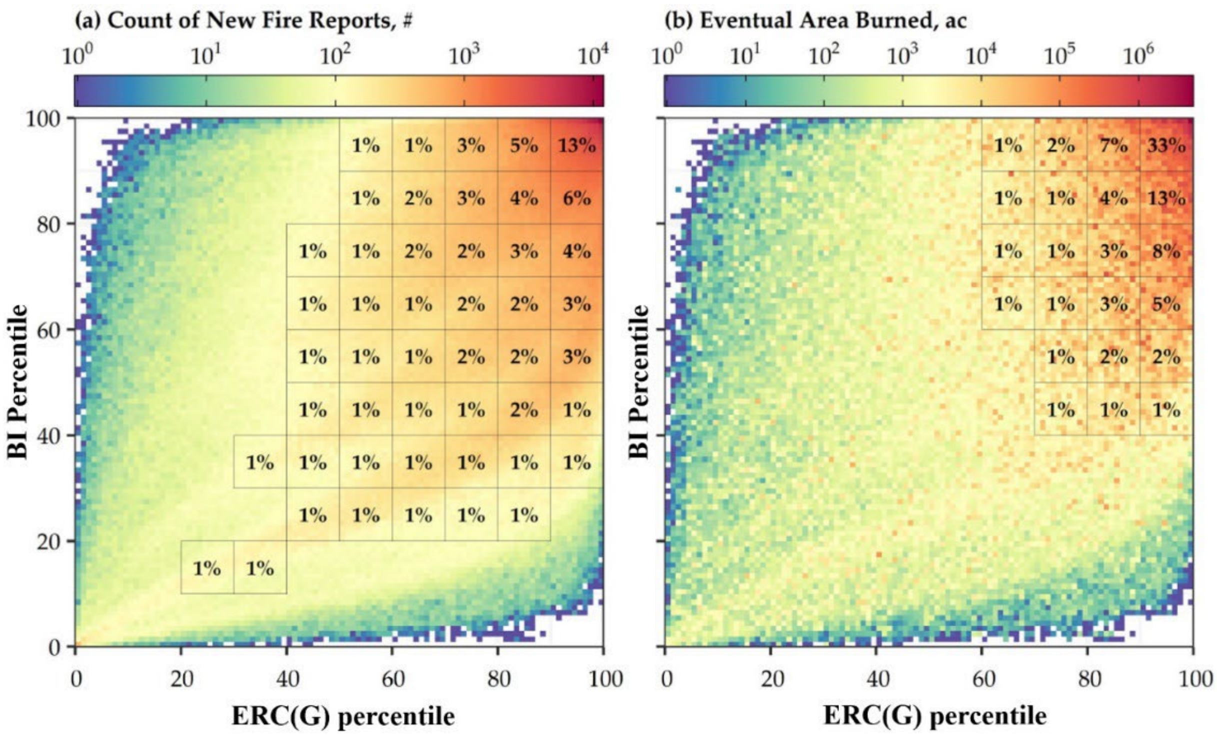


Figure 3: Liberty FPI Ratings and a Function of ERC and BI Percentiles

BI Percentile						
	97-100					Extreme
	90-97				Very High	
	80-90			High		
	60-80		Moderate			
	0-60	Low				
		0-60	60-80	80-90	90-97	97-100
		ERC Percentile				

Liberty PSPS Threshold Exceedance Frequency Analysis

Liberty currently uses a combination of Energy Release Component (ERC) percentile, wind gust, and Fosberg Fire Weather Index (FFWI) to guide de-energization decisions. The current threshold for most PSPS zones is 40 mph wind gust and FFWI of 50, with slightly higher thresholds for windier circuits. Gridded Real Time Mesoscale Analysis (RTMA) data were analyzed to estimate the frequency with which Liberty's overhead network is exposed to wind gust and FFWI values close to these thresholds. The result of this analysis is shown in the tables on the following page in Table 1. Each of the 12 tables provide an estimate of the annualized number of line mile hours that exceed the wind gust and FFWI thresholds indicted in the table by calendar month.

Table 1 demonstrates that wind gust and FFWI thresholds are conducive PSPS is year-round (independent of fuel dryness). However, precipitation usually (but not always) precludes fire spread in Liberty's service territory from approximately December-April so PSPS is most likely to occur in May/June (during low snow years) and September-November during most years. Table 1 suggests that peak PSPS frequency occurs during November (but only in years where season ending precipitation has not occurred). Although fuel moistures may trend toward seasonal lows in July and August, these tend to be the least windy months in Liberty's service territory because incoming troughs occur less frequently than later in the year, particularly October and November.

Although these tables capture the seasonality of elevated fire weather conditions in Liberty's service territory, they provide no information regarding spatial patterns of elevated fire weather conditions. For that reason, Figure 1 shows the number of hourly records where wind gust exceeds 40 mph and FFWI simultaneously exceeds 50 in RTMA pixels containing overhead lines. Figure 2 is analogous but with wind gust of 45 mph and FFWI of 60.

Since a single hourly excursion above joint thresholds is unlikely to present sufficient risk to justify PSPS, an estimate of the number of days where wind gust and FFWI exceed thresholds was made by identifying days where 3 or more hourly records exceeded the same thresholds shown in Figure 1 and Figure 2. The result is shown in Figure 3 (wind gust > 40 mph and FFWI > 50) and Figure 4 (wind gust > 45 mph and FFWO > 60). Since fuel dryness or presence of snow cover was not included in this analysis, Figure 3 and Figure 4 represent an upper limit on expected PSPS frequency, with actual PSPS frequency expected to be considerably lower.

Table 1. Annualized linemile hours exceeding joint FFWI / wind gust criteria by month.

January

		Wind gust (mph)					
		35	40	45	50	55	60
FFWI	45	1,741	1,107	398	106	18	6
	50	952	652	243	65	13	3
	55	485	353	130	28	7	3
	60	242	189	72	14	6	2
	65	108	84	33	5	3	2
	70	29	25	16	1	0	0

February

		Wind gust (mph)					
		35	40	45	50	55	60
FFWI	45	1,410	1,109	783	513	324	140
	50	880	736	561	382	246	110
	55	501	433	355	262	187	80
	60	321	281	236	180	136	52
	65	191	165	140	110	88	37
	70	98	87	76	56	45	26

March

		Wind gust (mph)					
		35	40	45	50	55	60
FFWI	45	759	607	400	276	163	86
	50	433	377	282	213	142	76
	55	253	242	199	156	112	70
	60	174	169	152	123	94	64
	65	113	111	99	83	70	52
	70	82	81	79	67	57	44

April

		Wind gust (mph)					
		35	40	45	50	55	60
FFWI	45	593	375	132	14	1	0
	50	333	252	104	11	1	0
	55	150	121	56	8	0	0
	60	61	49	19	1	0	0
	65	34	30	9	0	0	0
	70	21	18	4	0	0	0

May

		Wind gust (mph)					
		35	40	45	50	55	60
FFWI	45	392	220	156	51	11	0
	50	236	147	114	37	5	0
	55	128	92	79	28	2	0
	60	44	38	34	11	2	0
	65	11	10	10	5	0	0
	70	0	0	0	0	0	0

June

		Wind gust (mph)					
		35	40	45	50	55	60
FFWI	45	339	144	45	11	1	0
	50	173	93	35	10	0	0
	55	86	50	25	9	0	0
	60	36	22	13	6	0	0
	65	20	13	6	4	0	0
	70	8	7	5	4	0	0

July

		Wind gust (mph)					
		35	40	45	50	55	60
FFWI	45	52	11	2	0	0	0
	50	46	11	2	0	0	0
	55	30	10	2	0	0	0
	60	21	9	2	0	0	0
	65	13	7	2	0	0	0
	70	2	1	1	0	0	0

August

		Wind gust (mph)					
		35	40	45	50	55	60
FFWI	45	15	3	2	1	0	0
	50	10	2	1	1	0	0
	55	7	2	1	1	0	0
	60	4	2	1	1	0	0
	65	3	1	1	1	0	0
	70	2	1	0	0	0	0

September

		Wind gust (mph)					
		35	40	45	50	55	60
FFWI	45	230	91	33	6	1	0
	50	136	61	25	5	1	0
	55	61	40	19	3	1	0
	60	25	15	5	3	1	0
	65	10	6	2	1	0	0
	70	4	2	1	0	0	0

October

		Wind gust (mph)					
		35	40	45	50	55	60
FFWI	45	740	511	281	125	65	15
	50	431	281	163	85	43	8
	55	224	152	102	51	26	4
	60	103	66	49	27	19	0
	65	48	36	26	15	13	0
	70	20	13	9	6	6	0

November

		Wind gust (mph)					
		35	40	45	50	55	60
FFWI	45	1,631	1,119	742	463	265	182
	50	1,190	894	587	407	249	178
	55	907	735	515	365	241	176
	60	701	615	452	326	227	165
	65	527	485	384	291	204	155
	70	390	366	302	242	176	139

December

		Wind gust (mph)					
		35	40	45	50	55	60
FFWI	45	2,716	1,970	1,140	498	161	15
	50	1,991	1,517	966	453	155	14
	55	1,243	1,014	668	336	137	10
	60	783	645	439	237	106	7
	65	499	406	290	153	68	4
	70	312	253	184	90	30	2

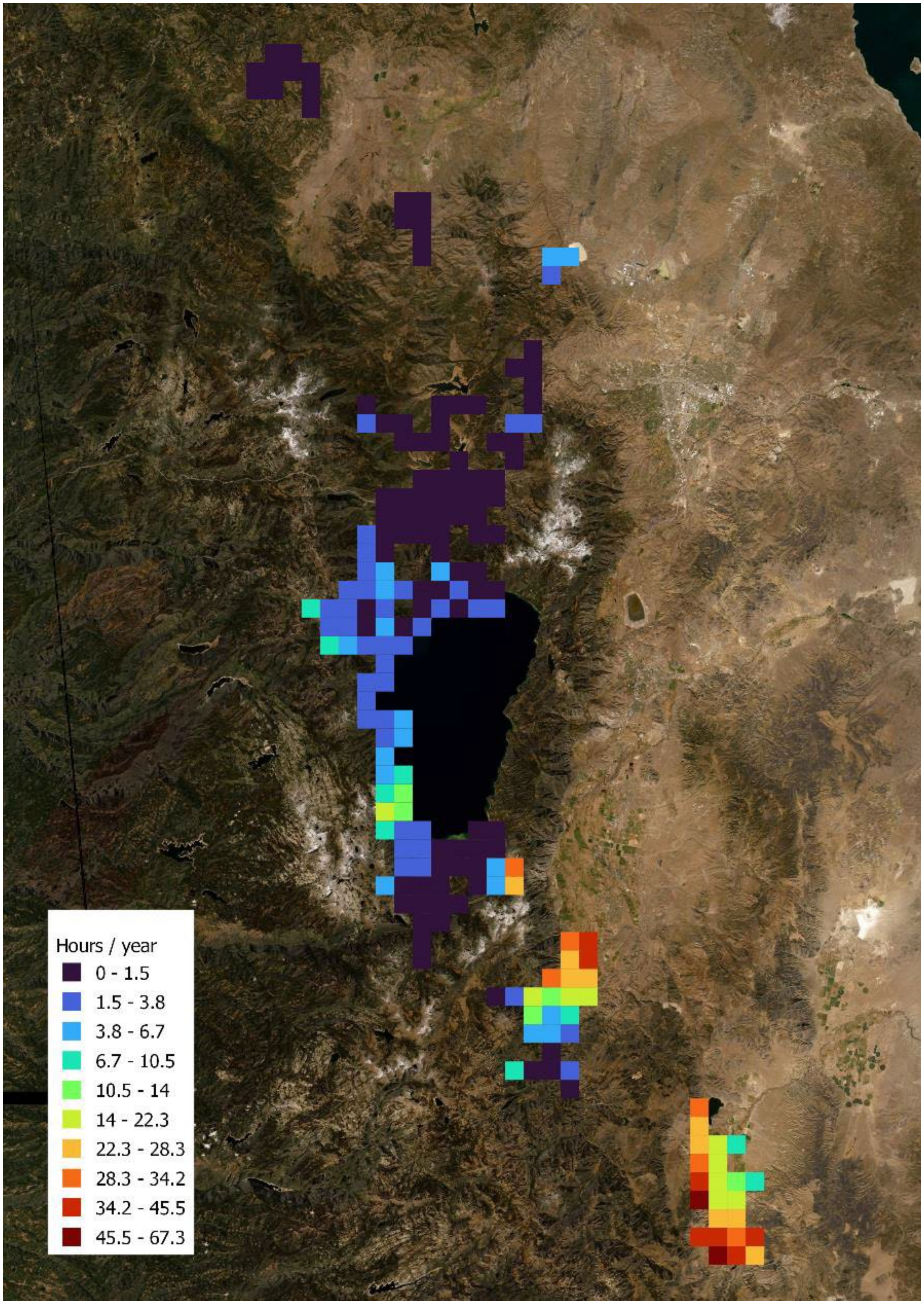


Figure 1. Hours per year where FFWI exceeds 50 and wind gust exceeds 40 mph.

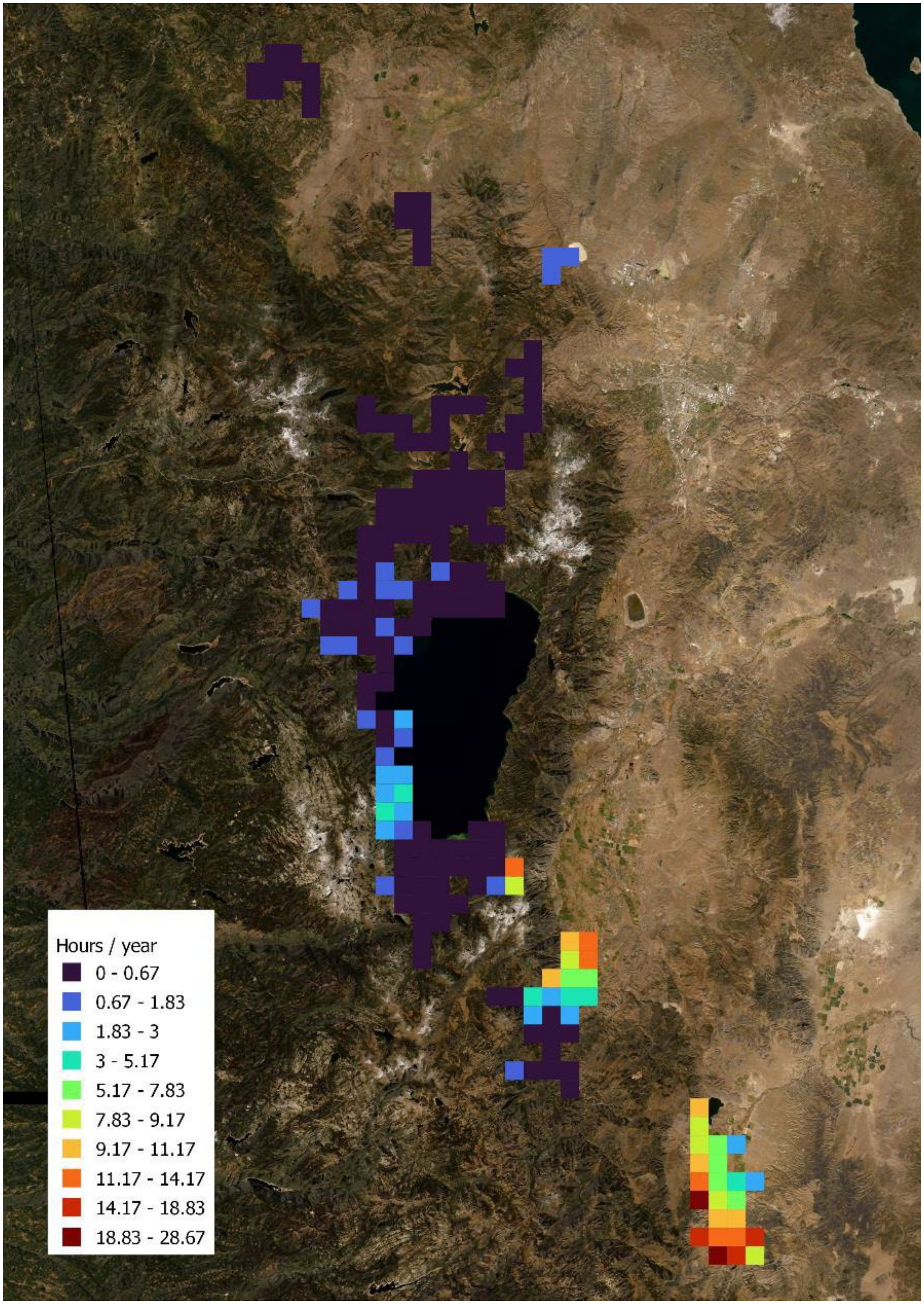


Figure 2. Hours per year where FFWI exceeds 60 and wind gust exceeds 45 mph.

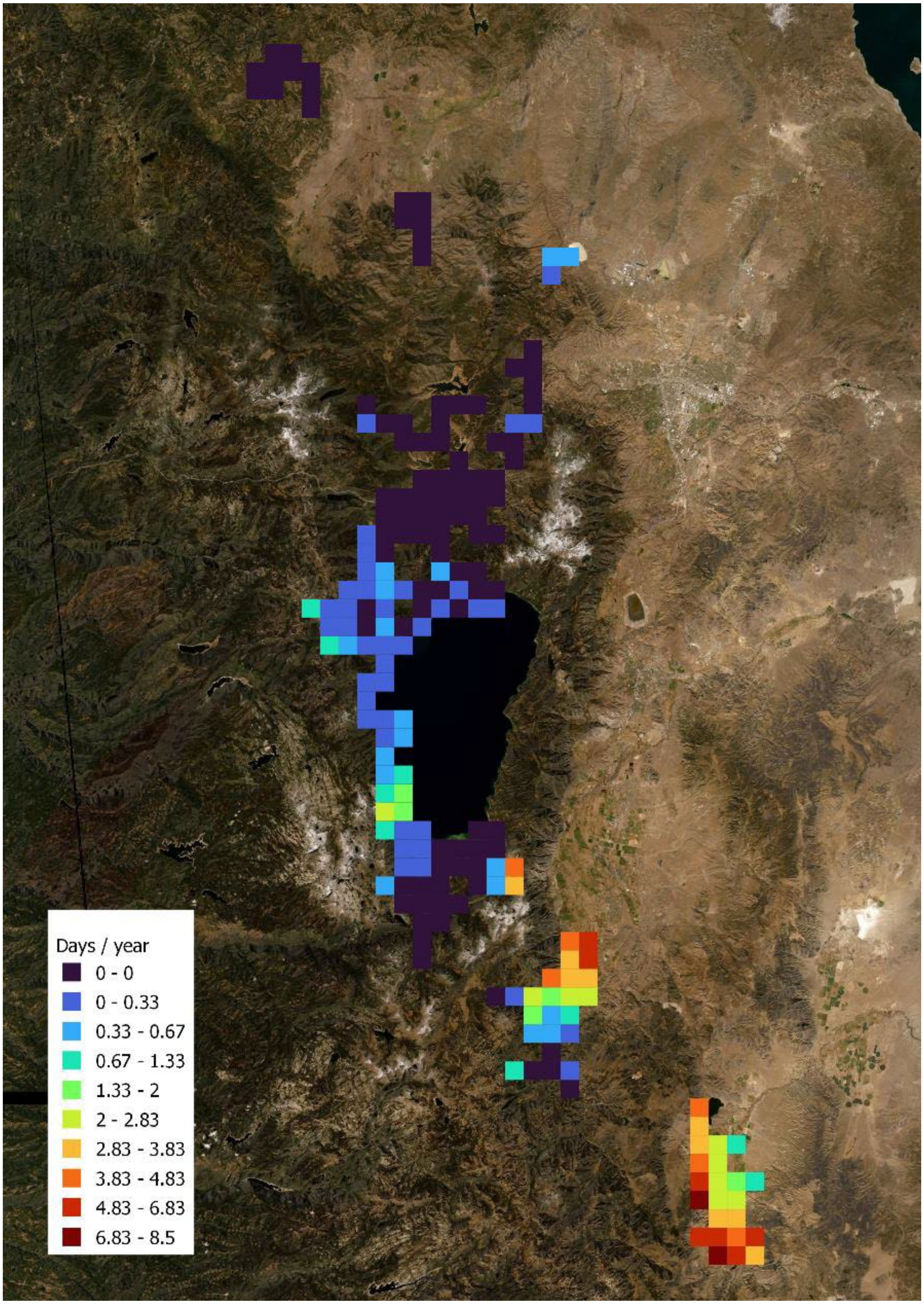


Figure 3. Number of days per year where 3 or more hourly records jointly exceed wind gust of 40 mph and FFWI of 50.

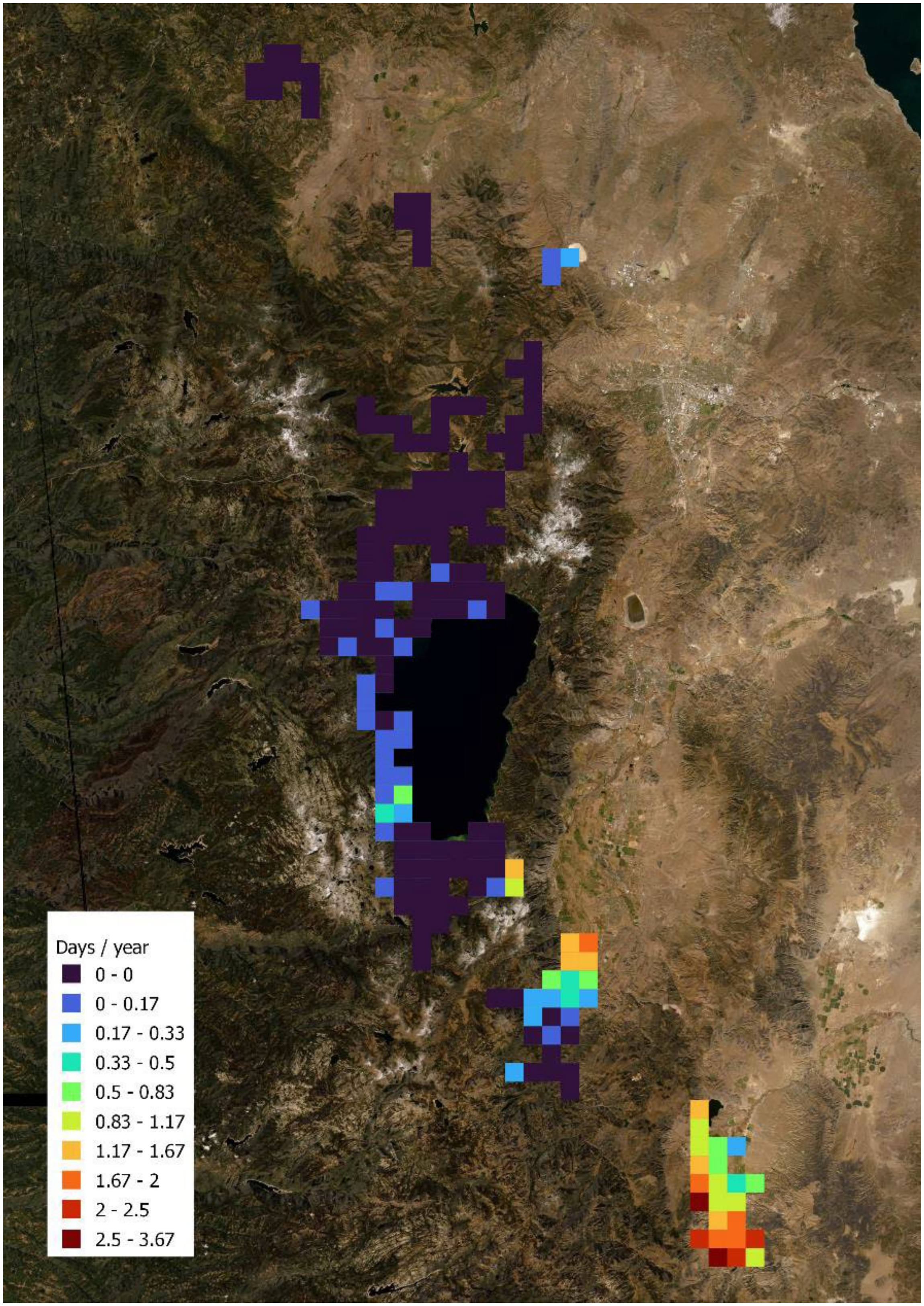


Figure 4. Number of days per year where 3 or more hourly records jointly exceed wind gust of 45 mph and FFWI of 60.

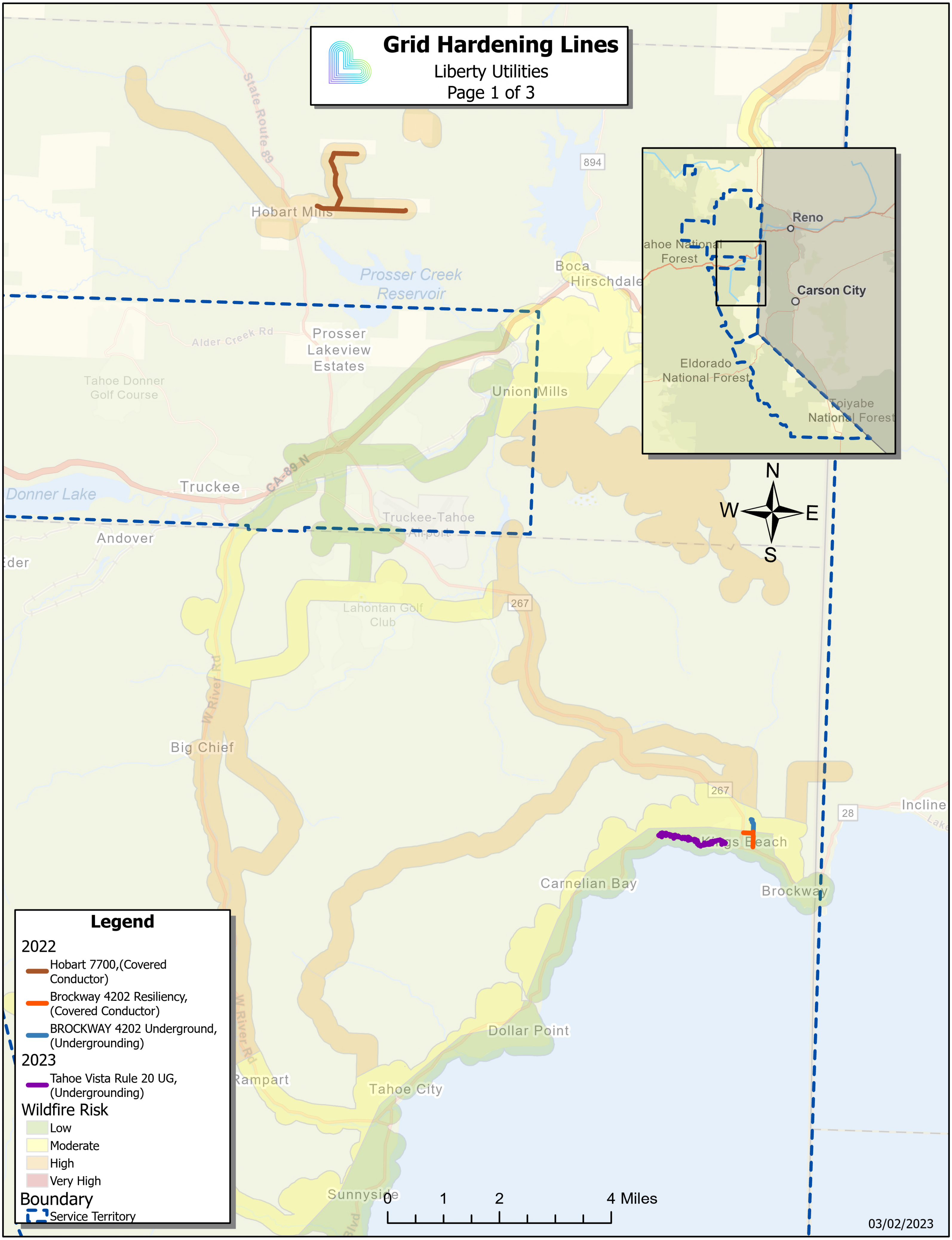
Appendix C
Additional Maps

Appendix C: Additional Maps

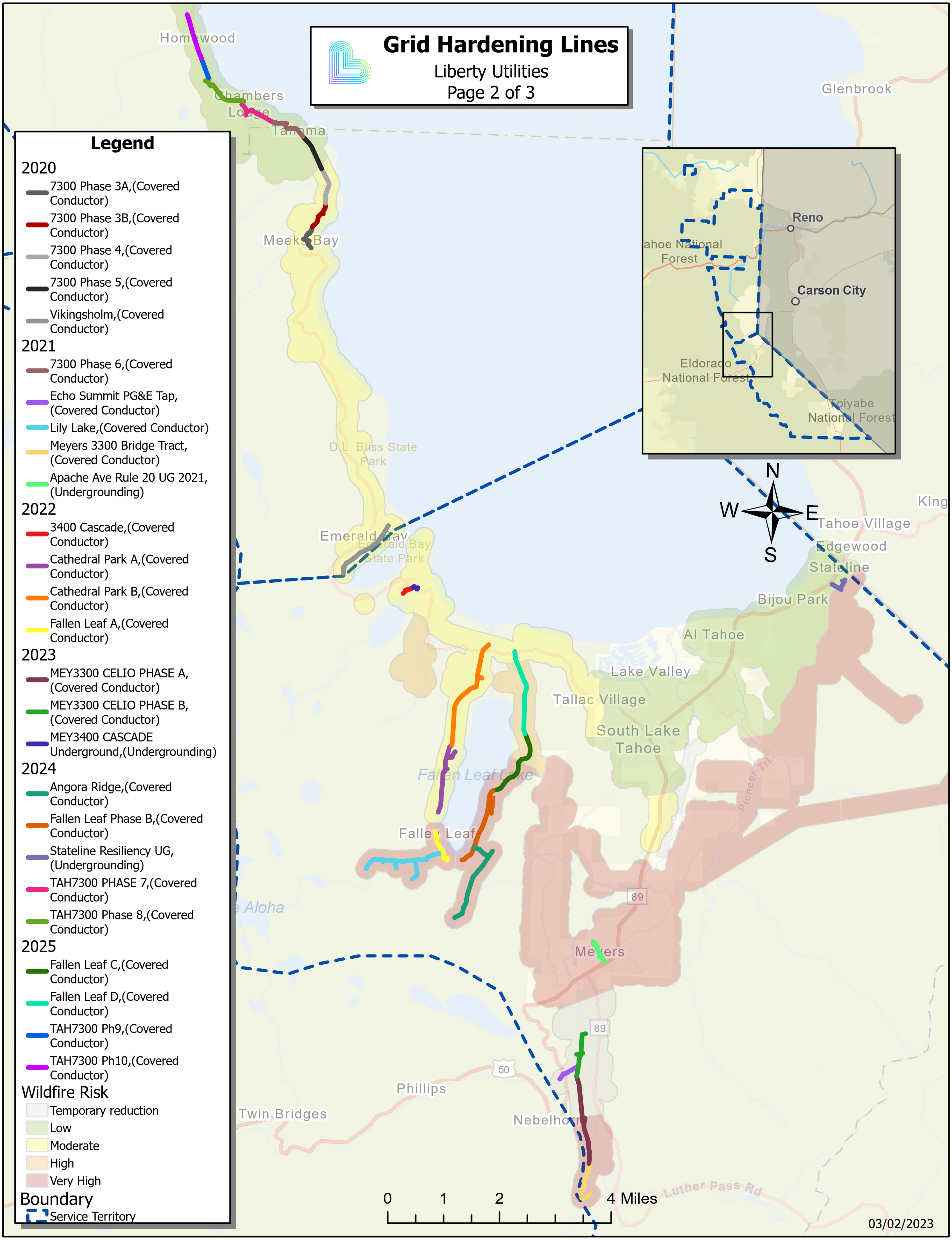
In this appendix, the electrical corporation must provide the additional maps required by the Guidelines. As stated in the General Directions, if any additional maps needed for clarity (e.g., the scale is insufficiently large to show useful detail), the electrical corporation must either provide those additional maps in this appendix or host applicable geospatial layers on a publicly accessible web viewer. If the electrical corporation chooses the latter option, it must refer to the specific web address in appropriate places throughout its WMP. Additionally, the electrical corporation must host these layers until the submission of its 2026-2028 WMP or until otherwise directed by Energy Safety. The electrical corporation may not modify these publicly available layers without cause or without notifying Energy Safety.

Below is a list of Liberty's 2023 WMP sections which require additional maps:

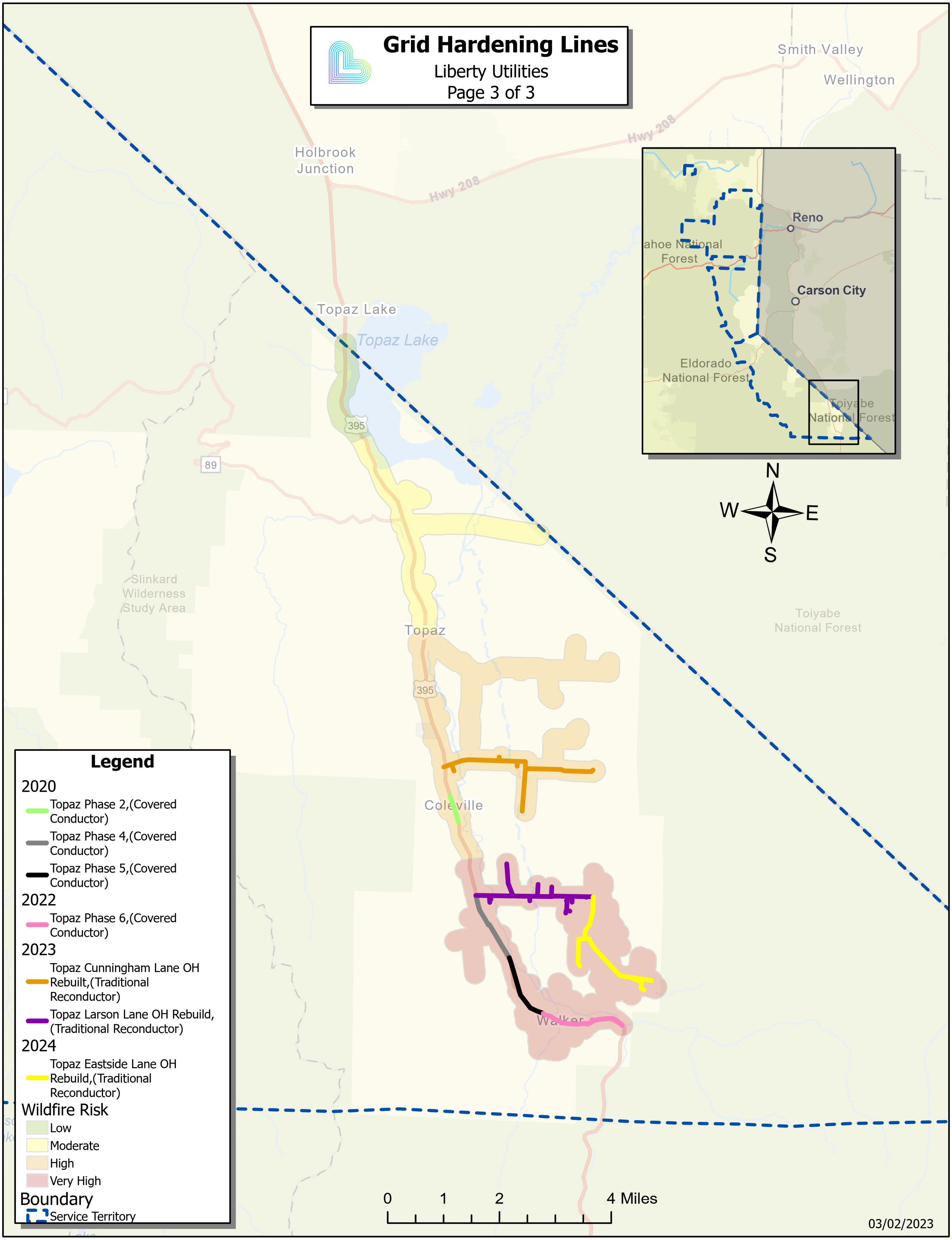
Section Number	Section Title
5.4.3.2	Social Vulnerability and Exposure to Electrical Corporation Wildfire Risk
8.1.2.1	Covered Conductor Installation
8.1.2.2	Undergrounding of Electric Lines and/or Equipment
8.1.2.3	Distribution Pole Replacements
8.3.2	Environmental Monitoring Systems
8.3.3	Grid Monitoring Systems

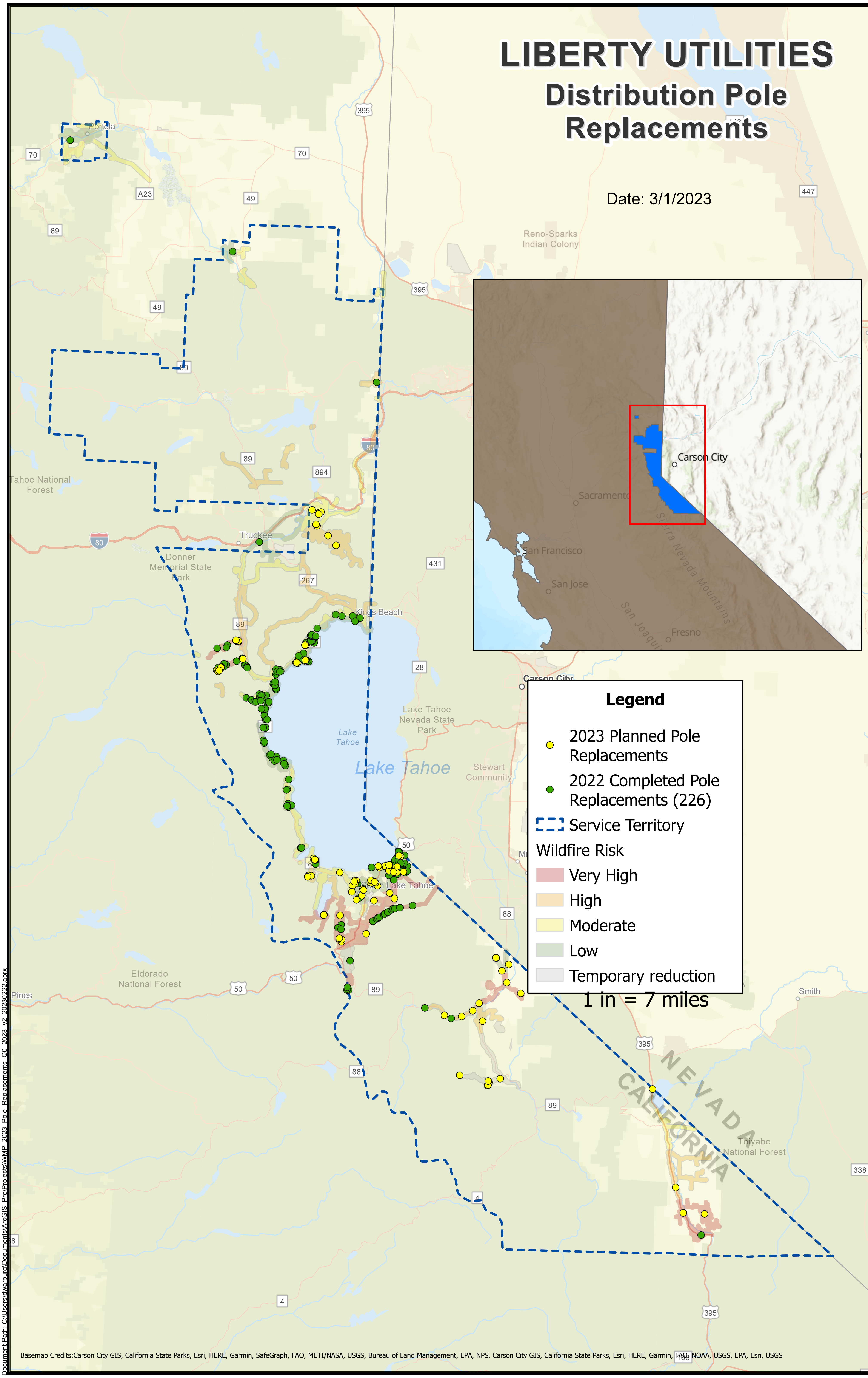


Grid Hardening Lines
Liberty Utilities
Page 1 of 3
Legend
2022
Hobart 7700,(Covered Conductor)
Brockway 4202 Resiliency, (Covered Conductor)
BROCKWAY 4202 Underground, (Undergrounding)
2023
Tahoe Vista Rule 20 UG, (Undergrounding)
Wildfire Risk
Low
Moderate
High
Very High
Boundary
Service Territory
0 1 2 4 Miles
N
W
E
S
Hobart Mills
Prosser Creek Reservoir
Prosser Lakeview Estates
Boca
Hirschdale
Union Mills
Truckee
Donner Lake
Andover
Truckee-Tahoe Airport
Lahontan Golf Club
Big Chief
Carnelian Bay
Kings Beach
Brockway
Incline
Dollar Point
Tahoe City
Rampart
Sunnyside
Tahoe Donner Golf Course
Reno
Carson City
Eldorado National Forest
Toiyabe National Forest
03/02/2023

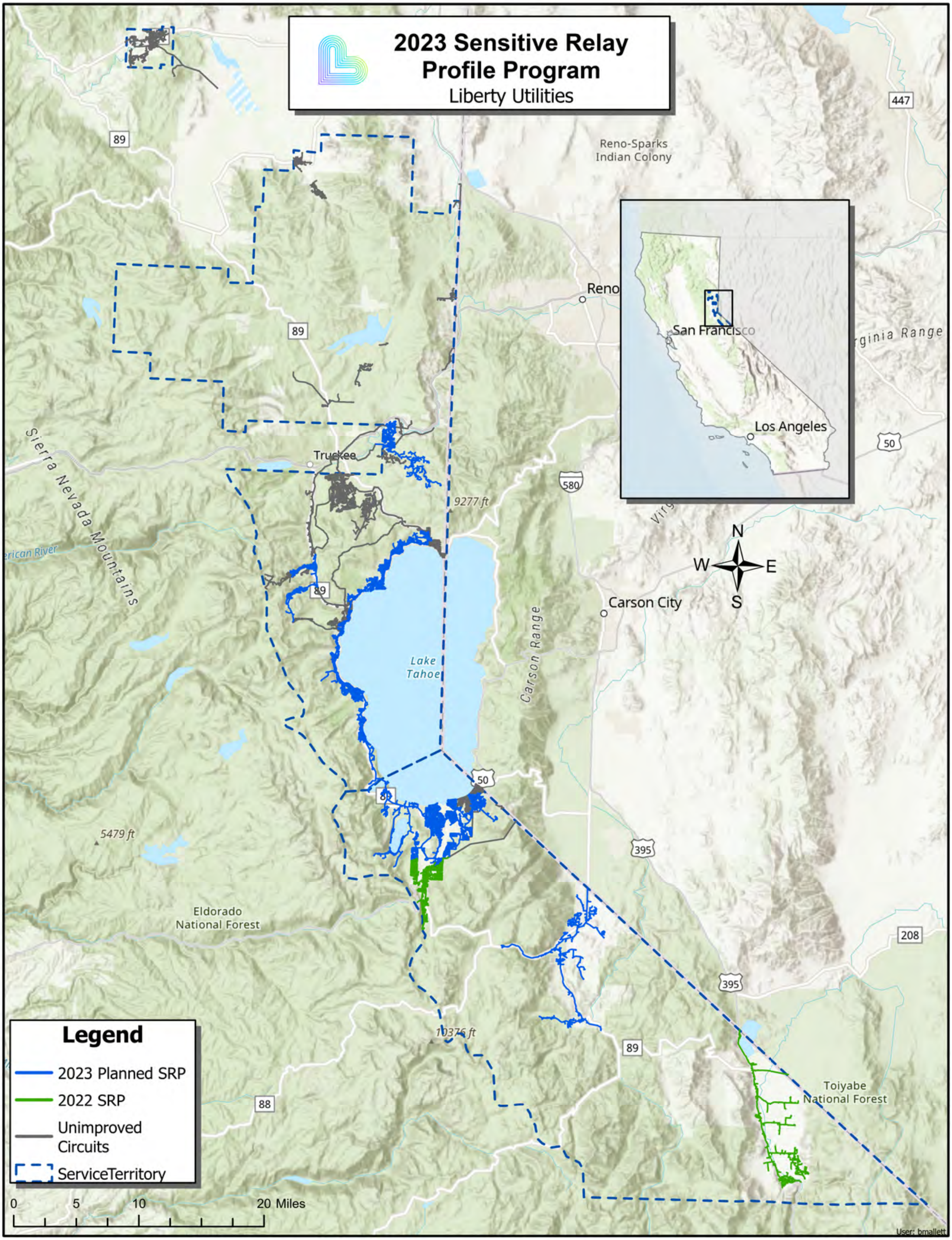


Grid Hardening Lines
Liberty Utilities
Page 2 of 3
Legend
2020
7300 Phase 3A,(Covered Conductor)
7300 Phase 3B,(Covered Conductor)
7300 Phase 4,(Covered Conductor)
7300 Phase 5,(Covered Conductor)
Vikingsholm,(Covered Conductor)
2021
7300 Phase 6,(Covered Conductor)
Echo Summit PG&E Tap, (Covered Conductor)
Lily Lake,(Covered Conductor)
Meyers 3300 Bridge Tract, (Covered Conductor)
Apache Ave Rule 20 UG 2021, (Undergrounding)
2022
3400 Cascade,(Covered Conductor)
Cathedral Park A,(Covered Conductor)
Cathedral Park B,(Covered Conductor)
Fallen Leaf A,(Covered Conductor)
2023
MEY3300 CELIO PHASE A, (Covered Conductor)
MEY3300 CELIO PHASE B, (Covered Conductor)
MEY3400 CASCADE Underground,(Undergrounding)
2024
Angora Ridge,(Covered Conductor)
Fallen Leaf Phase B,(Covered Conductor)
Stateline Resiliency UG, (Undergrounding)
TAH7300 PHASE 7,(Covered Conductor)
TAH7300 Phase 8,(Covered Conductor)
2025
Fallen Leaf C,(Covered Conductor)
Fallen Leaf D,(Covered Conductor)
TAH7300 Ph9,(Covered Conductor)
TAH7300 Ph10,(Covered Conductor)
Wildfire Risk
Temporary reduction
Low
Moderate
High
Very High
Boundary
Service Territory
Homewood
Chambers Lodge
Tahoma
Meeks Bay
D.L. Bliss State Park
Emerald Bay
Emerald Bay State Park
Fallen Leaf Lake
Fallen Leaf
Tallac Village
Lake Valley
South Lake Tahoe
Al Tahoe
Bijou Park
Stateline
Edgewood
Tahoe Village
Kingsbury
Glenbrook
Meyers
Phillips
Twin Bridges
Nebelhorn
Luther Pass Rd
Pioneer Trl
89
50
Reno
Carson City
Tahoe National Forest
Eldorado National Forest
Toiyabe National Forest
N
W
E
S
0
1
2
4 Miles
03/02/2023


Grid Hardening Lines
Liberty Utilities
Page 3 of 3
Smith Valley
Wellington
Holbrook Junction
Hwy 208
Hwy 208
Topaz Lake
Topaz Lake
395
89
Slinkard Wilderness Study Area
Topaz
395
Coleville
Walker
Toiyabe National Forest
Reno
ahoe National Forest
Carson City
Eldorado National Forest
Toiyabe National Forest
N
W
E
S
Legend
2020
Topaz Phase 2,(Covered Conductor)
Topaz Phase 4,(Covered Conductor)
Topaz Phase 5,(Covered Conductor)
2022
Topaz Phase 6,(Covered Conductor)
2023
Topaz Cunningham Lane OH Rebuilt,(Traditional Reconductor)
Topaz Larson Lane OH Rebuild,(Traditional Reconductor)
2024
Topaz Eastside Lane OH Rebuild,(Traditional Reconductor)
Wildfire Risk
Low
Moderate
High
Very High
Boundary
Service Territory
0
1
2
4 Miles
03/02/2023

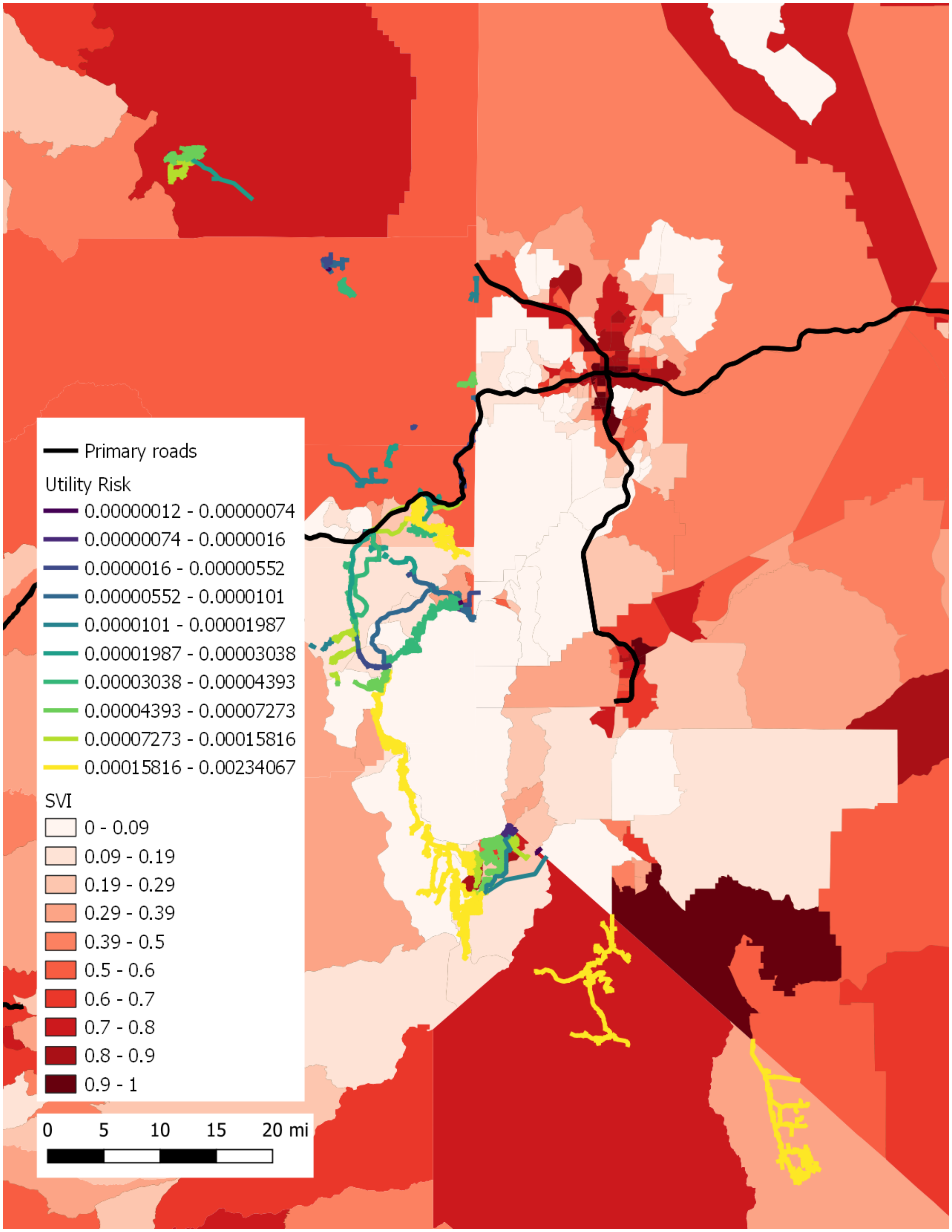


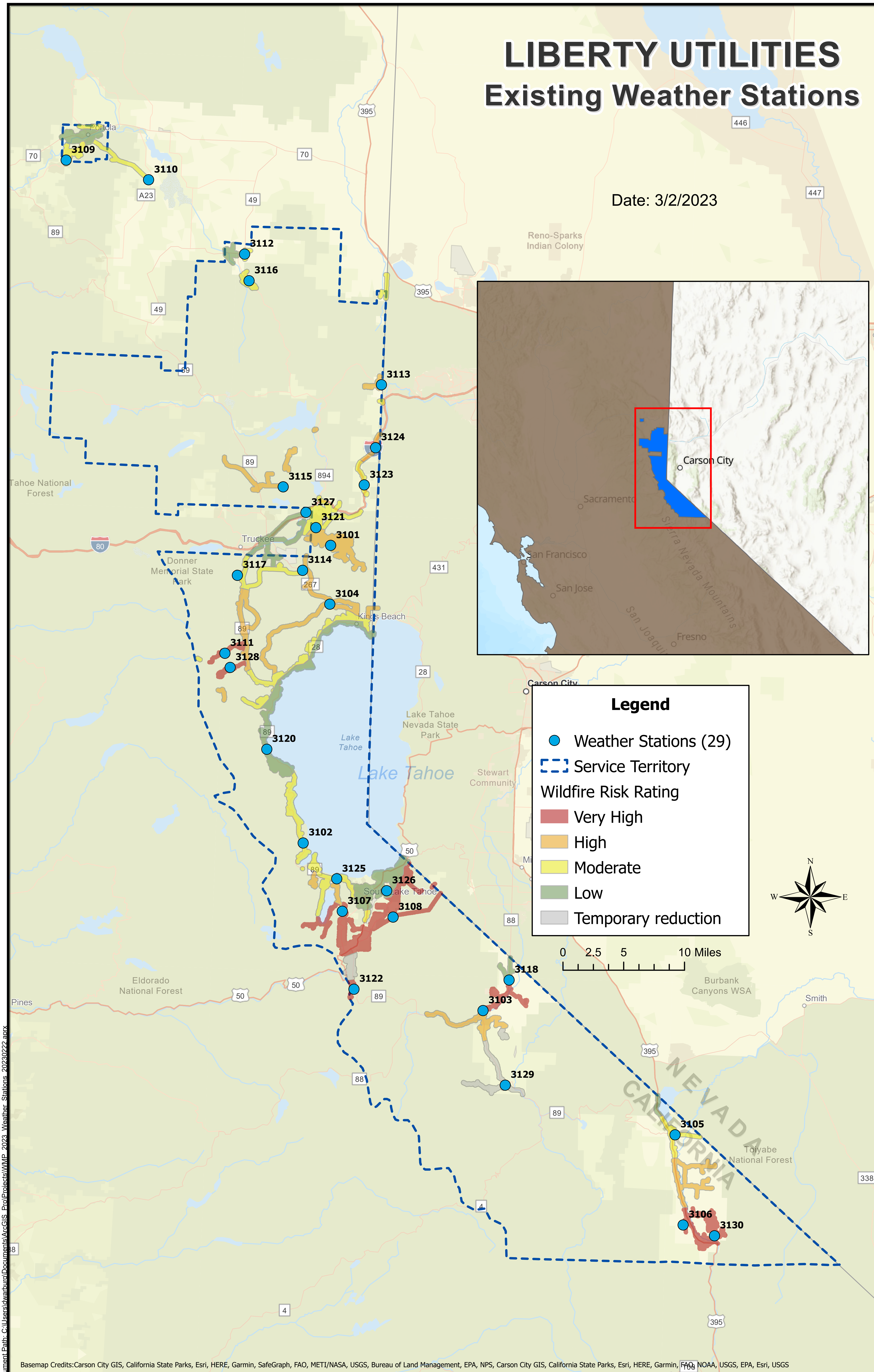
LIBERTY UTILITIES
Distribution Pole Replacements
Date: 3/1/2023
Legend
2023 Planned Pole Replacements
2022 Completed Pole Replacements (226)
Service Territory
Wildfire Risk
Very High
High
Moderate
Low
Temporary reduction
1 in = 7 miles
Carson City
Sacramento
San Francisco
San Jose
Fresno
Sierra Nevada Mountains
Lake Tahoe
Truckee
Kings Beach
Portola
Tahoe National Forest
Donner Memorial State Park
Lake Tahoe Nevada State Park
Stewart Community
Reno-Sparks Indian Colony
Eldorado National Forest
Toiyabe National Forest
NEVADA
CALIFORNIA
Smith
Pines
Document Path: C:\Users\dwarburg\Documents\ArcGIS_ProProjects\WMP_2023_Pole_Replacements_Q0_2023_v2_20230222.aprx
Basemap Credits:Carson City GIS, California State Parks, Esri, HERE, Garmin, SafeGraph, FAO, METI/NASA, USGS, Bureau of Land Management, EPA, NPS, Carson City GIS, California State Parks, Esri, HERE, Garmin, FAO, NOAA, USGS, EPA, Esri, USGS



2023 Sensitive Relay
Profile Program
Liberty Utilities
Reno-Sparks
Indian Colony
Reno
Truckee
Sierra Nevada Mountains
American River
9277 ft
Lake
Tahoe
Carson Range
Carson City
San Francisco
Los Angeles
Virginia Range
N
W
E
S
5479 ft
Eldorado
National Forest
10376 ft
Toiyabe
National Forest
89
447
580
50
395
208
88
Legend
2023 Planned SRP
2022 SRP
Unimproved
Circuits
ServiceTerritory
0
5
10
20 Miles
User: bmallett

Liberty Service Territory with Social Vulnerability Index, Liberty's Updated Utility Risk Analysis in its 2023 WMP and Major Roads





LIBERTY UTILITIES
Existing Weather Stations
Date: 3/2/2023
Legend
Weather Stations (29)
Service Territory
Wildfire Risk Rating
Very High
High
Moderate
Low
Temporary reduction
0 2.5 5 10 Miles
N
S
E
W
3109
3110
3112
3116
3113
3124
3115
3123
3127
3121
3101
3114
3117
3104
3111
3128
3120
3102
3125
3126
3107
3108
3122
3118
3103
3129
3105
3106
3130
Lake Tahoe
Truckee
Kings Beach
South Lake Tahoe
Carson City
Reno-Sparks Indian Colony
Tahoe National Forest
Donner Memorial State Park
Lake Tahoe Nevada State Park
Stewart Community
Eldorado National Forest
Toiyabe National Forest
Burbank Canyons WSA
Smith
Pines
Portola
NEVADA
CALIFORNIA
Sacramento
San Francisco
San Jose
Fresno
Sierra Nevada Mountains
Basemap Credits:Carson City GIS, California State Parks, Esri, HERE, Garmin, SafeGraph, FAO, METI/NASA, USGS, Bureau of Land Management, EPA, NPS, Carson City GIS, California State Parks, Esri, HERE, Garmin, FAO, NOAA, USGS, EPA, Esri, USGS

Appendix D
Areas for Continued Improvement

Appendix D: Areas for Continued Improvement

In this appendix, the electrical corporation must provide responses to its areas for continued improvement as identified in the Decisions on the 2022 WMP Updates in the following format:

Code and Title: LU-22-01. Collaboration and Research in Best Practices in Relation to Climate Change Impacts and Wildfire Risk and Consequence Modeling.

Description: While Liberty includes some climate projections within its modeling, Liberty does not sufficiently account for climate change in its planning.

Required Progress: Prior to the submission of their 2023 WMPs, all electrical corporations (not including independent transmission operators) must participate in an Energy Safety-led scoping meeting to discuss how utilities can best learn from each other, external agencies, and outside experts on the topic of integrating climate change into projections of wildfire risk. They must also participate in any follow-on activities to this meeting. In addition, the climate change and risk modeling scoping meeting will identify future topics to explore regarding climate change modeling and impacts relating to wildfire risk. This scoping meeting may result in additional meetings or workshops or the formation a working group. Energy Safety will provide additional details on the specifics of this scoping meeting in due course.

Liberty Response: Liberty participated in the Energy Safety-led Wildfire Risk Modeling Working Group meetings on August 10, 2022 and September 14, 2022. These meetings addressed best practices in relation to integrating climate change into projections of wildfire risk.

Code and Title: LU-22-02. Inclusion of Community Vulnerability in Consequence Modeling.

Description: Liberty does not currently include the impacts of wildfire on communities, such as community vulnerability, within consequence modeling.

Required Progress: Prior to the submission of their 2023 WMPs, all electrical corporations (not including independent transmission operators) must participate in an Energy Safety-led scoping meeting to discuss how to best learn from each other, external agencies and outside experts. They must also participate in any follow-on activities to this meeting. In addition, the community vulnerability scoping meeting will identify future topics to explore regarding integration of community vulnerability into consequence modeling and impacts relating to wildfire risk. This scoping meeting may result in an additional meetings or workshops or the formation of a working group. Energy Safety will provide additional details on the specifics of this scoping meeting in due course.

Liberty Response: Liberty participated in the Energy Safety-led Wildfire Risk Modeling Working Group meeting on November 17, 2021. This meeting addressed social vulnerability as a driver in consequence modeling.

Code and Title: LU-22-03. Wildfire Consequence Modeling Improvements.

Description: Liberty's risk model is limited in its evaluation of wildfire spread based on timing limitations as well as suppression effects.

Required Progress: As part of the Energy Safety's final decisions on the 2022 Updates of PG&E, SCE, and SDG&E, the large IOUs are required to evaluate spread timing and suppression effects for wildfire consequence modeling. Liberty must leverage these findings and implement the measures identified by the large IOUs into its consequence modeling, where appropriate. In its 2023 WMP, Liberty must explain which measures it selected for implementation and provide a report on its progress.

Liberty Response: Refer to Section 6.2 of Liberty's 2023 WMP.

Code and Title: LU-22-04. Review, Re-categorize and Fully Justify Risk Events that are Defined as "Other" and "Unknown."

Description: Within Tables 7.1 and 7.2 (2022 Update), many of Liberty's risk events are grouped in categories defined as "other" or "unknown."

Required Progress: In its 2023 WMP, Liberty must:

- Identify and review the causes of risk events that fall within the "other" category.
- Determine where new categories of risk events can be created based on any common causes found, with a goal of reducing the number of risk events that fall under the "other" category.
- Provide a plan for conducting a root cause analysis of "unknown" events; this should include how Liberty will review the findings of root cause analysis. Based on the findings of root cause analyses; Liberty must reduce the number of risk events falling within the unknown category.

Liberty Response:

- The primary causes of risk events included in the "Other" category are related to winter weather events, specifically wind and snow unloading. In 2022, Liberty has begun categorizing these winter storm outages as "Wire-to-wire Contact," "Vegetation Contact," or "Equipment failure" based on the specific circumstances of each outage related to winter storms. These causes represent a significant percentage of Liberty's total risk events because the majority of its service territory exists in mountainous, high-elevation terrain.
- A new category of risk events for "Snow Unloading" will significantly reduce the number of risk events that fall under the "Other" category. This new risk category will also more

accurately separate these snow-related outages from other “Wire-to-wire Contact” outages. All outages in the “Wire-to-wire Contact” category are counted as “events with probability of ignition” according to Table 2 of the WMP quarterly reports. Without a new category for “Snow Unloading”, many winter outages that occur when risk of ignition is significantly reduced in heavy snow will incorrectly be counted as high-risk events.

- Liberty has recently taken several steps that will decrease the number of unknown outages in 2023. In order to conduct a root cause analysis of unknown outages, system control now sends daily outage logs to the local operations managers to review and verify information. Operations managers review these lists with their teams to verify cause, restoration times, customer counts and completed repairs, before sending any corrections back to system control to update the outage database. In addition, Liberty’s system control department has assigned more dedicated electric dispatchers, which will improve performance and communication between system control and troublemen, resulting in more accurate outage data.

Code and Title: LU-22-05. Further Evaluate Risk Trends to Apply More Specific Lessons Learned.

Description: Liberty’s current risk trend analysis is not granular enough when applying lessons learned.

Required Progress: In its 2023 WMP, Liberty must:

- Perform root cause analyses to determine specific causes for ignitions and risk events.
- Implement changes based on lessons learned both at a cause-specific and programmatic level to reduce wildfire risks moving forward.
- Include descriptions to how root cause analyses and changes are directly related.

Liberty Response:

- Liberty has recently taken several steps that will decrease the number of unknown outages in 2023. In order to conduct a root cause analysis of unknown outages, system control now sends daily outage logs to the local operations managers to review and verify information. Operations managers review these lists with their teams to verify cause, restoration times, customer counts and completed repairs, before sending any corrections back to system control to update the outage database. In addition, the Liberty system control department has assigned more dedicated electric dispatchers, which will improve performance and communication between system control and troublemen, resulting in more accurate outage data.
- Section 11 of Liberty’s 2023 WMP provides examples of corrective actions taken related to risk events and other findings from asset and vegetation management inspections.

Code and Title: LU-22-06. Update Equipment and Procedures for Detecting Ignitions Along the Grid.

Description: Liberty does not currently have any procedures or well-defined equipment for detecting ignitions along the grid.

Required Progress: In its 2023 WMP, Liberty must provide an update on progress and details on the equipment it has operationalized and procedures it has developed for detecting ignitions along the grid.

Liberty Response: In Section 8.3.4 of its 2023 WMP, Liberty explains that it does not currently have equipment for detecting ignitions along the grid but plans to sponsor eight fire cameras in its service territory. Available ignition detection technology for electrical grids is limited, but Liberty is aware that infrared cameras and AI smoke detection algorithms are beginning to be deployed by some other utilities. Liberty will evaluate deploying these technologies and any other ignition detection equipment that becomes available.

Additionally, the procedures described in Section 8.1.8.2 of Liberty's 2023 WMP (call System Control to quickly de-energize a circuit if deemed an immediate safety or wildfire risk and call emergency services (i.e., 911) for suppression resources if personnel onsite are unable to suppress immediately) are aimed at automatically, accurately and notifying (in real time) suppression resources and key stakeholders if an ignition is detected or if Liberty deems a risk event as a wildfire risk.

Code and Title: LU-22-07. Update Progress Associated with Distribution Fault Anticipation / High-Impedance Fault Detection Research.

Description: Liberty had distribution fault anticipation ("DFA") technology and high-impedance fault detection ("HIFD") projects that experienced delays in 2021 due to contract terms and fire activity commitments. Liberty is now behind in its progress for these projects and are now planning to complete them in 2022.

Required Progress: In its 2023 WMP, Liberty must provide an update on its progress on its DFA technology installation and HIFD projects, including any evaluations that have been done on the effectiveness of the technologies since deployment.

Liberty Response: Liberty has made significant progress with DFA. DFA is still in the implementation phase. Ten DFA units have been installed at the Meyers, Stateline and Northstar Substations to monitor ten circuits. These units will be online within the first half of 2023 once the communication path for data collection is established. It is anticipated that the units will be collecting data in the early part of this year. The data will be collected and analyzed by an algorithm developed by a specialized team at the Texas A&M Power System Automation Laboratory. Reports will be sent out periodically with recommendations on which circuits to investigate for specific problems identified by the algorithmic report process. The reports are generated by DFA monitors, which look at the current and voltage wave forms in high fidelity. Liberty will evaluate the effectiveness of this technology for preventative maintenance and anticipation of fault events. Based on the results, Liberty will evaluate if and then how much to expand the program in future years.

Liberty also commissioned a study by the University of Nevada, Reno ("UNR") to look at the potential effectiveness of HIFD in its distribution system. The study concluded that HIFD is not the best technology for Liberty to pursue and that technologies such as fast trip and sensitive earth relay settings have more potential to reduce wildfire risk and improve reliability. UNR concluded that HIFD has the potential to cause nuisance trips and would only provide coverage for about 70% of the faults on the line. Liberty did enable the Meyers 3400 circuit with capabilities to search for high impedance faults. However, based on the information collected by UNR, Liberty will only be using HIFD sparingly to check for high impedance faults on the Meyers 3400 circuit. Based on this information, Liberty is not moving forward with HIFD technology at this time, but it will still be a consideration for the future depending on technology advancements.

Code and Title: LU-22-08. Justification of Weather Station Density.

Description: Liberty reports experiencing delays in deploying weather stations in 2021 and reduced the total number of weather stations it plans to install across its service territory by one weather station. Liberty states that this reduced total number of weather stations will be adequate coverage for its territory.

Required Progress: In its 2023 WMP, Liberty must discuss its assessment of weather station density and how the total number of weather stations for its service territory was determined, including any weather station to circuit mapping analysis that has been done to determine spatial gaps in weather stations coverage.

Liberty Response: In Section 8.3.2 of its 2023 WMP, Liberty describes its weather station network. In 2023, Liberty plans to install 4 weather stations that remain from the 2022 target. In 2023, Liberty will determine if new weather stations are needed in future years by using weather station optimization tools like the one developed by the Pyregence consortium and by leveraging expertise from the National Weather Service ("NWS") Reno's meteorology team. If blind spots are identified, Liberty will target these areas for additional weather station installation in 2024 and 2025. Refer to "Appendix C: Grid Hardening Maps" for a map of Liberty's weather station network.

Code and Title: LU-22-09. Apply Joint Lessons Learned Concerning Covered Conductor.

Description: Liberty has not yet provided goals or timelines for implementing lessons learned from the covered conductor effectiveness joint study.

Required Progress: In its 2023 WMP, Liberty must:

- Provide a list of goals with planned dates of implementation for any lessons learned from the covered conductor effectiveness joint study.
- Provide a table indicating which WMP sections include changes (compared to its 2021 and 2022 Updates) as a result of the covered conductor effectiveness joint study. This should include, but not be limited to:
  - Changes made to covered conductor effectiveness calculations.
  - Changes made to initiative selection based on effectiveness and benchmarking across alternatives.
  - Inclusion of rapid earth fault current limiter ("REFCL"), open phase detection ("OPD"), early fault detection ("EFD"), and DFA as alternatives, including for PSPS considerations.
  - Changes made to cost impacts and drivers.
  - An update on data sharing across utilities on measured effectiveness of covered conductor in-field and pilot results, including collective evaluation.

Liberty Response: Liberty considers covered conductor ("CC") to be an effective method for wildfire mitigation and also understands that it is important to evaluate all reasonable options for system hardening projects. Liberty subject matter experts ("SMEs") have modified initial effectiveness projections from 85% to 75% based on participation in the Joint IOU CC Group. Liberty has decided to temporarily slow the implementation of CC projects and put more focus on other initiatives while collecting more information on the actual effectiveness and best use cases for CC. Two key initiatives that Liberty is putting more focus on are sensitive relay profiles ("SRP") and traditional overhead hardening. Those initiatives are presented in Liberty's 2023 WMP. Liberty is assessing whether CC is best used on lines in heavily wooded areas with constrained clearances and/or areas where long spans are needed.

See Table below for additional information regarding changes to Liberty's CC program.

WMP Changes Related to Covered Conductor	
Covered Conductor Effectiveness	Through participation in the CC Effectiveness workstreams, Liberty SMEs have modified initial effectiveness projections from 85% to 75%.
Covered Conductor Selection	Liberty is continuing consideration of all applicable WMP initiatives. Liberty's wildfire mitigation planning efforts have resulted in decisions to implement more SRP and implementation of more

WMP Changes Related to Covered Conductor	
	conventional overhead hardening. Other initiatives strongly considered when applicable include undergrounding and microgrids.
Technology Considerations	Liberty has been and will continue to increase its efforts on evaluating alternatives and combined efforts for system hardening for all projects. Those considerations include technology efforts for safety, reliability, and wildfire mitigation.
Cost Considerations	Costs for all types of work have increased considerably over the last three years. While average costs for covered conductor decreased between 2021 and 2022, costs can vary significantly on a project-by-project basis due to the wide range of construction techniques required in the rough and varied terrain of Liberty's service territory.
Data Sharing	Liberty will continue to share data on CC effectiveness as requested. Because of the limited amount of CC installed in the Liberty system the data does not yet provide enough information to draw conclusions. Liberty intends to continue to participate in the CC Effectiveness Working Group to benefit from data collected by the entire group.

Code and Title: LU-22-10. Determine Best Practices for Covered Conductor Inspection and Maintenance.

Description: Liberty lacks specific directives for inspection procedures regarding covered conductor inspection and maintenance.

Required Progress: All electrical corporations (not including independent transmission operators) must work to share and determine best practices for inspecting and maintaining covered conductor, including either augmenting existing practices or developing new programs. This should be considered as a continuation of the covered conductor effectiveness joint study established by Energy Safety's 2021 WMP Action Statements. The study will continue to be utility-led, with the expectation for Energy Safety to be included as a participant. A report on progress on this continuation of the covered conductor effectiveness joint study will be expected in the 2023 WMPs.

Liberty Response: Refer to "Appendix F - CC Effectiveness Workstream_2023 WMP Report Draft" of Liberty's 2023 WMP.

Code and Title: LU-22-11. Address Unmet Grid Hardening Targets.

Description: Liberty fell behind on its grid hardening targets in 2021, including covered conductor, pole replacements, and installing sectionalization devices.

Required Progress: In its 2023 WMP, Liberty must provide its plan for addressing its unmet 2021 grid hardening targets. This plan should include resource allocation (including labor and materials), adjustments made to future targets based on incomplete 2021 targets, and corrections based on lessons learned to prevent future delays.

Liberty Response: Liberty establishes targets for its grid hardening WMP initiatives each year based on the best available current information at the time of establishing targets. As discussed in Section 7 of Liberty's 2023 WMP, Liberty selects a portfolio of initiatives that aligns with its current risk methodology and risk, and other operational and compliance considerations. Liberty continually reprioritizes its workload, including wildfire mitigation efforts, based on changing conditions and workload constraints.

As demonstrated by its missed grid hardening targets in 2021, events outside of Liberty's control such as the Caldor and Tamarack fires that burned into Liberty's service territory can divert resources away from planned WMP mitigation efforts. For instance, Liberty replaced 211 poles in 2021 as part of its WMP Pole Replacement initiative (7.3.3.6). Energy Safety assesses that Liberty missed its target of 400 poles for this initiative. However, Liberty replaced an additional 175 poles in 2021 resulting from fire or storm damage in 2021, which impacted available resources. These pole replacements were unplanned as part of Liberty's 2021 WMP but ultimately required the same resources that were planned for in Liberty's 2021 WMP. Based on these circumstances, the remaining Level 2 poles planned in Liberty's 2021 WMP Pole Replacement initiative were planned to be completed in 2022. Liberty completed 98% of its planned pole replacements in 2022. Likewise, Liberty completed 100% of its planned covered conductor projects in 2022, which included the projects that Liberty had planned to complete in 2021.

Liberty considers its WMP targets as its best estimate of the work that it can complete in a given year and understands that its targets can be impacted by outside factors such as wildfires and storms in its service territory that damage assets. Liberty will consider missed targets from a previous year in its current year WMP planning and in establishing future WMP initiative targets. Additionally, Liberty assesses its completed grid hardening efforts, such as covered conductor projects, asset repairs, and replacements completed in recent years along with enhanced vegetation management work to review holistically what is effectively working system-wide to reduce wildfire risk. To the extent possible, Liberty's risk mitigation planning utilizes updated risk metrics and analyses available in conjunction with subject matter expertise from operations, vegetation management, wildfire prevention, and engineering. This collaborative approach and information sharing amongst the various work groups is a vast improvement to Liberty's previous WMP submissions and allows Liberty to set future targets that will improve Liberty's overall wildfire mitigation planning.

Code and Title: LU-22-12. Progress on Formal QA/QC Program for Asset Inspections.

Description: Liberty has not implemented its formal QA/QC program for asset inspections, and therefore has yet to undergo an iteration with associated findings and results.

Required Progress: In its 2023 WMP, Liberty must:

- Provide the results of the QA/QC completed for asset inspections in 2022, including pass rate for each inspection type.
- Explain any lessons learned based on findings of the asset inspections from the QA/QC process.
- Describe any changes made to the QA/QC program, if any, based on lessons learned from implementation.

Liberty Response: Refer to Section 8.1.6 of Liberty's 2023 WMP.

Code and Title: LU-22-13. Further Integrate Risk-Informed Decision Making into Inspection Scheduling and Planning.

Description: While Liberty states it uses some risk-informed prioritization for inspections based on Tier 2 and Tier 3 designations and consequence modeling, Liberty has not yet implemented risk modeling-informed enhancements in its inspection program.

Required Progress: In its 2023 WMP, Liberty must:

- Provide a timeline detailing when Liberty plans to implement risk modeling-informed enhancements for each of its inspection types.
- Enhance and augment its existing inspections so that it reflects risk modeling outcomes (i.e., increased frequency, changes in inspection lists).
- Provide an update on its evaluations for including infrared as part of its asset inspections.

Liberty Response:

- In 2023, Liberty plans to evaluate its risk modeling and evaluation of the model results to inform all mitigation planning and not just asset inspections.
- Refer to Liberty's risk model improvement plan in Section 6.7 for asset risk analytics expected later this year. The evaluation of decision model interventions for asset inspections versus replacements will occur later this year. Also refer to Sections 7.1.3 and S7.1.4 of Liberty's 2023 WMP.

- Refer to Section 8.1.3.4 of Liberty's 2023 WMP.

Code and Title: LU-22-14. Participate in Vegetation Management Best Management Practices Scoping Meeting.

Description: Vegetation management processes and protocols for the reduction of wildfire risk are not uniform across electrical corporations.

Required Progress: Prior to the submission of their 2023 WMPs, Liberty and all other electrical corporations (not including independent transmission operators) must participate in an Energy Safety-led scoping meeting to discuss how utilities can best learn from each other and future topics to explore regarding vegetation management best management practices for wildfire risk reduction. Liberty must also participate in any follow-on activities to this meeting. This vegetation management best management practices scoping meeting may result in additional meetings or workshops or the formation of a working group. Energy Safety will provide additional details on the specifics of this scoping meeting later in 2022.

Liberty Response: Liberty participated in the Energy Safety-led Utility Vegetation Management Scoping Meeting on February 10, 2023.

Code and Title: LU-22-15. Improve Transparency of the Initiative Selection Process.

Description: As presented, Liberty's risk determination and initiative selection process lacks full transparency. Specifically, Liberty does not clearly explain or pinpoint where RSE estimates are considered in its decision-making process. In addition, Liberty's decision-making flow chart does not define each step towards initiative deployment.

Required Progress: In its 2023 WMP, Liberty must describe in detail and demonstrate where RSE estimates are considered in its WMP initiative selection decision-making flowchart. In addition, Liberty must explain its initiative selection process with greater granularity and further break out its flowchart to show steps taken from evaluation to deployment.

Liberty Response: Refer to Section 7.1.4.1 of Liberty's 2023 WMP. Liberty did not utilize RSE calculations for its initiative selection process. See Section 6 for additional information on Liberty's risk based decision making framework for the initiative selection process.

Code and Title: LU-22-16. Commit to Short-Term PSPS Reduction Targets

Description: Liberty's 2022 Update does not fully describe quantified short-term PSPS reduction commitments and mitigation initiative targets either in Table 11 or in Section 8.

Required Progress: In its 2023 WMP, Liberty must provide quantifiable risk reduction projections of frequency, scope, and duration of PSPS events during the plan term, including timelines for achieving these reductions. Energy Safety expects that Liberty will be able to fully quantify expected progress-based risk model developments through 2022. Liberty can use its modeled results to more comprehensively report expected reductions of, and benefits to, impacted customers and circuits.

Liberty Response: Liberty provides its PSPS objectives in Section 9.1 of its 2023 WMP. Additionally, Liberty provides details on its progress related to wildfire and PSPS risk modeling in Section 6 of its 2023 WMP. Liberty's progress on grid hardening (Section 8.1.2), situational awareness (Section 8.2), emergency management, training, and preparedness (Section 8.4), and community outreach and engagement (section 8.5) suggest that potential PSPS impacts would be reduced due to those efforts.

Liberty has not implemented a PSPS event and Liberty is not able to provide quantified risk reduction projections with the data available. Utilities with prior PSPS activations have been able to show quantifiable changes in frequency, scope, and duration based on data gathered from those events. For instance, other utilities are able to take year-over-year event statistics from prior seasons and present those in their current year WMP. Utilities use the number of PSPS activations (frequency), the number of customers de-energized (scope), the number of circuits de-energized (scope), and the customer minutes interrupted (duration) to quantify the percent reduction in frequency, scope, and duration. Because Liberty has not implemented a PSPS event, actual event statistics do not exist to analyze PSPS performance.

Appendix E
Referenced Regulations, Codes, and Standards

Appendix E: Referenced Regulations, Codes, and Standards

In this appendix, the electrical corporation must provide in tabulated format a list of referenced codes, regulations, and standards.

Name of Regulation, Code, or Standard	**Brief Description**
Public Utilities Code § 8386	Law that requires electric corporations to submit wildfire mitigation plans.
Public Utilities Code section 768.6	Statute related to emergency and disaster preparedness plans.
General Order 166	Standards for Operation, Reliability, and Safety During Emergencies and Disasters.
Government Code section 8593.3	The California Government Code Section 8593.3 defines Access and Functional Needs as "Individuals who have: Developmental, intellectual, or physical disabilities; Chronic conditions or injuries; Limited English proficiency or non-English speaking; Or individuals who are: older adults, children, or pregnant; living in institutional settings; or Low-income, homeless, and/or transportation disadvantaged."
Public Resources Code § 4292	CAL FIRE requires 10 feet of minimum clearance around the base of the pole cleared of all flammable vegetation down to bare soil and the removal of all dead tree branches within this cylinder up to the cross-arm (within the State Responsibility Area).
Office of Energy Safety ("OEIS") 2023-2025 Wildfire Mitigation Plan Process and Evaluation Guidelines	This document establishes guidelines1 outlining the process for disposition of Wildfire Mitigation Plans (WMPs) and details the public participation process and submission requirements. These guidelines will remain in effect for the 2023-2025 WMP three-year cycle.
OEIS 2023-2025 Wildfire Mitigation Plan Technical Guidelines	OEIS has authority under Government Code section 15475.6 to "adopt guidelines setting forth the requirements, format, timing, and any other matters required to exercise its powers, perform its duties, and meet its responsibilities described in Sections 326, 326.1, and 326.2 and Chapter 6 (commencing with Section 8385) of Division 4.1 of the Public Utilities Code.

Name of Regulation, Code, or Standard	Brief Description
OEIS Final Decision on Liberty 2022 Wildfire Mitigation Plan Update	This Decision represents OEIS' assessment of Liberty's 2022 WMP Update and approves Liberty's 2022 Update, with areas for continued improvement identified.
OEIS Final Data Guidelines (Version 3.0)	Data Guidelines that set forth the required standards, schemas, and guidance on data preparation, submittal, and schedule for submission of Quarterly Data Report (QDR), Geographic Information Systems (GIS) data, and tabular Wildfire Mitigation Data to Energy Safety in support of its oversight and enforcement of electrical corporations' compliance with wildfire safety.
General Order 95	Overhead electric line design, construction, and maintenance requirements in order to ensure adequacy of service and safety; covers topics such as proper grounding, clearances, strength requirements, and tree trimming.
General Order 165	Inspection requirements for transmission and distribution facilities in order to ensure safety and high-quality electrical service; sets maximum allowable inspection cycle lengths, scheduling and performance of corrective action, record-keeping, and reporting.
General Order 174	Inspection requirements for substations to promote the safety of workers, the public, and enable adequacy of service.
California Standardized Emergency Management Systems ("SEMS")	The California Emergency Services Act 2021 Edition ("ESA") requires SEMS for managing multiagency and multijurisdictional responses to emergencies in California.
National Incident Management System ("NIMS")	NIMS provides guidelines for government, nongovernmental organizations and the private sector to work together to prevent, protect against, mitigate, respond to and recover from emergency management incidents.
Resolution WSD-011	California Public Utilities Commission ("CPUC") Resolution implementing the requirements of Public Utilities Code Sections 8389(d)(1), (2) and (4), related to catastrophic wildfire caused by electrical corporations subject to the Commission's regulatory authority.

Name of Regulation, Code, or Standard	Brief Description
R.18-10-007	Order Instituting Rulemaking (OIR) to Implement Electric Utility Wildfire Mitigation Plans Pursuant to Senate Bill 901 (2018).
R.20-07-013	OIR to Further Develop a Risk-based Decision-making Framework for Electric and Gas Utilities.
D.20-03-004	Decision on community awareness and public outreach before, during and after a wildfire, and explaining next steps for other Phase 2 issues. Decision in Rulemaking 18-10-007 requiring IOUs to conduct community awareness and public outreach before, during, and after a wildfire in any language that is “prevalent” in its service territory or portions thereof.
D.19-05-042	CPUC Decision Adopting De-Energization (Public Safety Power Shutoff) Guidelines (Phase 1 Guidelines).
D.20-05-051	CPUC Decision Adopting Phase 2 Updated and Additional Guidelines for De-Energization of Electric Facilities to Mitigate Wildfire Risk.

Appendix F
CC Effectiveness Workstream Joint IOU Report

2023 -2025 WMP
Joint IOU Covered Conductor Working Group Report

Introduction:
In the 2021 WMP Update Final Action Statements, Energy Safety ordered the Joint IOUs[1] to coordinate to develop a consistent approach to evaluating the long-term risk reduction and cost-effectiveness of covered conductor (CC) deployment, including 1) the effectiveness of CC in the field in comparison to alternative initiatives and 2) how CC installation compares to other initiatives in its potential to reduce PSPS risk. The utilities thus formed a Joint IOU Covered Conductor Working Group and developed an approach, assumptions, and preliminary milestones to enable the utilities' to better discern the long-term risk reduction effectiveness of CC to reduce the probability of ignition, assess its effectiveness compared to alternative initiatives, and assess its potential to reduce PSPS risk in comparison to other initiatives. The approach consisted of multiple workstreams including: Benchmarking, Testing, Estimated Effectiveness, Recorded Effectiveness, Alternatives Comparison, Potential to Reduce PSPS Risk, and Costs. In the 2022 WMP Update filings, the utilities produced a joint report that provided an update on their progress for each of the workstreams, added efforts, and preliminary plans for 2023.

In the 2022 WMP Update Final Decisions, Energy Safety identified Areas of Continued Improvement and Required Progress (ACI) for all utilities to expand this working group to include: 1) Joint CC Lessons Learned, 2) CC Maintenance and Inspection (M&I) Practices, and 3) New Technologies Implementation. Given these directions, the utilities expanded the Joint IOU Covered Conductor Working Group to include 10 workstreams and began meeting on the new workstreams in Q3/Q4 2022.

Overview:
The information compiled and assessments completed in 2022 continue to indicate CC effectiveness between approximately 60 to 90 percent in reducing the drivers of wildfire risk, consistent with benchmarking, testing and utility estimates. In 2022, laboratory testing on CC has largely been completed with a few tests remaining.

In 2023, the utilities plan to conduct workshops across several workstreams to assess testing results, identify CC M&I best practices, develop a common framework for calculating the effectiveness of a combination of alternatives, assess data and information for effectiveness of new technologies and share practices and implementation strategies, and assess studies to be performed on CC's ability to reduce PSPS impacts amongst other actions. The utilities will also continue to meet to further benchmark efforts, improve methods for estimating and measuring effectiveness, and continue to track and compare unit costs. Below, the utilities describe the progress made on each workstream and steps planned to continue this effort in 2023.

As explained in the 2022 WMP Update report, the current type of CC being installed in each of the utilities' service areas is an extruded multi-layer design of protective high-density or cross-linked polyethylene material. In this report, "covered conductor" or "CC" refers generally to a system installed on cross-arms, in a spacer cable configuration, or as aerial bundled cable (ABC). Distinctions are made where utilities install CC on cross arms and in a spacer cable configuration. Table F-1, below, provides an

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[1] In this progress report, "Joint IOUs," "IOUs," or "utilities" refers to SDG&E, PG&E, SCE, PacifiCorp, BVES, and Liberty.

updated snapshot of the approximate amount and types of CC installed in the utilities' service areas through 2022.

Table F-1
Covered Conductor Type and Approximate Circuit Miles Deployed by Utility

Utility	First covered conductor installation (year)	Type of covered conductor installed	Approx. miles of covered conductor deployed through 2022	Notes
SCE	2018	Covered Conductor	4,400	Includes WCCP and Non-WCCP
	2022	Spacer Cable	0.15	Pilot
	Installed Historically	Tree Wire	50	
	Installed Historically	ABC	64	
PG&E	2018	Covered Conductor	960	Primary distribution overhead only
	2022	ABC	3	Like for like replacement
SDG&E	2020	Covered Conductor	84	
		Tree Wire	2	
		Spacer Cable	6	
Liberty	2019	Covered Conductor	11	
	2019	Spacer Cable	9	
Pacificorp	2007	Spacer Cable	76	
	2022	Covered Conductor	7	
Bear Valley	2018	Covered Conductor	34	

Testing:

Introduction:

In 2022, the joint IOUs performed Phase 2, or testing of CC, to better understand the advantages, operative failure modes, and current state of knowledge regarding CCs. As explained in the utilities' 2022 WMP Update filings, the utilities contracted with Exponent, Inc. (Exponent) to develop a report for a Phase 1 study. The Phase 1 study consisted of a literature review, discussions with SMEs, a failure mode identification workshop, and a gap analysis comparing expected failure modes to currently available test and field data. The Phase 1 report was completed in December 2021 and was an attachment to the utilities' 2022 WMP Update filings. The outcome of the Phase 1 report identified gaps in previous testing and informed the scope of laboratory testing. For the remainder of 2022, the IOUs executed Phase 2 to perform testing and analyses of CC, which had the following objectives:

- Develop test plans based on Phase 1 report identified gaps and recommendations
- Complete physical testing of CC
- Document and discuss results from physical testing of CC

Within Phase 2 of the study, SCE, SDG&E, and PG&E all performed specific testing scopes of work, informed by the findings and recommendations of the Phase 1 report issued by Exponent. The three utilities, led by SCE, contracted with Exponent to independently investigate the effectiveness of CC for overhead distribution systems and, in the case of PG&E and SDG&E, executed additional testing plans as part of this joint effort.[2] Exponent conducted several testing scenarios that covered various contact-from-object, wire down, system strength, flammability, and water ingress scenarios. PG&E developed an additional test plan to ensure coverage of failure modes and additional CC types. SDG&E's additional test plan included environmental, service life, UV exposure, degradation, and mechanical strength tests. Exponent's investigation included lab-based testing of 15 kV rated 1/0 aluminum conductor, steel reinforced (ACSR) CC provided by SDG&E, 17 kV and 35 kV rated 1/0 ACSR provided by SCE, 22 kV rated 397.5 kcmil all aluminum conductor (AAC) provided by PG&E, and 17 kV rated 2/0 copper CC provided by SCE (corrosion testing only). PG&E's additional testing included 15 kV rated 397.5 AAC and 15 kV rated 1/0 ACSR. SDG&E's additional testing included a 15 kV rated 1/0 ACSR conductor.

SCE's testing began in Q1 2022 and was completed in Q4 2022. Exponent completed its final report in late December 2022.[3] SDG&E and PG&E began testing in Q2 2022. PG&E completed its testing and finalized its report in December 2022.[4] SDG&E has not completed all its testing with some tests anticipated to be competed in Q1 and early Q2 2023. All testing is not yet complete; however, the utilities have recently started to collaborate on the results of the tests that have been completed. This report provides a summary of the test results that have been completed. In 2023, the utilities plan to continue discussing the results of the tests as further described below.

Based on all the testing completed as of the end of December 2022, the following high-level conclusions were made:[5]

- CC effectiveness was evaluated by phase-to-phase contact and simulated wire-down testing. The study indicated that CCs are up to 100% effective at preventing arcing and ignition in tested scenarios at rated voltages. This is consistent with documented field experience as reported in the Phase I report.
- The study indicated CCs showed effectiveness at preventing arcing and ignition and limited current flow to less than 2.5 mA in 100% of tested phase-to-phase contact scenarios at rated conductor voltages, which included different types of vegetation, balloons, simulated animals, and conductor slapping.
- CCs exceeded insulation ratings for rated voltage with 50% covering removed.
- In wire down situations, broken CCs and CCs with damage that exposed the underlying metal showed potential for arcing/ignition. However, pursuant to the CCs tested, the results showed the CCs prevented arcing and ignition during simulated wire-down events in dry brush in the Exponent testing.
- Thermal testing was performed to understand the impact of a nearby wildfire on CC installations. Results suggested that the heat fluxes and times required for auto-ignition of the polyethylene sheaths were unlikely to be encountered during a surface or low-lying brush fire;

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2 To distinguish between the results described below, "SCE testing" refers to the joint IOU Exponent testing, "PG&E testing" refers to the testing PG&E conducted, and "SDG&E testing" refers to the testing SDG&E has completed and is still conducting for the Joint IOU effort.

3 The joint IOU Exponent report entitled, "Joint-IOU Covered Conductor Testing Cumulative Report 12-22-22" is included in each utility's Supporting Documents.

4 The PG&E report entitled, "PGE Covered Conductor Testing-1219" is included in each utility's Supporting Documents.

5 All tests were performed under controlled conditions. Actual field performance may vary depending on a variety of factors.

however, a canopy fire may be sufficient to cause conductor sheath ignition.

- Water ingress testing was performed to understand if implementation of CCs inherently seals the conductor from moisture exposure, recognizing moisture is often a factor in corrosion occurrences. Stripped ends of CCs and CCs with insulation-piercing connectors (IPCs) were found to be susceptible to water ingress. While the test conditions were extreme relative to typical service conditions, water may travel down the conductor length from a stripped end.
- Corrosion was observed under the CC sheath near the stripped ends but was not observed under IPCs following salt spray testing. While this indicates that subsurface corrosion is possible near a stripped CC end, subsequent tensile testing showed minimal reduction in total strength of the conductor after corrosive environmental exposure for 1,000 hours. Potential water-ingress mitigation measures may help to prevent corrosion in areas where precipitation is likely to collect on the conductor.
- Mechanical testing was performed to assess the strength of CCs and their associated hardware. Strength testing of splices met or exceeded the rated strengths of the conductors. In simulated tree-fall conditions and insulator slip tests, one insulator type exhibited deformation of the metal pin but at a slip strength beyond GO 95 requirements. Another type of insulator exhibited conductor slippage with no apparent signs of damage but at a slip strength below GO 95 requirements.

Summary of Testing Results:

Arc Testing

The purpose of the Arc testing was to understand the effectiveness of CC in mitigating faults and ignition for various contact-from-object scenarios. These tests involved simulating wire-to-wire contact and contact from foreign objects by bridging two conductors, one energized and one grounded. Several permutations of CC, sheath damage, and bare conductors were tested. Overall, CC was successful at mitigating arcing/ignition under all tested conditions at their design voltages. Current flows for CC were recorded to be less than 2.5 mA. In comparison, current flows for bare wire were recorded to be greater than 2,000 mA. For a five-minute contact duration, no arcing, insulation breakdown, or visual damage was observed.

The testing of phase-to-phase contact demonstrates that CC is effective at reducing arcing and the potential for ignitions whenever the insulation is intact, and the operating voltage is within normal ranges. Potential for ignition exists when the insulation is damaged/removed which may occur when objects collide with the CC. This testing also involved energizing the CC at extreme voltages much higher than the CC was designed to withstand. At 90 kV, which far exceeds the conductor ratings, there was no insulation breakdown, pinhole formation, or arcing/ignition observed.

These test results illustrate the effectiveness of CC at mitigating ignitions due to contact-from-object events. Future testing may be done to simulate branches or other debris striking the conductor at speed to determine the ability of the insulation to withstand impact. Future testing may also include simulating the effects of long-term object contact.

Simulated Wire-down Testing

The wire-down testing investigated ignition risk posed by CC and bare wire wire-down events. Flaws were introduced to the covering to represent various scenarios during a CC wire-down. These flaws included the full removal of the covering, removing half the thickness of the covering, and having a broken end. The SCE wire-down testing demonstrated that conductors whose covering was still intact upon contacting the dry brush did not result in an ignition. Upon introducing a full thickness flaw into the covering, which exposed the bare conductor, arcing and ignition were observed. PG&E testing showed that Individual conductor strands can be exposed from the covering during simulated conductor breaks.

SCE testing was also performed by inserting a half-thickness flaw into the covering which did not result in arcing or ignition; this indicates that the CC can sustain significant damage without exposing the bare conductor and still be effective at mitigating ignitions. This conclusion is also corroborated through testing that showed that the CCs had a minimum of 66% of the insulation rating even with 50% abraded insulation.

Fire risk / Flammability Testing

SCE's Fire Risk testing subjected a small segment of conductor to local radiant heat to simulate how CCs would react to various magnitudes of wildfires. The magnitude of the heat represents surface fires, brush fires, and crown fires. Crown fires with a long residence time have the highest potential to cause damage to the covering of the conductor. The study noted that the measurements were taken with direct contact of the flame; however, properly maintained vegetation clearances would decrease an overhead primary distribution line's potential of being in contact with a flame. According to the inverse square law for heat, the intensity of the flame is inversely proportional to the distance squared X=1/d^2. Using this equation, we can approximate the amount of radiated heat the conductor might experience at a particular distance away from a flame. The shortest distance that should be expected between vegetation and the conductor would be when there are crowns of trees nearby (6-foot clearance, GO 95). There would be a significantly greater distance between the conductor and vegetation for surface and brush fires. At 6 feet, the heat flux is approximately 30% of what would be felt directly at the flame. At a distance of 6 feet (1.8288m) and utilizing the scenario-based heat fluxes provided, we can approximate the amount of heat the conductor would encounter. See Table F-2 below that shows the heat flux ranges for direct contact and contact at six feet for the different fire types.

Table F-2
Heat Flux Ranges by Fire Type

Fire Type	Heat Flux (kW/m^2) Range with Direct Contact		Heat Flux (kW/m^2) Range with Contact at 6 feet (1.8288m)	
Surface fires	18	77	5	23
Brush fires	97	110	29	33
Crown fires	179	263	54	79

Corrosion Testing

To make electrical and structural connections, some utilities remove the covering of the conductor to expose bare wire. When a bare wire is exposed to the elements, it becomes more susceptible to various types of corrosion. This was a common failure mode that was identified when benchmarking with other utilities. To mitigate this failure mode, some utilities use medium voltage fusion tape (MVFT) on electrical connections to the line. SDG&E utilizes Insulated Piercing Connectors (IPCs) to make electrical connections and a tensioning clamp for structural connections. Water ingress testing was performed by both SCE and PG&E to evaluate the corrosion susceptibility for instances when the covering is removed. SCE varied the test by utilizing a tool specifically designed to remove the covering to expose a length of bare conductor and removing the covering manually without unique tools; they also varied the conductor material to include copper and aluminum. The conductor was then placed vertically with a dedicated reservoir of fluorescent water at the top to simulate moisture intrusion. In all the tests, water was visible at the opposite end of the conductor segment within 5-10 minutes. PG&E's version of the testing was varied to test various types of CC with and without water-blocking agents. PG&E's test was also slightly different because a length of exposed conductor was not left at the top, but rather a clean cut was made on each of the conductors. For the conductors without water-blocking agents, fluorescent water was observed at the opposite ends of the conductor while there was no liquid observed for the conductors with water-blocking.

Although the water ingress testing setup, conducted in a submersible configuration, is not likely to occur in the field, water ingress can lead to accelerated corrosion. Additional preventative actions taken during installation and/or maintenance, such as the use of IPCs, tension clamps, gel wraps/packs, wildlife covers, or MVFT, may help limit moisture ingress and related corrosion effects. For example, PG&E's water immersion test of gel wraps demonstrates this mitigation's ability to prevent water intrusion for splice and other electrical connections. Additionally, corrosion can potentially be mitigated with the use of copper CCs due to copper being less susceptible to corrosion than aluminum in high corrosive areas.

Salt spray testing was performed by SCE to evaluate the susceptibility of exposed ends of CC to corrosion in coastal and industrial environments. This testing utilized a 5% salt solution for 168 hours with a SO2 solution introduced intermittently. The testing varied like the water intrusion testing, but also added artificial defects to simulate mid-span damage and performed the testing on bare conductors as well. Corrosion was identified on the exposed portion of the CC as well as under the covering. When a conductor had simulated damage, the most severe corrosion occurred. Exponent did identify that a segment of CC was evaluated which utilized an IPC; however, this did not demonstrate corrosion.

PG&E's atmospheric corrosion tests consisted of 1,000 hours of exposure using a 5% salt solution. This test evaluated bare conductor, CC, and splice connections with MVFT or gel packs. PG&E summarized that aluminum CCs are more susceptible to corrosion compared to bare conductor when exposed to a corrosive environment. This ingress is reduced with the application of MVFT and altogether eliminated with the use of gel packs. It is also important to note that all conductors met the rated breaking strength after the testing was completed.

Aging Susceptibility Testing

PG&E performed UV weathering tests with 1,000 hours of exposure time (ASTM G155-21). Two types of CCs were tested and neither met the tensile or elongation requirements of ANSI/ICEA S-121-733 to be considered resistant to sunlight. The results indicate that the covering is susceptible to degradation and cracking after long-term exposure to UV for the conductors tested.

Exponent, with SDG&E, performed accelerated aging testing by monitoring a segment of the cover at 10% thickness. It is assumed that the rate of change that is observed with a segment at 10% thickness can be used to anticipate the amount of deterioration over 40 years. Three tests were performed at 80C, 110C, and 130C; one test was performed at 80C with 1.60W/m^2 at 340nm UV. The UV data would then be interpolated with the results of the 110C and 130C samples to test the properties of interest; those include dielectric constant, mechanical strength, chemical changes, and visual changes. The results of this test also indicate that the covering is susceptible to degradation and cracking after long-term exposure to UV.

System Strength Testing

After the salt-spray corrosion testing, Exponent evaluated the tensile testing strength of the various aluminum, copper, and steel strand samples. The results from the individual strands can be used to assess the condition of the whole conductor. They showed that even though the aluminum strands underwent corrosion due to the accelerated aging, there was not a significant loss of strength in the conductor overall. For conductors with IPCs installed, there was a measurable decrease in tensile strength of the conductor strands related to the damage caused by the IPC, the degradation was not due to corrosion. Other utilities that utilize IPC's to make electrical connections have not identified this to be a concern.

PG&E evaluated the tensile strength of the conductors to confirm that they met the rated breaking strength and to evaluate how the conductor and cover would react. Both conductors tested exceeded the rated breaking strength. At the point of fracture, necking occurred but was more significant for the covering than the aluminum and steel wires. Small segments of exposed conductor could be seen protruding from the covering. Because of this, breaks in the conductor could result in phase-to-ground contact, which could lead to an ignition.

SCE's system strength tests included a splice maximum load test, insulator slip test, and a tree fall test. For the splice max load test, all spices met or exceeded specifications. For the insulator slip test and tree fall test, two different types of insulators were used. One experienced deformation of the metal pin while the other showed signs of slippage with no apparent damage. For a simulated tree fall on a dead-end configuration, a failure occurred with smaller sized conductor due to it slipping out of the dead-end shoe. It was noted that the failure likely occurred above the rated strength of the conductor. For larger conductors, the failure point was at the crossarm.

Electrical Properties Testing

PG&E performed leakage current and dielectric withstand tests on the covering and various splice coverings. For the covering tests, two different types and sizes of conductor were used, both with full cover thickness and 50% cover thickness to simulate a flaw. In all the covering test cases, the insulation failed at a voltage level that greatly exceeded its rated value. The splice covers tests consisted of a compression splice with gel pack, compression splice with MVFT, and a fired wedge connector with a cover. In all cases the splice coverings met or exceeded the ratings of the CC insulation rating.

To understand if CC could be susceptible to tracking damage, inclined plane tracking and erosion tests and tracking resistance with salt fog tests were performed. For the inclined plane and erosion tests, both conductor samples passed; however, one of the conductors showed a greater erosion depth. The tracking resistance with salt fog tests were designed to understand the impacts of long-term vegetation contact. Again, for these tests, both conductors met the passing criteria but, again, the same conductor showed a greater erosion depth.

PG&E tested the damaging effects that lightning might have on the covering. This was a custom test with guidance from IEEE Std. 4 and IEC 60060-1. The conductor samples were subjected to lightning impulses starting at 85 kV and then increased in the magnitude of the voltage until a breakdown occurred. Both of the conductor samples tested experienced breakdowns between 90-110 kV for each of the 5 samples. The conclusion of the lightning tests is that both coverings have the potential to be damaged by lightning; however, damage is expected to be localized and would be unlikely to cause auto-ignition of the covering.

Covering Properties Testing

The thermal properties of conductor layers were tested by PG&E to verify the glass transition temperatures for each layer of two different conductors. One of the conductors exhibited an onset of glass transition in the conductor shield layer at a lower than emergency temperature rating which could indicate possible early covering degradation if exposed to emergency temperatures repeatedly. The other conductor showed no signs of degradation up to the emergency operating temperatures.

Next Steps:
As explained above, several testing results were completed in December 2022 with a few still remaining. The utilities have met to overview the results of some completed tests but have not yet discussed all results nor in detail yet. In 2023, the utilities will conduct meetings and workshops to assess the testing results, determine if any additional tests are needed, determine if any mitigations are warranted (such as changes to materials, construction methods, or inspection practices), and will meet to assess whether changes to effectiveness estimates are warranted. Additionally, and as part of the workshops, the utilities will discuss the testing results in relation to PSPS de-energization thresholds. Below, we present a preliminary schedule for workshops and discussion themes.

- March 2023 – Corrosion Testing
- April 2023 – Aging Susceptibility Testing
- May 2023 – Arc Testing
- June 2023 – High Impedance Faults
- July 2023 – Tree Fall-in

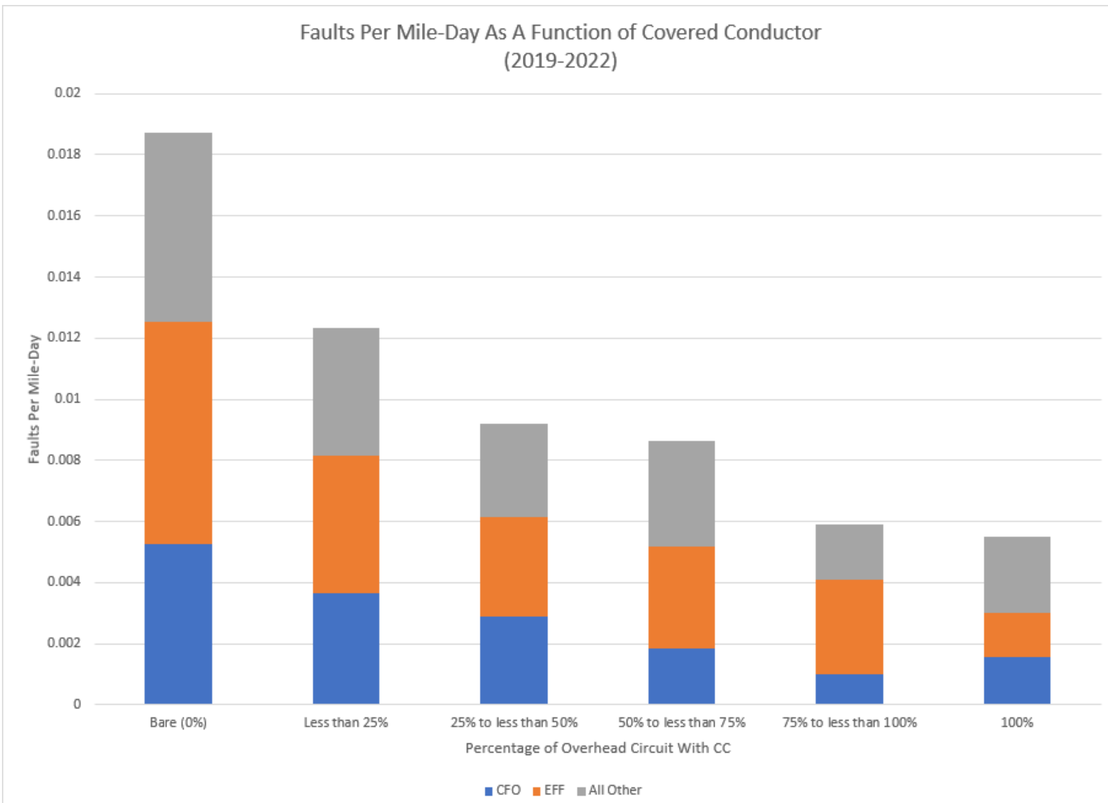
Once the utilities finalize the workshop schedule, Energy Safety will be invited. Based on findings from the workshops, additional workshops may be scheduled in 2023. Additionally, the utilities will continue to meet on a biweekly basis. Should the results of the workshops lead to changes in materials, construction practices, effectiveness values, etc., the utilities will establish plans to implement these changes and document as part of lessons learned.

Recorded Effectiveness:
As explained throughout this report, the utilities have continued to implement CC and are using recorded data to help assess its effectiveness in the field. Though the utilities’ data is still relatively limited, the outcomes in 2022 in addition to previous years outcomes, as presented below, continue to show CC effectiveness at reducing the risk drivers that can lead to wildfires range between approximately 60 to 90 percent, which is consistent with the utilities’ estimated effectiveness values and supported by recent testing results. Below, the utilities provide an update on its 2022 WMP Update report describing data and analyses used to measure recorded effectiveness of CC and plans for 2023 to continue to discuss and share recorded data and methods to measure effectiveness, and document lessons learned.

Covered Conductor Recorded Effectiveness:
<u>SCE</u>
SCE has continued to refine its data and methods to measure the effectiveness of CC in the field. In 2022, SCE set up a CC dashboard that tracks fault rates on overhead distribution circuits with 100% CC installed, circuits that are partially covered, and circuits with no CC installed (bare wire). The data can be broken down by fault sub-drivers such as CFO, EFF, and Other. The data is based on all circuits that traverse HFTD and includes a breakdown of how many miles fall into the fully covered, partially covered,

and not covered categories. The dashboard refreshes daily with updated fault and CC data. Because faults that occur on partially covered circuits are difficult to determine if occurred on the covered or bare portion, SCE has further delineated this data into the following partially covered groups: Less than 25%, 25% to 49%, 50% to 74%, 75% to less than 100%. Furthermore, SCE is now using a faults per mile-day method that factors in how long the circuit was fully or partially covered. In 2022, SCE provided overviews of its dashboard, grouping and methods to this working group. Faults per mile-day data from 2019-2022 are shown in Figure **Error! No text of specified style in document.**-1 below.

Figure** Error! No text of specified style in document.**-1
SCE Faults Per Mile-Day as a Function of Covered Conductor



By comparing fault events on fully and partially covered circuits to bare circuits in its HFRA on a per mile-day basis from 2019 to 2022, the data shows that circuits fully covered experience approximately 70% less faults than bare conductor when factoring in all sub-drivers (see Table F-3 below). Additionally, circuits that are in the 75% to less than 100% covered group experience a similar improvement over bare conductor at approximately 69% less faults. The data also shows a predicted trend with an increasing reduction in faults as more of a circuit is covered. Furthermore, on segments where SCE has covered bare wire, there has not been a CPUC-reportable ignition from the drivers that CC is expected to mitigate.

Table F-3
SCE Fault Events on Fully and Partially Covered Circuits Compared to Bare Circuits

Grouping	Reduction Compared to Bare			
	CFO	EFF	All Other	Total
Bare (0%)	0.0%	0.0%	0.0%	0.0%
Less than 25%	30.6%	38.3%	32.0%	34.1%
25% to less than 50%	45.3%	54.9%	50.7%	50.8%
50% to less than 75%	65.0%	54.0%	43.9%	53.8%
75% to less than 100%	81.0%	57.6%	70.8%	68.5%
100%	70.3%	80.3%	59.2%	70.5%

PG&E

As of the end of 2022, the number of ignitions observed on the CC lines does not provide statistically significant data for calculating effectiveness with respect to ignitions. As most distribution outages (momentary and sustained) typically involve a fault condition, PG&E assumes that all distribution outages can potentially result in an ignition, regardless of other prevailing conditions. Therefore, PG&E is measuring the recorded effectiveness of CC by comparing the outages on the circuit segments with CCs to outages on circuit segments with bare conductors.

PG&E's recorded effectiveness is calculated in three different snapshots. The first snapshot considers all CC installations by the end of 2019 and average yearly outages in 2020-2022. The 2nd snapshot considers the CC installations by the end of 2020 and average yearly outages in 2021-2022. Lastly, all CC installations by the end of 2021 and outages in 2022 are considered in the 3rd snapshot.

PG&E has not included CC installations that were completed in the middle of year 2022. PG&E is only including locations that were completed by end of year (EOY) 2021, so that there is a minimum of 1 year of outage performance data to be able to compare with outage performance in areas with bare conductor.

The comparison was conducted on an outages per year, per mile basis to normalize outage rates pre- and post- CC. Table F-4 below presents the results of this preliminary recorded effectiveness analysis.

Table F-4
PG&E Recorded Effectiveness Snapshots

Snapshot	Category of OH HFTD circuit segments (downstream of SSDs)	Total CC miles in this category	Total OH HFTD miles in this category	% CC'ed	Average yearly HFTD outages	Outage / Total OH HFTD miles / year	Improvement compared to Category 1
1: CC miles % of total OH miles by the end of 2019	**Outages considered: 2020-2022**						
	Category 1: not covered at all	0	24,849	0%	9339.7	0.38	-
	Category 2: 1-80% (partial)	27	242	11%	53.7	0.22	**41%**
	Category 3: 80%+ (mostly)	36	38	95%	4.3	0.11	**69%**
2: CC miles % of total OH miles by the end of 2020	**Outages considered: 2021-2022**						
	Category 1: not covered at all	0	24,950	0%	9544	0.38	-
	Category 2: 1-80% (partial)	122	640	19%	157.5	0.25	**36%**
	Category 3: 80%+ (mostly)	178	185	96%	19.5	0.11	**72%**
3: CC miles % of total OH miles by the end of 2021	**Outages considered: 2022**						
	Category 1: not covered at all	0	24,942	0%	5978	0.24	-
	Category 2: 1-80% (partial)	148	877	17%	151	0.17	**28%**
	Category 3: 80%+ (mostly)	238	248	96%	18	0.07	**70%**

The calculated outage reduction percentage (used as a measure for the recorded effectiveness) shows that CC sections experience approximately 28-70% fewer faults compared to bare conductor circuit segments.

PG&E's results are presented in Table F-4. These results are preliminary due to the following factors:

- Using an averaged per mile rate for the outages inherently omits the granular perspective related to each individual section of the circuits in PG&E's service area because it does not capture the impact of localized environmental/weather conditions. Hence, this analysis may over or under-represent effectiveness.
- It is assumed that all distribution outages could potentially result in an ignition. It does not factor in if one type of outage is more or less likely to result in an ignition. However, there are several failure modes such as tie-wire failure that have a much lower likelihood of ignition compared to an outage due to a broken conductor.
- The outages in partially covered and mostly covered categories (category 2 and 3) could have occurred on parts of the line that are not covered, which cannot be validated due to lack of exact geospatial information for the outages.

As part of PG&E's ignition investigation process, it is incorporating additional review of ignition identification that occurs on a CC line to ensure visibility of failures based on observed incidents. Below are some examples related to the effectiveness of CCs in the field that have been observed in PG&E's service area.

<u>Example 1:</u>
On 5/10/2021, a 125-foot ponderosa pine that was 55-feet away from a pole, failed approximately 40-feet above ground, severing the CC, causing a wire down, and a subsequent CPUC reportable ignition.

Figure F-2
PG&E Covered Conductor Effectiveness – Example 1

Affected Asset | Fallen Tree | Burn Scar | Severed Conductor

Example 2:
On 5/2/2022, a 120-foot ponderosa pine that was being abated for previously reported structural concerns, fell on a CC line, severing it, and starting a CPUC reportable ignition.

Figure F-3
PG&E Covered Conductor Effectiveness – Example 2

These two incidents highlight some limitations concerning CC. In both incidents, there were vegetation management inspections and CC deployed. But even with the combined mitigations, it still resulted in an ignition.

Example 3:
On 12/27/2021, two CCs were supporting an entire tree. There was no ignition; however, an electrical outage did occur on the line.

Figure F-4
PG&E Covered Conductor Effectiveness – Example 3

SDG&E

As CCs become a larger part of the system, the performance indicators that impact the efficacy of this mitigation will continue to be monitored and measured, including the measured effectiveness. As there are approximately 84 miles of CC installed with an average age of less than one year, SDG&E does not have sufficient data yet to draw any conclusions on the recorded effectiveness of CC.

Moving forward, SDG&E will continue to track the mileage, years of service, and faults on all CC circuit segments and will continue to collaborate with this working group to improve methods to measure the effectiveness of its system hardening initiatives. SDG&E's approach is to calculate the risk events per one hundred miles per year on segments that have been covered and compare the risk event rate before and after the installation of CC.

PacifiCorp

PacifiCorp continues to track risk events within each zone of protection (ZOP) with known conductor types and assumes homogenous performance across the ZOP. Current processes do not establish specific locations where fault events occur, but are reconciled to the device that protects the ZOP. To establish the recorded effectiveness, PacifiCorp queried pre- versus post-installation performance with risk event drivers for all ZOPs having CC (specifically spacer cable construction). It was important to recognize that legacy projects were focused on reliability and thus did not require reconductoring of the entire ZOP. As such, the recorded effectiveness calculations accounted for the percentage of the ZOP that wasn't reconductored. The smaller the percentage of the ZOP the less the confidence of the recorded effectiveness, while the higher the percentage of the ZOP the higher the confidence of the calculation.

PacifiCorp has also documented known contact-related events with CC. As shown in Figure F-5 below, these events did not result in faults, wires down, or ignitions because spacer cable was deployed and provide examples of effectiveness in the field.

Figure F-5
PacifiCorp Covered Conductor Effectiveness Examples

PacifiCorp will continue to monitor and track all faults on our CC circuits and track performance as compared to bare wire installs. PacifiCorp will also continue to collaborate in this working group to ensure we gather and share information from the other IOUs.

Bear Valley

BVES has approximately 211 circuit miles of overhead conductor between 34.5 kV and 4.16 kV in its system. BVES started a CC pilot program in Q2 2018 and completed it in Q3 2019 using two different type of cover conductor wires (394.5 AAAC Priority wire and 336.4 ACSR Southwire). Then, BVES started the cover conductor WMP in late 2019 with plans to cover 4.3 circuit miles on 34.5 kV over the next 4 years and 8.6 circuit miles on 4.16 kV over the next 10 years. As of end of Dec. 2022, BVES has covered approximately 34 miles between its 34 kV and 4 kV systems.

In Q3 2018, BVES started a new tree-trimming contract with a new tree service contractor. BVES has been very aggressive with its vegetation manage program having up to four tree crews or more at a time to complete its three-year cycle and remediating any issue trees which has helped reduce outages from vegetation contacts. As of end of 2021, BVES has completed its vegetation three-year cycle and in 2022 has started a new three-year cycle vegetation manage program.

As part of its wildfire mitigation efforts, in June 2019, BVES began replacing all explosion fuses in its service area with Trip Savers and Elf Fuses. BVES completed this project in May 2021, which eliminated the potential for ignitions from explosion fuses.

Though 2022, BVES has still not had any outages, wire down, tree limbs and/or ignitions on the lines that have been covered. BVES is still in the early stages of its CC program. As more areas are covered and as more time passes, BVES will compile more recorded data to inform on the effectiveness of CC. Table F-5 below provides a simple assessment of recorded outages since 2016 and through 2022.

Table F-5
BVES Recorded Outages (2016-2022)

Year	# of Outages
2016	75
2017	95
2018	34
2019	26
2020	57
2021	46
2022	52

Liberty

Liberty's CC program is relatively new, having begun in 2020. Because the program is new, data on the performance of CC effectiveness do not yet demonstrate meaningful recorded effectiveness results based on the limited sample period and the wide variations in weather conditions from year-to-year. In addition, the CC projects completed thus far represent a small percentage of each circuit's total line miles.

Based on a review of Liberty's Outage Management System (OMS) data, there have been zero reported outages or ignitions caused by an event on CC spans. The only known event that occurred on a CC span, in a spacer cable configuration, happened during a winter storm in early January 2023. The event did not create an outage or ignition and it was found as a result of a post-storm aerial patrol. In this incident, a tree fell across a spacer cable span that was installed in 2020. The tree pulled down the span and caused three poles to lean significantly; however, the messenger wire held up the tree and prevented a fault and a wire from falling to the ground. In Figure F-6 and Figure F-7 below represent this one incident.

Figure F-6
Liberty Spacer Cable System Preventing a Fault – Viewpoint 1

Figure F-7
Liberty Spacer Cable System Preventing a Fault – Viewpoint 2

Upon finding the damage, the poles were reset to vertical and the damaged support brackets were replaced. No damage was found related to the conductor.

Liberty intends to continue to monitor CC effectiveness and reinforce the need to collect and highlight any events that occur on CC. As more CC is installed and is in service for a longer period of time, the data collected will become more meaningful.

Next Steps:

In 2023, the utilities will continue meet on a regular basis, provide updates on risk event recorded data, discuss the methods used to measure the effectiveness of CC in the field, and continue to work towards developing consistent methods to measure the effectiveness of CC for better comparability. The utilities also plan to discuss outage data, causation identification and reporting. These efforts will require SME discussions and review of outage, wire-down and ignition data across the utilities. The utilities will also document any lessons learned.

Alternatives:

Overview:

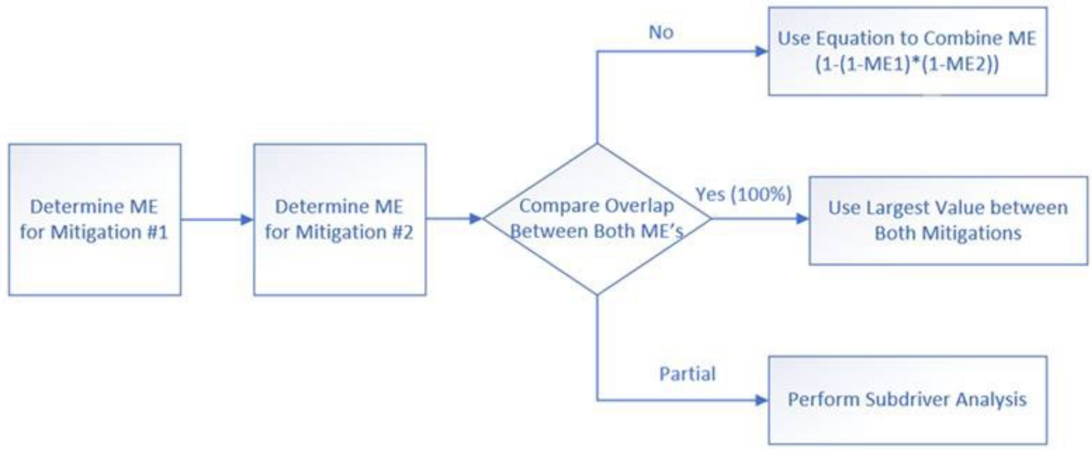
In the 2022 WMP Update filings, the utilities identified a list of viable alternatives to CC and conducted workshops with SMEs that assessed the effectiveness of those alternatives against the same risk drivers that CC is designed to mitigate. In 2022, the utilities focused on the combination of mitigations utilities deploy as it relates to CC and alternatives to CC and discussing a framework to calculate the effectiveness of the combination of mitigations deployed on the same circuit or circuit-segment. Below, we describe these efforts and plans for 2023 to further this workstream.

Combination of Mitigations:

The combination of mitigations refers to the suite of mitigations utilities deploy in relation to CC and alternatives to CC on circuits or circuit-segments to mitigate wildfire risk and/or reduce the impacts of PSPS. For example, all utilities deploy CC and where CC is installed all utilities conduct vegetation management mitigations and asset inspection mitigations. Additionally, circuits that have CC are still in scope for potential PSPS and most utilities also employ fast curve settings on these circuits during elevated fire-weather conditions. Likewise, several utilities deploy undergrounding to mitigate wildfire risk and PSPS impacts and where circuits are undergrounded, vegetation management mitigations are significantly lessened if not eliminated, the potential for PSPS is in most cases eliminated, and asset inspection mitigations can also be reduced. Notwithstanding system configuration, geography, terrain, permitting, costs, the time to deploy, operational/resource constraints, environmental constraints and other considerations, utilities can choose to install CC or other mitigations such as traditional hardening, new bare conductor, undergrounding, a remote grid, and/or new technologies to mitigate wildfire risk and/or reduce the impacts of PSPS. In choosing between CC and alternatives to CC, utilities will also deploy other mitigations. As such, the utilities understand the need to explore methods to assess the effectiveness of a combination of mitigations.

Historically, utilities have largely estimated the effectiveness of mitigations separately. The utilities have discussed methods to calculate the effectiveness of multiple mitigations deployed on the same circuit or circuit-segment. In 2022, the utilities discussed efforts to perform such a combination of mitigations calculation. While PG&E and SDG&E have not yet adopted a framework for this evaluation, SCE shared its preliminary framework (Figure **Error! No text of specified style in document.**-8) to calculate the effectiveness of a combination of mitigations.

Figure** Error! No text of specified style in document.**-8
SCE Preliminary Framework – Calculation of a Combination of Mitigations



SCE's preliminary framework includes three prongs given that mitigation measures can target the same or different risk drivers. For example, CC is highly effective at reducing most contact-from-object sub-drivers such as light vegetation contact, animal contact, and metallic balloons. However, CC is not highly effective at reducing faults/ignitions from large trees that can fall into lines. The framework thus distinguishes the overlap of multiple mitigations. In the first prong, if multiple mitigations have no overlap in the risk drivers they mitigate, a standard equation can be used to calculate the combined effectiveness, as seen in Figure **Error! No text of specified style in document.**-8. In the second prong, SCE considers where mitigations directly overlap with one another for a particular risk driver. In these instances, the mitigation with the highest effectiveness would be the combined effectiveness value. In the third prong, SCE considers where mitigations may target the same risk driver but they reduce the risk differently. In these situations, further analysis is needed to determine the incremental effectiveness prior to then combining the effectiveness values. Additionally, once the effectiveness of combined mitigations by driver are calculated, those values then need to be applied to the frequency of the driver risk events. Given that these estimated values are based on calculations and quantitative data can be limited and not always available, the utilities have also discussed discounting the individual estimated mitigation values.

To illustrate this framework, we use a subset of SCE's CC++ portfolio mitigation strategy. CC++ represents deploying CC, vegetation management, asset inspections, and other mitigations on the same circuit / circuit-segment that work collectively to better address the risk drivers than each by themselves. The tables and descriptions below are based on assessing the combination of CC, asset ground inspections, enhanced line clearing, pole brushing, and SCE's HTMP.

Table F-6 shows independent estimated mitigation effectiveness values for the selected mitigations across selected contact-from-object and equipment failure sub-drivers. For purposes of this illustration, no discounting of individual estimated mitigation values was included.

Table F-6
SCE Independent Mitigation Effectiveness Values

Risk Driver Description	WCCP	Distr Ground Asset Inspections	VM - Hazard Tree	VM - Expanded Pole Brushing	VM - Expanded Line Clearing
Animal contact- Distribution	65%	48%	0%	0%	0%
Balloon contact- Distribution	99%	0%	0%	0%	0%
Other contact from object - Distribution	77%	0%	0%	0%	0%
Unknown contact - Distribution	80%	0%	0%	0%	0%
Veg. contact- Distribution	71%	77%	64%	33%	36%
Vehicle contact- Distribution	82%	0%	0%	0%	0%
Capacitor bank damage or failure- Distribution	20%	87%	0%	20%	0%
Conductor damage or failure — Distribution	82%	80%	0%	7%	0%
Switch damage or failure- Distribution	2%	76%	0%	20%	0%
Transformer damage or failure - Distribution	20%	66%	0%	20%	0%

Using the risk driver vegetation contact, Table F-6, above, shows varying estimated effectiveness values for WCCP, asset inspection, HTMP, expanded pole brushing, and expanded line clearing. All these mitigations work together to reduce the risk of vegetation contact causing a fire. For example, though CC addresses vegetation making contact with wires, line clearance and HTMP activities are also necessary to reduce heavy branches or trees falling into lines that CC may not be able to withstand. Asset inspection work assures equipment is in good condition, covers are in place, and if abnormalities are found, these are scheduled for remediation. These inspections also identify where vegetation may be in contact with equipment and conductors. While CC has shown, in the field, that there are times where it can withstand a large limb / tree fall-in and not create an outage and/or ignition, CC is not designed to withstand tree fall-ins. As such, and for purposes of this illustration, it is assumed these two mitigations do not overlap. Using the formula, described above, these two mitigations have an estimated combined mitigation effectiveness of approximately 90% (1-(1-71%)*(1-64%)). Asset inspections, expanded pole bushing, and expanded line clearing all have overlaps with CC for mitigating vegetation contact and thus require separate analyses. For purposes of this illustration, we assume these mitigations provide an approximate 9% incremental effectiveness for reducing vegetation contact risk. Combining all these values provides an estimated approximately 99% effectiveness value for risk of vegetation contact when all five mitigations are deployed on the same circuit / circuit-segment.

Following the same process, Table F-7, below, shows the illustrative combined effectiveness values without considering quality control discounts. Additionally, applying the average annual frequency of historic faults and ignitions for these risk drivers, the table also shows the combined weighted average estimated effectiveness value for the selected mitigations.

Table F-7
SCE Combined Mitigation Effectiveness Values

Risk Driver Description	Combined Effectiveness	Annual Fault Frequency in HFRA (2015-2020 Avg)	Fault-Weighted Combined Effectiveness	Annual Ignition Frequency in HFRA (2015-2020 Avg)	Ignition-Weighted Combined Effectiveness
Animal contact- Distribution	71%	644	6%	4.8	12%
Balloon contact- Distribution	99%	866	11%	5.0	17%
Other contact from object - Distribution	77%	420	4%	1.7	4%
Unknown contact - Distribution	80%	0	0%	0.0	0%
Veg. contact - Distribution	99%	469	6%	4.7	16%
Vehicle contact - Distribution	82%	550	6%	3.7	10%
Capacitor bank damage or failure- Distribution	92%	382	4%	0.2	1%
Conductor damage or failure - Distribution	85%	2,280	24%	8.3	24%
Switch damage or failure - Distribution	82%	58	1%	0.0	0%
Transformer damage or failure - Distribution	78%	2,334	23%	1.3	4%
Total Estimated Combined Effectiveness			84%		86%

In this illustration, Table F-7 shows that when you combine WCCP with asset inspections, HTMP, expanded pole brushing, and expanded line clearing, the combined estimated effectiveness in mitigating faults and ignitions for the selected risk drivers and without discounting is approximately 84% and 86%, respectively.

Understanding the effectiveness of the combination of mitigations can be a helpful guide in utility decision-making. A common framework could also assist in greater comparability across the utilities. Challenges to developing such calculations include data availability, disaggregating effectiveness below the driver/sub-driver level to determine mitigation overlaps, and limitations in a purely formulaic method.

Next Steps:
In 2023, the utilities will meet regularly to discuss methods to determine effectiveness for the combination of mitigations. This will include building on the preliminary framework described above by detailing examples across the utilities. Because many mitigations overlap with one another and can reduce a driver of a risk event differently, the utilities will also discuss and share available data and analytical methods to determine these differences. Additionally, the utilities will explore the process to develop suites of mitigation measures that include new technologies in continuing to evaluate methods to calculate the effectiveness of a combination of mitigations.

New Technologies:
Introduction:
In the utilities' 2022 WMP Update Action Statements, Energy Safety identified an ACI for all utilities to collaborate to evaluate the effectiveness of new technologies supporting grid hardening and situational awareness such as REFCL and DFA/EFD, particularly in combination with other initiatives. The utilities were also ordered to share practices and evaluate implementation strategies and that this effort should

be a continuation of the CC study from the 2021 WMP Action Statements, including Energy Safety as a participant. Below, we outline the utilities' approach, information gathered to date, and 2023 milestones to assess the effectiveness of new technologies and share practices and implementation strategies.

Summary of Approach:
The utilities initiated this workstream in Q4 2022 and have since conducted bi-weekly meetings. The initial meetings focused on identifying utility SMEs, discussing types of alternative technologies employed by the utilities, the status of those technologies, effectiveness values, approaches to sharing practices and implementation strategies and how to meet the ACI requirements, timelines/milestones. Evaluating the effectiveness of the technologies in combination with other mitigations is addressed in the scope for the Alternatives workstream, as described in the section above. Based on these initial discussions, it was first decided to document the various alternative technologies the utilities are employing. As seen below, very few technologies are employed across all utilities. The utilities then generally discussed effectiveness values and whether the new technologies can help reduce the impact of PSPS. It was learned that the majority of new technologies are still undergoing investigation and have limited data regarding effectiveness values. The utilities also discussed practices of how the technologies are being employed and learned that where utilities all employ a technology such as disabling reclosing settings, the practices are not all consistent. These areas of focus are further described below along with 2023 plans to conduct regular meetings and workshops focused on specific technologies. Beyond assessing the new technologies, the utilities also plan to document questions for benchmarking with other utilities and discuss any new research and/or other new technologies that the utilities are made aware of.

<u>New Technologies</u>
The utilities have identified 15 new technologies that one or more utilities employ, are piloting, and/or investigating. These include, for example, disabling reclosing settings, fuse replacements, fast curve settings, RAR/RCS, DFA, EFD, REFCL, and OPD. Table F-8, below, identifies the new technologies or protection strategies being employed, piloted, and/or investigated to either mitigate wildfire risk and/or reduce the impacts of PSPS.

Table F-8
New Technologies By Utility

New Technology / Protection Strategy	SCE	SDG&E	PG&E	Liberty	BVES	PacifiCorp
Fuse replacement (current limiting fuses, expulsion fuses)	Yes	Yes	Yes	Yes	Yes	Yes
Reclosing Settings (Disabling)	Yes	Yes	Yes	Yes	Yes	Yes
Fast curve settings / EPSS / SRP	Yes	Yes	Yes	Yes	No	Yes
Remote Controlled Automatic Reclosers / Remote Controlled Switches (RAR/RCS)	Yes	Yes	Yes	Yes	Yes	Yes
Distribution Fault Anticipation (DFA)	Yes	Yes	Pilot - Moving to Deployment	Investigating	No	Pilot
Early Fault Detection (EFD)	Yes	Yes	Pilot	No	No	No
Rapid Earth Fault Current Limiter (REFCL)	Pilot - Moving to Deployment	No	Pilot	No	No	No
Open Phase Detection (OPD)	Yes	No	Yes	No	No	No
Falling Conductor Protection (FCP)	No	Yes	Pilot	No	No	No
Smart meter (MADEC)	Yes	Yes	Yes	No	No	No
Household Outlet	Pilot	No	Pilot	No	No	No
Sensitive ground fault detection (relays)	Pilot	Yes	Yes	No	No	No
Electrical Grid Monitoring (EGM)	No	No	No	No	Pilot	No
Thor Hammer	No	No	Pilot	No	No	No
Intumescaent wrap / Fire-wrap poles	Yes	No	Yes	No	Yes	Yes

As seen in Table F-8, there are only three types of new technology or protection strategies employed by all utilities. These include fuse replacements, disabling reclosing settings, and RAR/RCS. The other technologies are either being deployed, piloted, and/or investigated by a few utilities. Two technologies, DFA and REFCL, are moving from a pilot phase to deployment for PG&E and SCE, respectively. The utilities will further discuss the differences of these technologies to understand overlaps and similarities. For example, OPD and FCP have a similar purpose.

Practices and Implementation Strategies

The utilities have started to share practices for the new technologies. For example, while all utilities disable reclosing settings to mitigate wildfire risk, utility practices vary. For instance, SCE, PG&E and Liberty disable reclosing settings on circuits in HFRA during fire season, SDG&E disables settings, also on circuits in HFRA, but does it year-round, and BVES disables from April to October. The utilities believe that focused meetings and workshops on specific technologies are needed to share practices and implementation strategies. As such, the utilities will conduct focused workshops for specific technologies, as described below, to determine if best practices can be identified and will continue to share practices and implementation strategies in bi-weekly meetings.

Effectiveness Values

In many instances, the utilities are still investigating or have limited data as it relates to effectiveness values. The utilities have documented and shared effectiveness values for a few technologies but have not yet discussed these in detail. For example, effectiveness values for fast curve settings (when operating) range from approximately 49% to 100% effective at reducing ignitions (based on limited data that is not statistically significant). Given the large range, the utilities will conduct a workshop on the effectiveness of fast curve settings to share data and methods. Additionally, the utilities will discuss whether the technologies help reduce the impact of PSPS. As described in the next steps, the utilities have identified certain technologies for workshops and will continue to document estimated effectiveness values and the potential to reduce PSPS across all technologies.

Next Steps:
In 2023, the utilities will continue to document and assess the estimated effectiveness of new technologies where data is available, their ability to reduce PSPS impacts, and will continue to document and share practices and implementation strategies. These objectives will be accomplished through biweekly meetings and a series of workshops. Based on discussions to date, the utilities provide the following preliminary workshop schedule and themes.

- April 2023 – Disable Reclosing Settings – Discuss practices and effectiveness
- May 2023 – Fast Curve Settings – Discuss practices and effectiveness
- June 2023 – DFA – Discuss implementation strategies, practices and effectiveness
- July 2023 – EFD – Discuss implementation strategies, practices and effectiveness
- Aug 2023 – REFCL Discuss implementation strategies, practices and effectiveness

Once the utilities finalize the workshop schedule, Energy Safety will be invited. Additional workshops may also be scheduled in Q3/Q4 2023. Should the results of the workshops lead to best practices, the utilities will establish plans to implement the changes and document as part of lessons learned.

M&I Practices:
Introduction:
In the utilities' 2022 WMP Update Action Statements, Energy Safety identified an ACI for all utilities to share and determine best practices for inspecting and maintaining CC, including either augmenting existing practices or developing new programs, to include this effort as part of the Joint IOU Covered Conductor Working Group, and for the IOUs to continue to lead this study and to include Energy Safety as a participant. Below, we outline the utilities' approach, information gathered to date, and 2023 milestones to assess the utilities' CC M&I practices, determine if best practices can be identified, and if best practices can be identified, put in place plans to implement those best practices.

Summary of Approach:
The utilities initiated this workstream in Q4 2022 and have since conducted weekly meetings. The initial meetings focused on identifying utility SMEs, discussing approaches to determine best practices and how to meet the ACI requirements, and timelines and milestones. Based on these initial discussions, the utilities agreed to a common approach that is both broad and focused. The approach includes first capturing information such as each key utility facts (e.g., service area size in HFRA), types of inspections utilities perform on distribution overhead conductor, general M&I practices for distribution overhead conductor, specific practices for CC, general and specific training the utilities conduct, and QA/QC information. Capturing broad information such as the types of inspections utilities perform provides a high-level understanding of how each utility performs inspections, the frequency it performs them at, and other related information. In assessing these sets of information, the utilities believe the determination of best practices will require a series of focused workshops and follow up meetings with

SMEs, engineers, inspectors, QA/QC personnel and other resources as needed. Focused workshops are needed to facilitate determining if best practices can be identified. For example, all utilities perform ground and aerial inspections which are generally conducted similarly; however, they are not all performed the same way. Determining a best practice relating to performing a ground and/or aerial inspection for CC will require detailed discussions focusing on very specific aspects of the resources that do the work, tools and equipment used, the methods used, and other factors, some of which may only be obtained by conducting field observations across the utilities. It is also important to note that while there are differences in practices, determining best practices can take months, if not years, and that a best practice for one utility may not be a best practice for another utility for reasons such as costs, geographic size of the utility, and resource limitations. Given these facts, the utilities will also document any lessons learned that may be helpful for one or more utilities and can be added to existing M&I practices. Beyond assessing existing practices, the utilities also plan to document M&I-related questions for benchmarking with other utilities, learn from the testing workstream (should any CC inspection and/or maintenance practice be recommended from that workstream), and discuss any new research and/or new technologies that the utilities are made aware of as it relates to CC M&I practices.

Key Distribution Data

The joint utilities vary in size and it is important to consider this information when assessing best practices. Table F-9, below, provides a few data points in HFRA, unless as otherwise noted, regarding the utilities' service area size, the facilities they maintain, and the average number of distribution inspectors. The figures in the table are approximate values.

Table F-9
Key Distribution Data by Utility

Key Data in HFRA	**PG&E**	**SCE**	**SDG&E**	**PacifiCorp**	**Liberty**	**BVES**
Distribution Overhead Circuit Miles	25,200	9,600	3,400	813	676	211
Distribution Poles	630,000	290,000	81,000	20,378	23,058	8,860
Square Miles	41,000	14,000	2,600	7,155	938	32
Average Number of Ground Inspectors (Systemwide)	203	153	50	5	4	2

As illustrated in Table F-9 above, PG&E has significantly more square miles, distribution overhead circuit miles, and distribution poles in its HFRA to inspect and maintain. Conversely, BVES has the smallest HFRA square miles and least amount of distribution overhead circuit miles and distribution poles to maintain and inspect. As described more below, due to HFRA size alone, a best practice at PG&E may not be an ideal practice for BVES and vice versa.

Types of Distribution Inspections

The utilities perform several types of inspections on distribution facilities. These include detailed ground inspections, aerial inspections, infrared, patrols, Areas of Concern (AOCs) and LiDAR. These distribution inspection types are designed to meet or exceed GO 95 and GO 165, and also to mitigate wildfire risk. Table F-10 and Table F-11 below highlight the types of distribution inspections the utilities perform.

Table F-10
Types of Distribution Inspections performed by SCE, PG&E and SDG&E

Types of Distribution Inspections	SCE	PG&E	SDG&E
Detailed - Ground	Every distribution structure inspected between twice a year and up to once every 3 years, and high-risk structures inspected at least every year; Inspectors on the ground can use binoculars and/or cameras when needed	HFTD: Structures inspected every 1-3 years based on wildfire consequence; Top 10% risk structures inspected every year; Non-HFTD: every 5 years Inspectors use binoculars when needed	Every distribution structure inspected every 5 years
Detailed - Aerial	Every distribution structure inspected between twice a year and up to once every 3 years, and high risk structures inspected at least every year; SCE does 360 degree inspection from ground and the air with the same resources (drone) in the same time period	Will cover ~48K distribution structures in 2023 in the highest wildfire consequence areas; Longer-term plan will be developed based on the learnings from 2023 drone program	Drone inspections are performed on high-risk assets each year; Risk assessment performed annually to determine scope of assets to be inspected that year; Approximately 15,000 structures inspected per year.
Infrared	5,100 distribution overhead circuit miles targeted for inspection in 2023; performed on the ground	Conducted at high risk locations on an ad hoc basis	18,000 structures per year; plus ad hoc based on cause-unknown outages; Combination of aerial and ground
Patrol	100% of above ground and subsurface assets inspected annually; Conducted by ground mostly and helicopter/drone if needed (e.g., access issues)	HFTD: 100% of assets that are not inspected each year Non-HFTD: Based on urban/rural designations	100% of assets inspected annually
Areas of Concern (AOCs)	Additional inspections based on area of concern analysis conducted in late spring / early summer	Additional inspections are performed in areas of concern when needed.	See drone inspections - areas of concern determined by risk assessment and these are performed via drone
LiDAR	In 2023, will evaluate the use of this technology for asset-condition assessments; Historically, used for construction, planning, crew access, vegetation, etc.	Utilized to update pole orientation and associated attributes such as communication line, guy, anchor Database is then leveraged to conduct pole loading assessment to identify overloaded poles for replacement	Only utilized for construction planning purposes

Table F-11
Types of Distribution Inspections performed by PacifiCorp, BVES, and Liberty

Types of Distribution Inspections	PacifiCorp	BVES	Liberty
Detailed - Ground	Every distribution structure inspected every 5 years; Inspections on ground use cameras and binoculars	Every distribution structure inspected every 5 years	Every distribution structure inspected every 5 years
Detailed - Aerial	Every distribution structure is inspected every year in Tier 2/3 areas and every 2 years in non-Tier areas; Inspection is performed from the ground with same resources in the same time period	Contractor performs drone inspections yearly with infrared on 100% of 34 kV and 4 kV distribution circuits	No aerial inspections on distribution at this time.
Infrared	Only when requested	100% of 34 kV and 4 kV distribution circuits per year	No infrared at this time
Patrol	100% of assets inspected annually	100% of assets inspected annually	100% of assets inspected annually
Areas of Concern (AOC)	Additional inspections performed when requested	May complete addition patrol inspection during extreme dry day with possible high fire risk	Additional inspections are performed in areas of concern when needed
LiDAR	Not performed on distribution circuits, but has been used in the past for vegetation	Use yearly for vegetation management (Check to see if vegetation is near lines)	Use for vegetation management

As shown in the tables above, the utilities perform similar types of inspections. Given the requirements of GO 95 and GO 165, this was to be expected. There are differences, however, in some inspection types as well as in some practices. For example, not all utilities conduct detailed ground inspections on high-risk / high consequence structures (and conductor) every year. Being that the focus of this effort is on CC M&I practices, obtaining findings for CC during these inspections and discussing amongst the utilities will help inform if a best practice can be identified and whether that best practice should and can be applied to all utilities. Similarly, some utilities conduct Areas of Concern (AOCs) inspections and SCE is evaluating LiDAR for asset condition assessments, which has historically been used for vegetation clearances and construction-related purposes. The utilities will discuss these types of inspections, focused on CC, and assess how useful they are in maintaining CC to determine if they should and can be utilized across all utilities.

<u>General M&I Practices</u>

Because utilities have performed inspections and remediation on overhead facilities for decades, the utilities have shared and discussed various aspects of what inspectors look for when assessing the condition of overhead conductor, regardless if covered or bare (as most assessments for bare will also apply to covered). For example, during detailed ground inspections, inspectors will assess (naked eye and/or binoculars) all components and equipment attached to a pole and any materials connected to conductors. These inspections look for deterioration/corrosion, pitting, damage, clearance issues, sagging, loading, alignment issues (e.g., dead-end covers), misconfigurations, conformance with construction standards (e.g., missing covers/guards), exposed sections for splices, connectors, vegetation in immediate need for remediation, and other abnormal conditions. All of these potential issues apply to bare and CC. In large part, many of the methods and potential issues inspectors look for with bare conductor equally apply to CC. Given this fact, it is important to understand the general M&I practices for overhead conductor that utilities use. The utilities will also explore determining abnormal conditions that could cause a safety or fire ignition risk resulting in remediation and how these are prioritized. Additionally, inspectors that perform this work have understanding and knowledge that can inform the assessment of potential best practices and the utilities intend to include these resources in the workshops. The utilities will continue to discuss and document these practices and prepare for workshops to determine if best practices for CC can be determined.

Specific M&I Practices

This category refers to specific M&I practices for CC. SCE has shared its specific M&I practices which include prompts for data accuracy including types of CC and directions CC is installed, construction standard checks including any missing items such as dead-end covers, connector covers, fuse covers, lightning arrestors and covers, and pothead covers, and identifying abnormal conditions such as visible signs of tracking or damage on the outer jacket. Additionally, in 2023, PG&E updated their Detailed Ground Inspection checklist to include prompts for identifying failure modes that are unique to CC such as CC wire jacket cut into and bare conductor exposed, CC exposed and burnt, and dead-end cover mis-aligned on CC construction. While other utilities may not have tools that have these specific prompts, as part of their training, they look for visible signs of tracking and/or damage on the covering as well as discoloration. As noted above, the majority of M&I practices for bare conductor apply to CC. Because damage to the outer layer of CC may lead to faults/failures, this is an important inspection assessment all utility inspectors perform. Likewise, all utility inspectors are trained on their CC construction standards and thus assess conformance to the construction standard in the field. Most utilities do not collect asset information for data quality checks as some SCE prompts provide for; however, if deficiencies are noted during other utilities' inspections, they can be submitted through their processes. The utilities will assess these details in workshop settings to determine if best practices can be identified. Field observations may also be conducted to capture additional information.

Training

All utility inspectors are trained to understand CC construction standards and maintenance of CC through new inspector training, refresher training, ad hoc training and/or training conducted by the conductor manufacturer or through industry partners. The large utilities have similar types of training including new inspector training, refresher training, and ad hoc training for changes to standards, materials, etc. that may occur. The small utilities have few inspectors and typically are trained linemen with 20+ years' experience. These inspectors are trained on CC through industry organizations and/or the manufacturer as opposed to through a utility-developed training curriculum. For example, BVES has two inspectors that are trained lineman with over 20 years' experience. As such, developing a training curriculum for two inspectors may not be cost-effective when alternative training through the manufacturer or industry partner is available. The utilities will continue to collect training information and conduct a workshop to determine any best practices.

<u>QA/QC</u>

All utilities employ a quality assurance / quality check (QA/QC) process for asset inspections as well as construction of CC lines. For example, the large utilities will QA/QC CC as part of their QA/QC program, which are based on sampling methods. BVES and Liberty QA/QC all CC installations. Given the difference in size of utilities, it makes sense that the large utilities use QA/QC sampling methods whereas the small utilities QA/QC all new CC work. The utilities will further discuss and assess each utilities QA/QC practices related to CC in a workshop setting to determine if best practices can be identified.

Next Steps:

In 2023, the utilities will continue to capture general and specific CC M&I practices across the utilities and will conduct workshops to determine if best practices can be identified. Meetings will also be held to follow up on the workshops and set plans to implement any best practices that are identified. Below, the utilities provide a preliminary workshop schedule and themes.

- April 2023 – General conductor and specific CC M&I practices
- May 2023 – General conductor and specific CC Training
- June 2023 – QA/QC of CC
- July 2023 – Recommendations from Testing Results
- Aug 2023 – Inspection Types and Tools Used

Once the utilities finalize the workshop schedule, Energy Safety will be invited. Additional workshops may also be scheduled if needed. Should the workshops lead to best practices, the utilities will establish plans to implement the changes and document as part of lessons learned.

Estimated Effectiveness:

Overview:

As explained in the 2022 WMP Update report, each utility's CC programs are different due to factors such as location, terrain, and existing overhead facilities. The utilities also have different frequencies of risk drivers. Additionally, the utilities are still at different phases of installing CC as some have limited miles deployed while others have deployed thousands of miles of CC. These features, amongst others, result in data, calculations, and methods of estimating effectiveness that are different. As such, the utilities have been working on understanding differences and discussing methods for better consistency. In 2022, the utilities focused on testing, recorded effectiveness, and the new requirements. The utilities' continue to estimate CC effectiveness from approximately 60 to 90 percent at reducing outages/ignitions and/or the drivers of wildfire risk.

Below, the utilities describe any updates to their data, analyses, and methods used to estimate the effectiveness of CC to mitigate outages/ignitions and/or the drivers of wildfire risk and present their estimated effectiveness values, and describe next steps to improve consistency of data, calculations and methods.

Covered Conductor Estimated Effectiveness:

SCE:

SCE's Wildfire Covered Conductor Program (WCCP) consists of replacing bare conductor with CC, the installation fire-resistant poles (FRPs) where applicable, wildlife covers (animal safe construction), lighting arresters, and vibration dampers below 3,000 feet. Additionally, in 2022, SCE modified its CC construction standard to include the replacement of open wire secondary or weather-resistant aluminum (OWS or WAL) with multiplex secondary conductors. Weather resistant aluminum wire on the secondary system are outdated technology and will be updated to the new standard when WCCP is installed. Because this standard update will only affect WCCP installations starting in 2024, and not WCCP completed in 2022 or planned for 2023, This activity is not yet accounted for in determining the overall mitigation effectiveness of SCE's WCCP.

In 2022, SCE assessed the Joint IOU testing results and mapped the test results to risk drivers and sub-drivers to determine if any changes were warranted. Results from the Wire Down Event Scenarios demonstrate that the bare portion of the conductor must be exposed to lead to an ignition. The System Strength Tests demonstrates that tangent structures will not significantly damage the conductor enough to expose the bare conductor. Tangent structures without equipment do not have any exposed bare conductor or taps (~50% of all structures are tangent). As a result, the current mitigation effectiveness of Vehicle Contacts did not account for the performance of CC on tangent structures, therefore SCE increased the mitigation effectiveness from 50% to 82%. SCE also evaluated phase-to-phase contact and simulated wire-down testing. CCs were 100% effective at preventing arcing and ignition in tested scenarios at rated voltage, consistent Exponent's Phase I field reporting. Per the testing results, adjustments were also made for vegetation contact and unknown contacts. Below, SCE provides the updated estimated mitigation effectiveness for WCCP. Overall, the estimated mitigation effectiveness for WCCP increased from approximately 67% to 72%.

Table F-12
SCE Covered Conductor Mitigation Effectiveness Estimate

Driver Type	Sub-Driver/ Consequence Type	% Drivers	Current Driver ME	New Drive ME	Directional Change	Indicative Test Result
D-CFO	Vegetation contact	12%	60%	71%	Increased	Wire Down Events + System Strength
D-CFO	Animal contact	13%	65%	65%	No Change	Wildlife cover test
D-CFO	Balloon contact	13%	99%	99%	No Change	
D-CFO	Vehicle contact	10%	50%	82%	Increased	Wire Down Events + System Strength
D-CFO	Unknown contact	8%	77%	80%	Increased	Aggregate of CFO Result
D-CFO	Other contact from object	3%	77%	77%	No Change	
D-WTW	Wire-to-wire contact / contamination	3%	99%	99%	No Change	
D-EFF	Conductor damage or failure	13%	90%	90%	No Change	Degraded covering
D-EFF	Connection device damage or failure	5%	90%	90%	No Change	
D-EFF	Connector damage or failure	5%	90%	90%	No Change	
D-EFF	Crossarm damage or failure	~0%	50%	50%	No Change	System Strength
D-EFF	Insulator and brushing damage or failure	4%	90%	90%	No Change	
D-EFF	Splice damage or failure	5%	90%	90%	No Change	

PG&E:

PG&E's overhead hardening program consists of primary and secondary CC replacement along with pole replacements, replacement of non-exempt equipment, replacement of overhead distribution line transformers, framing and animal protection upgrades, and vegetation clearing. PG&E understands the focus of this request to be centered on CC, however our efforts to estimate effectiveness include all elements of our Overhead Hardening program, which PG&E believes is more complete.
Determining whether a specific event could result in an ignition depends upon a wide variety of factors,

including the nature of the event itself and prevailing environmental conditions (e.g., weather, ground moisture level, time of year). As PG&E does not have complete information to make this determination for each event, estimating overhead hardening effectiveness relies upon the following proxy to derive its estimates. Most distribution outages (momentary and sustained) typically involve a fault condition. Thus, for purposes of estimating overhead hardening effectiveness, it is assumed that all distribution outages could potentially result in an ignition, regardless of other prevailing conditions. This approach aligns with what has been previously stated in PG&E's 2020 WMP as well as its 2020 RAMP filing.

In early 2023, PG&E assessed the Joint IOU testing results to re-evaluate the SME effectiveness designations and adjusted the effectiveness in a few key areas. While this is expected to be an ongoing process, we have refreshed our effectiveness values based on updated designations and the data as follows:

- Tree fall-in associated with wire on object, and wire on ground, changed from "none" (not effective) to "medium" (some effectiveness). While other IOUs considered a higher effectiveness than PG&E, there are large enough trees in our service area that can damage CC and as such, CC does not have as substantial an increase in effectiveness.

- Contact from Object Vehicle changed from "none" (not effective) to "medium" (some effectiveness). We agree with other IOUs that this has some limited benefit. Given that we are installing larger poles to support CCs, the larger poles have the potential to sustain more impact from vehicle than existing infrastructure.

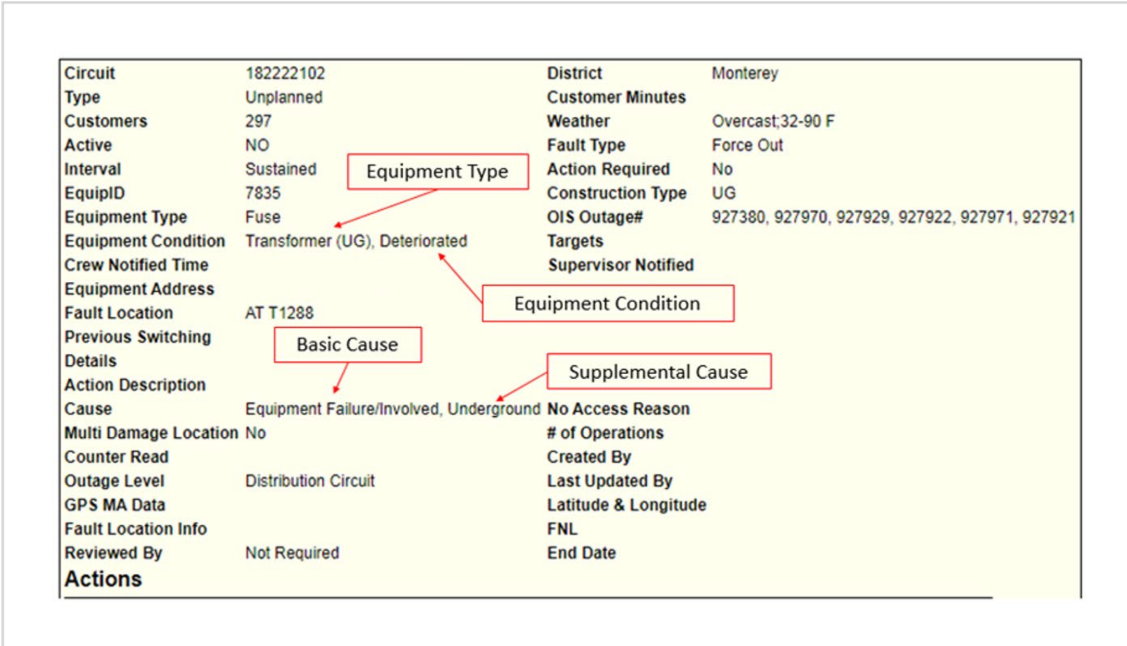
- Animal caused outages associated with conductor contact changed from "none' (not effective) to "All" (very high effectiveness). Testing on the covering material of the CCs showed a high resiliency to damage. Also, PG&E found that the insulating properties of the covering did not diminish significantly when damaged. Therefore, we have increased CC effectiveness for mitigating damage caused by animals like squirrels and birds.

Additionally, PG&E has refreshed our data for estimated effectiveness to include outage data through 2022. Previously, the last PG&E update including outage data was from PG&E's 2023 GRC filing, which had data through 2020.

With the above assumptions from the PG&E's 2020 WMP as well as our 2020 RAMP filing, PG&E updated the estimated effectiveness factor for overhead hardening in 2023, incorporating the 2023 re-evaluated SME effectiveness designations:

1. SMEs identified ~80k distinct outages between 2016-2022 by using all known combinations of basic cause, supplemental cause, equipment type and equipment condition from the distribution outage database as show in Figure F-9 below. Whenever an outage is reported, an operator fills in different fields that provide information about the outage. Through SME evaluation, it was decided that a combination of the four aforementioned fields provide an appropriate distinction of different outage types.

Figure F-9
PG&E Distribution Outage Database Record



Circuit	182222102	District	Monterey
Type	Unplanned	Customer Minutes	
Customers	297	Weather	Overcast;32-90 F
Active	NO	Fault Type	Force Out
Interval	Sustained	Action Required	No
EquipID	7835	Construction Type	UG
Equipment Type	Fuse	OIS Outage#	927380, 927970, 927929, 927922, 927971, 927921
Equipment Condition	Transformer (UG), Deteriorated	Targets	
Crew Notified Time		Supervisor Notified	
Equipment Address			
Fault Location	AT T1288		
Previous Switching			
Details			
Action Description			
Cause	Equipment Failure/Involved, Underground	No Access Reason	
Multi Damage Location	No	# of Operations	
Counter Read		Created By	
Outage Level	Distribution Circuit	Last Updated By	
GPS MA Data		Latitude & Longitude	
Fault Location Info		FNL	
Reviewed By	Not Required	End Date	

Actions

2. Subject matter experts identified whether overhead hardening would eliminate, reduce significantly, reduce moderately, reduce minimally, or not affect the likelihood of a certain type of outage occurring leading to an ignition when an asset has been hardened. From this classification the following qualitative categorization was performed:

    - **All** = Eliminates likelihood of a certain type of outage occurring resulting in an ignition
    - **High** = Reduces likelihood significantly of a certain type of outage occurring resulting in an ignition
    - **Medium** = Reduces likelihood moderately of a certain type of outage occurring resulting in an ignition
    - **Low** = Reduces likelihood minimally of a certain type of outage occurring resulting in an ignition
    - **None** = Will not affect the likelihood of a certain type of outage occurring resulting in an ignition

3. Each qualitative category was assigned a quantitative value, which measured the likelihood of outage reduction:
    - **All =** 90%
    - **High =** 70%
    - **Medium =** 40%
    - **Low =** 20%
    - **None =** 0%

4. The above criteria were applied to historical outages, and this resulted in the likelihood of outage reduction for each outage.

5. Outages were classified by drivers. The outage drivers identified were: Animal, D-Line Equipment Failure, Environmental/External, Third Party, Vegetation. The Wildfire Mitigation driver was excluded as it captures all PSPS triggered outages.

6. A Pivot table was then created to aggregate Outages in HFTD. The aggregation was done at the outage driver level and the result are shown below in Table F-13.

Table F-13
PG&E Covered Conductor Mitigation Effectiveness Estimate

Driver	**Average Yearly Count of Incident ID**	**Average of SH_Effect_Pct**
Animal	429	75%
D-Line Equipment Failure	2233	69%
Environmental/External	255	42%
Third Party	397	57%
Vegetation	2735	62%
Grand Total	**6049**	**64%**

Based on the latest update using outage data through 2022 and repeating the process from PG&E's 2020 WMP filing, the updated estimated effectiveness is 64% where Overhead Hardening has been completed. Therefore, a section of a line that has been hardened is approximately 64% less likely to have an outage of any type. Similarly, a section of a line that has been hardened is approximately 64% less likely to have an outage of each of the drivers. This result is consistent with the previous results that were completed using data for the 2020 WMP.

SDG&E:

SDG&E initially began to examine CC from a personnel safety and reliability standpoint. The three-layered construction showed prospective reduction of injuries to people in the event of an energized wire-down in which the wire contacted a person and/or also might reduce the step potential to people in the vicinity. Outages that result from light momentary contacts (i.e. mylar balloons, birds, palm fronds) also have shown the potential to be reduced. In late 2018, focus was shifted towards using CC as an alternative to SDG&E's traditional overhead hardening program with the primary focus of reducing utility-caused ignitions.

SME's conducted research on the history and use of CC in the industry. Additionally, the SMEs reached out to utilities on the East Coast and internationally to receive their feedback of the effectiveness and work methods for installation purposes.

In addition to other studies/tests that have been and will be performed by SCE and PG&E, as described in the Testing section, SDG&E will have a third-party evaluate the likelihood and effect specific to conductors clashing at various wind speeds. Accelerated aging studies will also be performed to mimic a

40-year service life; after which, the samples will be subjected to tests designed to understand the potential for both mechanical degradation, as well as reduction in dielectric strength. These tests will be performed in accordance with ASTM or other industry recognized standards. Final reports for this testing are expected to be completed in April 2023.

In order to quantify the risk reduction of wildfires that would be achieved by CC, SDG&E evaluated 80 events that resulted in ignitions. SME's weighed in on the likelihood that CC installation would prevent an ignition for the particular type of outage depending on the severity of the incident. As seen in Table F-14 below, the result is a reduction in ignitions from 60 to 20.6, and a resulting effectiveness estimate of 65.7%.

In 2022, SDG&E has been participating in collaborating with other utilities as part of the Joint IOU working groups in the evaluation of the testing that has been and is currently still being performed. Once all testing has been completed in 2023, SDG&E will perform an analysis based on risk drivers to re-evaluate the estimated efficacy of CC.

Table F-14
SDG&E Covered Conductor Mitigation Effectiveness Estimate

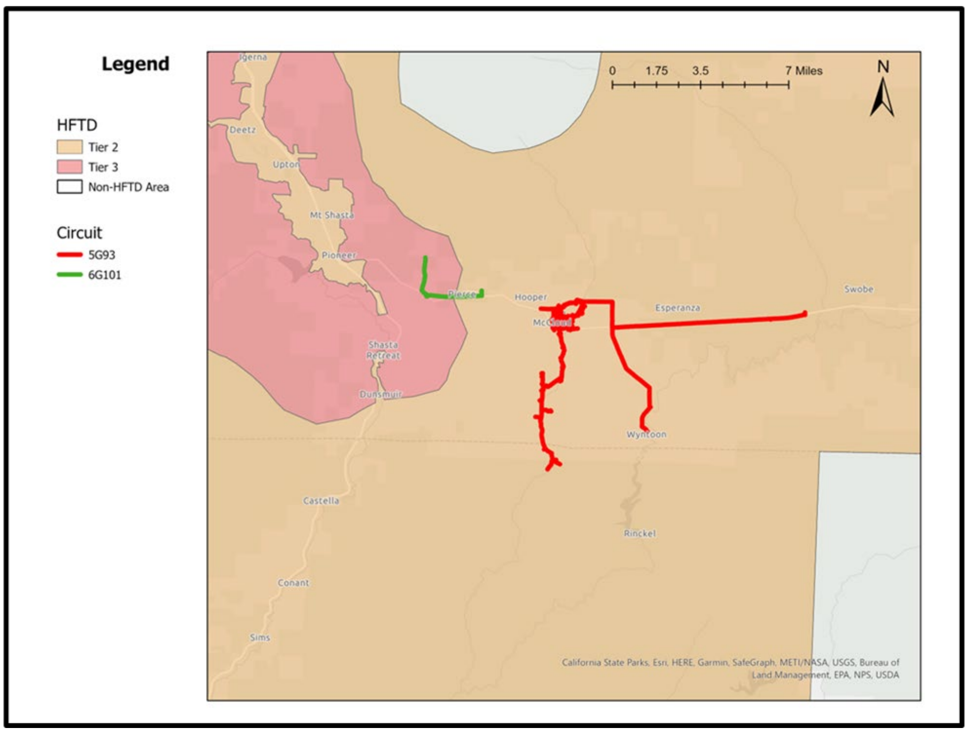
Fault/Ignition Cause	***Number of Ignitions***	***SME Effectiveness***	***Post-Mitigation Ignitions***
Animal contact	7	90%	0.7
Balloon contact	9	90%	0.9
Vegetation contact	2	90%	0.2
Vehicle contact	8	20%	6.4
Other contact	3	10%	2.7
Other	4	10%	3.6
Equipment - All	26	80%	5.2
Unknown	1	10%	0.9
Total	60	65.7%	20.6

The table above was updated with the number of ignitions occurring between 2017-2021 compared to last year's report that was based on 2016-2020 data. Updates to SDG&E's overall effectiveness methodology are anticipated to be completed by December 2023.

PacifiCorp:
Prior to development of the WMP, PacifiCorp historically pursued CC designs and systems due to historical experience with elevated outage count from trees, limbs, and incidental contact (resulting in grow in) throughout its service area. Additionally, access conditions on some of its circuits are extremely difficult in certain times of the year, and those circuits also tend to have elevated outage rates. For the above-mentioned reasons, when siting its historic CC pilot projects, PacifiCorp tended to focus its deployment on circuit-segments that had above average vegetation and/or animal outage rates in conjunction with difficult access. Now, as part of the company's line rebuild program to install CC and mitigate wildfire risk, PacifiCorp is actively pursuing both CC and spacer cable systems. Most projects completed so far as part this program have leveraged a spacer cable system, which primarily includes CC, a structural member (messenger), and specialized attachment brackets. Therefore, the effectiveness examples and estimations were determined for spacer cable.

As an example of how to assess the effectiveness of newly installed spacer cable, PacifiCorp compared two circuits, one with bare wire and one with spacer cable installed. Both circuits are in the same general geographic area and shown in Figure F-10 below. Additionally, the circuits are in a HFTD, with the spacer cable partially located in a tier 3 area near Mt. Shasta and the bare conductor located completely within a tier 2 area, though it is still located within a few miles of the tier 3 boundary.

Figure F-10
PacifiCorp Map Showing the Two Circuits Plotted with the HFTD Overlay



To begin characterizing outage frequency variation prior to and after the installation of spacer cable, 18 years of outage data (2005-present) for both circuits was reviewed and is summarized in Table F-15, below.

Table F-15
PacifiCorp Outage Frequency for Bare Wire and Spacer Cable Circuits
(2005 – present; Asterisk (*) indicates the year spacer cable was installed)

Year:	Outages - Bare Wire Circuit:	Outages - Spacer Cable Circuit (Q4 2021):
2005	8	0
2006	6	2
2007	2	2
2008	10	10
2009	0	0
2010	6	12
2011	42	18
2012	6	4
2013	10	2
2014	2	0
2015	2	2
2016	2	2
2017	2	4
2018	0	0
2019	4	2
2020	4	0
2021	2	4 *
2022	8	**0**
2023	4	**0**

Generally, the data demonstrates that outage frequency can significantly vary year over year. Additionally, in this example, the bare wire circuit has historically experienced either an equivalent or higher frequency of outages than the circuit the spacer cable was installed, except in 2010. While many factors can impact outages and reliability, this general trend is expected given the significant differences in circuit length. This same data was then normalized based on circuit mile and summarized in Table F-16 below.

In both tables, the data generally shows that for the spacer cable installation (completed in Q4 2021), there was a reduction in outages in all years following the rebuild project (0 for 2022 and 2023 so far). Additionally, the nearby bare wire circuit experienced a total of 12 outage events in 2022 and 2023 (as of January 2023). While certainly not conclusive or representative of a clear trend, the data does support that potential impact spacer cable can have on outage frequency.

A further analysis into outage causes for each circuit at the time of spacer cable installation was performed and included in Table F-16 below. The table shows the spacer cable experienced 0 outages in 2022 and 2023 (as of January 2023) for all risk drivers. However, for the bare wire circuit, there was a total of 12 outages across all risk drivers, with trees being the main driver in 2022.

Table F-16
PacifiCorp Outage Frequency for Bare Wire and Spacer Cable Circuits
(2005 – present; Asterisk (*) indicates the year spacer cable was installed)

Year:	Outages - Bare Wire Circuit:	Outages - Spacer Cable Circuit (Q4 2021):
2005	8	0
2006	6	2
2007	2	2
2008	10	10
2009	0	0
2010	6	12
2011	42	18
2012	6	4
2013	10	2
2014	2	0
2015	2	2
2016	2	2
2017	2	4
2018	0	0
2019	4	2
2020	4	0
2021	2	4 *
2022	8	**0**
2023	4	**0**

Table F-17
PacifiCorp Risk Drivers for Bare Wire and Spacer Cable Circuits
(2021 – present; Asterisk (*) indicates the year spacer cable was installed)

Year:	Risk Drivers:	Bare Wire Circuit:	Spacer Cable Circuit (Q4 2021):
2021	TREES	2	0 *
2021	LOSS OF SUPPLY	0	4 *
2022	TREES	4	**0**
2022	INTERFERENCE	2	**0**
2022	PLANNED	2	**0**
2023	TREES	2	**0**
2023	WEATHER	2	**0**

While promising, this analysis is neither conclusive nor representative of a clear trend. Additionally, this individual analysis may not be representative of macro trends. The circuit that has the spacer cable is installed on only 6.1 miles which serves only 12 customers and has been in place since Q4 2021. Furthermore, PacifiCorp believes that determining the long-term effectiveness of CC, both in its ability to reduce wildfire risk and PSPS impacts, requires additional data and time. At a minimum, a longer history of outage data would be necessary to fully understand the impacts of the spacer cable.

BVES

BVES has approximately 211 circuit miles of overhead conductor between 34.5 kV and 4.16 kV in its system. BVES started a CC pilot program in Q2 2018 and completed it in Q3 2019 using two different types of cover conductor wires (394.5 AAAC Priority wire and 336.4 ACSR Southwire). Then BVES started the cover conductor WMP in late 2019 with a plan to cover 4.3 circuit miles on 34.5kV over the next 5 years and 8.6 circuit miles on 4.16 kV over the next 10 years. As of the end of Dec. 2021, BVES has covered approximately 21.1 miles between its 34 kV and 4 kV systems. BVES' average span length is approximately 150 feet and installing CC on cross arms. As part of its CC program when there are spliced locations, BVES installs premade cold shrink kits (3M) and installs avian protection (raptor protection/wildlife guard).

Based on benchmarking with other utilities' estimated effectiveness against ignition risks, discussions with its CC supplier, and the short amount of time that it has installed CC, BVES continues to believe that the estimate of effectiveness on ignition risk drivers in its service area is approximately 90%. As BVES installs more CC and gathers more historical data, it will continue to assess the estimate of effectiveness. BVES presents its estimated effectiveness in Table F-18 below.

Table F-18
BVES Covered Conductor Mitigation Effectiveness Estimate

Ignition Risk Driver	Percent Reduction	Discussion (Contacts on Cover Conductor cable)
Vegetation Contact	90% +	Vegetation contact on 1, 2, 3 phase and/or neutral wire.
Animal Contact	90% +	Animal contact on 1, 2, 3 phase and/or neutral wire.
Balloon Contact	90% +	Balloon contact on 1, 2, 3 phase and/or neutral wire.
Wire down contact	90% +	Due to the following: tree/tree limb fallen on line, car hit pole, wind gust, etc.
Vehicle Contact	90% +	Vehicle Contact due to wire down on vehicle.
Wire to Wire Contact	90% +	Due to the wind gust forces causing tree/tree limb fall on line or just wire to wire contact.
Splice location contact	90% +	BVES installs Avian protection/raptor protection/wildlife guards and uses premade cold shrink kits (3M) on splice locations.
Vandalism/Theft	90% +	In BVES' service area there is a low risk of conductor theft as well as vandalism. If vandalism occurs, Ex. damage from "gunshot" to the conductor covering installed.
Lightning Contact	90% +	During raining seasons, sometimes encounter a good amount of lightning strikes in BVES' service area. BVES using priority covered conductor (flame resistant) cable.
Third Party	90% +	Third party including contact from joint use, boom arms, etc. should be mostly mitigated with covered conductor cable.
Flame Propagation along the covered conductor	90% +	Caused by Lightning or other.
Flame particle dripping	90% +	Caused by Lightning or other.

Liberty

The CC mitigation estimated effectiveness values for the various ignition risk drivers in 2023 remain unchanged from values in Liberty's 2022 WMP report update. The estimated effectiveness ranges from

95% for vegetation contact risk driver to 15% for lightning risk driver.

Next Steps:
As detailed above, the utilities estimate the effectiveness of CC between approximately 60 and 90 percent. In 2023, the utilities will continue to meet on a regular basis to discuss estimated effectiveness methods, data and calculations. The utilities will learn from the testing, and recorded results and collaborate to improve each utilities' understanding and approach to estimate effectiveness. The utilities will also discuss opportunities to align data and methods for greater comparability and will document any lessons learned.

PSPS:

Introduction:
In the 2022 WMP Update report, the utilities described their general PSPS approach and how a CC system can reduce PSPS impacts, and provided an assessment of alternatives and their ability to reduce PSPS impacts compared to CC. As described in the 2022 WMP Update report, only SCE has increased PSPS thresholds for fully-isolatable circuit-segments that are covered in comparison to bare conductor. Other utilities, such as SDG&E, informed that circuits with CC could likely withstand higher wind speed tolerances; however, more real-world experience and studies would be required prior to increasing PSPS thresholds. As SDG&E completes construction and obtains this data, it will inform wind-speed tolerances for PSPS. Below, the utilities describe its efforts to better understand the ability of CC and alternatives to reduce the impacts of PSPS as well as plans for 2023 to further this effort.

Summary:
In 2022, the utilities continued to meet and discuss CC and its ability to reduce the impact of PSPS. No utility made changes, per descriptions in last year's report, to their general PSPS practices and thresholds in 2022. The utilities did discuss studies being considered to further assess CC and other mitigations in their ability to reduce the impact of PSPS. Additionally, the utilities have recently discussed the testing results in relation to reducing the impact of PSPS. For example, SCE described how the testing results can provide boundary conditions/limits that enable more granular analysis. While other data such as improved understanding of local hazards are needed to fully inform of potential changes to PSPS thresholds, the testing results can help enable analyses that could provide additional benefits like changes in PSPS de-energization thresholds. SCE and SDG&E will be conducting studies to investigate different aspects and conditions of CC and local conditions to further inform potential changes to PSPS de-energization thresholds. Additionally, and as identified in the Testing workstream, the utilities will discuss the results of the testing in relation to PSPS de-energization thresholds in the testing workshops.

Next Steps:
In 2023, the utilities will assess new technologies in their ability to reduce PSPS impacts as part of the New Technology workstream. Additionally, the utilities will discuss the testing results to further inform PSPS de-energization thresholds as part of the testing workshops. The utilities will also regularly meet to assess the status of related studies and discuss any changes to PSPS practices. If changes to PSPS de-energization thresholds are made and/or to general PSPS practices, the utilities will document any lessons learned.

Benchmarking:

In 2021, the utilities benchmarked with utilities around the world to improve its understanding of CC deployment and applications. A survey was sent to over 150 utilities around the globe. In total, 19 utilities participated in the benchmarking survey. The survey consisted of 24 questions that focused on CC usage, performance metrics, conductor applications, and system protection. While a limited number of utilities responded (compared to the outreach), the benchmarking survey provided helpful information on CC deployment and performance metrics. This information supported the utilities understanding of the benefits of CC including reliability and safety improvements and wildfire risk reduction. The utilities did not conduct additional benchmarking outside of this joint IOU effort in 2022. In 2023, the utilities will develop a new survey that accounts for results from the testing workstream, learnings from the M&I best practices and new technologies workstreams, and other information that becomes available. The utilities will deploy a new survey in Q3/Q4 2023. Based on the results of the survey and the collaboration and learnings from the other workstreams, the utilities will look to continue to benchmark over this WMP period.

Costs:

Introduction:

In the 2022 WMP Update filings, the utilities presented an initial capital cost per circuit mile comparison of installation of CC and described the types of costs incurred, cost accounting methods, and the factors that can drive CC costs higher or lower. The utilities demonstrated that based on each utilities' CC / system hardening program, costs are relatively comparable taking into account each utilities' resources, scope, and operational constraints. Since the 2022 WMP Update, the utilities have continued to meet and discuss CC unit costs and undergrounding unit costs. Below, the utilities provide an updated CC capital cost per circuit mile, initial undergrounding unit costs, and plans for 2023.

Updated Covered Conductor Capital Cost Per Circuit Mile:

The utilities have prepared an updated capital cost per circuit mile comparison of the installation of CC. To construct this unit cost comparison, the utilities used the same six cost categories presented in the 2022 WMP Update filings including labor, material, contract, overhead, other, and financing.[6] These cost categories are intended to capture the total capital cost per circuit mile of CC installations. For purposes of this report, the utilities obtained recorded and/or estimated costs for construction that occurred during 2022. Table F-19, below, shows the current CC capital unit cost per circuit mile comparison across the six utilities.

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6 Labor represents internal utility resources, such as field crews, that charge directly to a project work order. Materials include conductor, poles, etc. that get installed as part of a project. Contract represents all contractors, such as field crews and planners, and consultants utilities use as part of their CC programs. Overhead represents costs, such as engineers, project managers and administrative and general, that get allocated to project work orders. Other represents costs such as land fees, permit fees and costs not assignable to the other categories. Financing represents allowance for funds used during construction (AFUDC) which is the estimated cost of debt and equity funds that finance utility plant construction and is accrued as a carrying charge to work orders.

Table F-19
IOU Comparison of Covered Conductor Capital Costs Per Circuit Mile

Cost Components	SCE Cost per Circuit Mile	SCE %	PG&E Cost per Circuit Mile	PG&E %	SDG&E Cost per Circuit Mile	SDG&E %	Liberty Cost per Circuit Mile	Liberty %	PacifiCorp Cost per Circuit Mile	PacifiCorp %	BVES Cost per Circuit Mile	BVES %
Labor (Internal)	$ 9,000	1%	$ 130,000	16%	$ 321,000	22%	$ 117,000	10%	$ 18,000	2%	$ 18,000	2%
Materials	$ 132,000	19%	$ 151,000	18%	$ 84,000	6%	$ 73,000	6%	$ 218,000	28%	$ 360,000	49%
Contractor	$ 383,000	56%	$ 394,000	48%	$ 303,000	21%	$ 857,000	70%	$ 446,000	57%	$ 300,000	41%
Overhead (division, corporate, etc.)	$ 141,000	20%	$ 140,000	17%	$ 355,000	24%	$ 163,000	13%	$ 50,000	6%	$ 60,000	8%
Other	$ 14,000	2%	$ 3,000	0%	$ 317,000	22%		0%	$ 25,000	3%		0%
Financing Costs	$ 9,000	1%	$ 8,000	1%	$ 71,000	5%	$ 10,000	1%	$ 21,000	3%		0%
2022 Total	$ 688,000	100%	$ 826,000	100%	$1,451,000	100%	$ 1,220,000	100%	$ 777,000	100%	$ 738,000	100%

As illustrated in Table F-19, the 2022 CC capital cost per circuit mile ranges from approximately $688 thousand to approximately $1.45 million. While not a true comparison, because the figures are in nominal dollars, the 2022 unit cost range is similar to the 2021 unit cost range of approximately $565 thousand to approximately $1.5 million. As discussed in the 2022 WMP Update report, the capital cost per circuit mile for CC can vary due to multiple factors such as type of CC system and components installed, terrain, access limitations, permitting, environmental requirements and restrictions, construction method (e.g., helicopter use), amount of poles/equipment replaced, degree of site clearance and vegetation management needed, and economies of scale. Below, the utilities describe any changes to their cost make-up and the factors that contribute to the cost changes from 2021.

Initial Undergrounding Capital Cost Per Circuit Mile:

PG&E, SCE and SDG&E have prepared an initial capital cost per circuit mile comparison of the conversion of overhead conductor to underground. Liberty and BVES are not installing undergrounding as part of their wildfire mitigations. PacifiCorp has only installed one half of a mile so does not have sufficient recorded data to add; however, PacifiCorp is installing undergrounding projects over this WMP period and thus unit cost data will be assembled once more undergrounding is installed. Similar to the construction of the CC unit cost comparison, the utilities organized their capital costs (and/or estimates) into the same six cost categories. These cost categories are intended to capture the total capital cost per circuit mile of undergrounding. For purposes of this report, the utilities obtained recorded and/or estimated costs for construction that occurred during 2022. Table F-20, below, shows the initial undergrounding capital unit cost per circuit mile comparison across the three large utilities.

Table F-20
SCE, PG&E and SDG&E Comparison of Undergrounding Capital Costs Per Circuit Mile

Cost Components	SCE		PG&E		SDG&E		Liberty		PacifiCorp		BVES	
	Cost per Circuit Mile	%	Cost per Circuit Mile	%	Cost per Circuit Mile	%	Cost per Circuit Mile	%	Cost per Circuit Mile	%	Cost per Circuit Mile	%
Labor (Internal)	$ 9,000	1%	$ 130,000	16%	$ 321,000	22%	$ 117,000	10%	$ 18,000	2%	$ 18,000	2%
Materials	$ 132,000	19%	$ 151,000	18%	$ 84,000	6%	$ 73,000	6%	$ 218,000	28%	$ 360,000	49%
Contractor	$ 383,000	56%	$ 394,000	48%	$ 303,000	21%	$ 857,000	70%	$ 446,000	57%	$ 300,000	41%
Overhead (division, corporate, etc.)	$ 141,000	20%	$ 140,000	17%	$ 355,000	24%	$ 163,000	13%	$ 50,000	6%	$ 60,000	8%
Other	$ 14,000	2%	$ 3,000	0%	$ 317,000	22%		0%	$ 25,000	3%		0%
Financing Costs	$ 9,000	1%	$ 8,000	1%	$ 71,000	5%	$ 10,000	1%	$ 21,000	3%		0%
2022 Total	$ 688,000	100%	$ 826,000	100%	$1,451,000	100%	$ 1,220,000	100%	$ 777,000	100%	$ 738,000	100%

Table F-21
SCE, PG&E and SDG&E Comparison of Undergrounding Capital Costs Per Circuit Mile

Cost Components	SCE		PG&E		SDG&E	
	Cost per Circuit Mile	%	Cost per Circuit Mile	%	Cost per Circuit Mile	%
Labor (Internal)	$ 25,000	1%	$ 231,000	9%	$ 45,000	2%
Materials	$ 417,000	19%	$ 271,000	11%	$ 165,000	7%
Contractor	$ 1,201,000	56%	$ 1,665,000	66%	$ 1,754,000	71%
Overhead (division, corporate, etc.)	$ 438,000	20%	$ 247,000	10%	$ 417,839	17%
Other	$ 35,000	2%	$ 63,000	3%	$ 14,654	1%
Financing Costs	$ 29,000	1%	$ 31,000	1%	$ 77,756	3%
Total	$ 2,145,000	100%	$ 2,508,000	100%	$ 2,474,739	100%

As illustrated in Table F-21, the 2022 undergrounding capital cost per circuit mile ranges from approximately $2.03 million to approximately $2.51 million. The capital cost per circuit mile for undergrounding across the three utilities is remarkably consistent given that undergrounding costs typically have a much larger cost range than CC. Similar to CC, undergrounding costs vary due to multiple factors such as type of undergrounding system and conductor, terrain, access limitations, route changes, permitting, environmental requirements and restrictions, construction methods, and economies of scale. Below, SCE, SDG&E and PG&E describe the make-up of their undergrounding capital costs and the factors that contribute to the cost differences.

SCE

<u>CC Unit Cost Make Up:</u>

The 2022 CC costs are based on work completed in 2022. Some projects completed in 2022 have incurred costs from prior years. SCE's unit cost is based on the average cost of nine different regions within SCE's service area. SCE's unit costs are typically presented as direct costs only (exclude corporate overheads and financing costs). For purposes of this report, SCE has added corporate overheads (to the overhead cost category) and financing costs to its direct unit cost for comparison with the other utilities. SCE continues to use two CC designs, a 17 kV and 35 kV CC with multiple ACSR and copper conductor sizes.

In 2022, SCE did make a change to its WCCP construction standard by adding the replacement of open wire secondary or weather-resistant aluminum (OWS or WAL) with multiplex secondary conductors; however, this change is not anticipated to show up in the unit costs until 2024. No CC projects completed in 2022 included replacement of secondaries. SCE estimates, on average, replacing secondaries will cost approximately $60 thousand per circuit mile.

<u>CC 2022 Cost Changes:</u>
Using the nominal amounts of the 2021 and 2022 unit costs, SCE experienced an approximate 16% increase. The primary drivers of this increase include a combination of a larger percentage of work in the Rural region, e.g., the Arrowhead District, and contractor rate increases. Work in higher elevations in rugged areas tend to take longer, increasing contract labor costs. This increase coupled with higher contractor rates were the main cost drivers. Additionally, SCE experienced material and supply price increases. Also, in 2022, SCE began to use SCE labor in some regions.

<u>Undergrounding Cost Make up:</u>
The 2022 undergrounding costs are based on work completed in 2022. Projects completed in 2022 have incurred costs from prior years. SCE's unit cost is based on approximately 14 miles of undergrounding. The 14 miles of undergrounding had a low level of difficulty and did not include secondaries or services. A low difficulty level means the terrain was relatively flat, there was less civil construction due to existing infrastructure, and there were none to minimal re-routing required. SCE anticipates higher costs in future unit cost assessments because the projects will have a mix of low to high difficulty.

<u>Undergrounding Cost Drivers:</u>
For undergrounding projects, SCE leverages its Integrated Wildfire Mitigation Strategy consequence model, which defines the most severe locations in SCE's HFRA. These are locations that meet one or more of the following characteristics: 1) egress constrained, 2) burn-in buffer, 3) 10,000+ acres burned at 8 hours, 4) extreme high wind areas, and 5) communities of elevated fire concern. The costs to underground in these areas can vary significantly. Below, SCE describes several cost drivers that could lead to increased costs.

Construction – in various types of terrain, geography, topography, and population density. Different levels of difficulty in construction can significantly impact the costs. For example, a low difficulty level project that includes straight/minimal bends and minimal re-routing will likely be a lower cost compared to a high difficulty level project, which can have rocky, hilly terrain requiring significant re-routing. Additionally, any unanticipated changes in design after release can impact costs. For example, sometimes, during construction, a trench is not able to be constructed due to other infrastructure already there (an outcome of outdated basemaps). In this type of circumstance, the planning department would re-design the route including seeking agency feedback which would take additional time to complete and impact schedule and costs.

Permitting and environmental clearances – acquiring permits, resolving land rights and agency requirements, and curing cultural discoveries can be a lengthy process. The number of permits, the types of permits, the amount of land right issues that need to be resolved, and the types of cultural discoveries can increase the costs of a project.

Labor type and resource availability – Both civil crews and QEW electrical crews are required and using internal SCE labor versus contract labor may impact costs.

Additionally, delays can occur due to weather (e.g., rain/snow, RFW days, etc.), supply chain constraints, permit requirements, and environmental constraints (e.g., nesting birds), which can also increase costs.

PG&E

CC Unit Cost Make Up:

PG&E's unit cost analysis is based on completed projects. Projects are defined by circuit and span. Costs are recorded using SAP software. Of the 335 miles used to analyze the unit cost, these were projects that were marked completed in 2022. Some of the mileage may have been constructed in previous years. Five of the miles were fire rebuild, which typically have a lower unit cost. 329 miles completed were regular system hardening work and one mile was classified as other.

Costs were organized per the six main categories agreed upon with the other utilities. 200 miles were constructed using external crews, categorized as Contract and 135 miles were constructed using Internal labor, categorized as Labor.

PG&E's Overhead Hardening (CC Installation) scope achieves risk reduction through these foundational elements: bare primary and secondary conductor replacement with covered equivalent, pole replacements, non-exempt equipment replacement, overhead distribution line transformer replacement, framing (composite crossarms and insulators) and animal protection, and vegetation clearing.

CC Cost Drivers:

PG&E's CC installation costs are driven by these key contributors:

1. Pole replacement – nearly 100% of the poles require replacement due to the additional weight/sag of the new CC.
2. PG&E incorporates numerous initiatives into a single hardening project. Non-exempt equipment and ignition component replacement impacts the cost by including the material and labor installation cost of the new equipment where it requires replacement.
3. Vegetation clearing in support of the new overhead line can be a significant cost added to these projects. Both the increased height of the poles, the widened cross-arms, and the increased sag of the line can vary the cost considerably. This cost alone can add between $50k to $400k per

mile depending on the terrain and the location of the line. The rural nature of much of the high-risk HFTD infrastructure drives this need.

CC Cost and Impact Driver changes for 2022:

For PG&E, unit costs have steadily decreased for the Overhead System Hardening program, that includes CC, into 2022. Major cost drivers include a decreased volume of vegetation impacts on overhead hardened lines and unit cost RFPs (request for proposals) to stabilize contract pricing.
It is likely that these unit costs have mostly leveled off and will only increase due to inflation and economic pressures as this program continues.

Continued costs for PG&E are labor costs, both internal and external (contractor) costs.

For impact drivers to CCs, PG&E is continuing to utilize a combination of undergrounding and microgrids as the primary system hardening effort to reduce wildfire risks. Where these efforts are less feasible, PG&E may use CC as a wildfire mitigation tool for Overhead System Hardening. As PG&E continues undergrounding efforts and finds additional areas that are prohibitive to the undergrounding program, PG&E may increase CC use for those specific areas.

Undergrounding Cost Make up:

PG&E's unit cost analysis is based on completed projects with costs recorded in our SAP software. Of the 76 miles used to analyze the unit cost, these were projects that were marked completed in 2022. Some of the mileage may have been constructed in previous years, 46 of the miles were fire rebuild, which typically have a lower unit cost, and 30 miles completed were regular system hardening work.

Costs were organized per the six main categories agreed upon with the other utilities, 53 miles were constructed using external crews, categorized as Contract, and 23 miles were constructed using internal labor, categorized as Labor.

Undergrounding Cost Drivers:

In executing the System Hardening program, PG&E first uses a scoping criterion that identifies the highest risk areas, and then selects the appropriate risk mitigation approach for that circuit which may include undergrounding, remote grid installation, line removal, or overhead hardening (depending on the local circumstances). Since late 2021, PG&E has prioritized undergrounding as the preferred approach to reduce the most system risk. Once a circuit is selected for undergrounding, PG&E evaluates each proposed circuit segment quantitatively and qualitatively to mitigate the maximum amount of risk and evaluate feasibility and executability. Potential cost drivers can include:

- Existing infrastructure (e.g., water, natural gas, and sewer/stormwater drainage systems, bridges, streetlights, SCADA communications, number of services and transformers, community traffic and access impacts)
- Major execution dependencies (e.g., land rights, environmental permitting, requirements for future road widening, paving plans, or moratoriums by local governments)
- Land and environment considerations (e.g., accessibility for ingress and egress of areas, waterway crossings, sensitive species habitats, land rights and easements, tribal lands, steep

gradient, hard rock, tree density)

- Community and Customer Considerations (e.g., cultural considerations, community, and customer impact)

Any of the above considerations may create delays or complexities that can impact the scope, cost, and schedule of undergrounding projects.

Furthermore, undergrounding projects are executed in multiple stages once the circuit segment has been identified based on the criterion described above for undergrounding:

1. Scoping: Identifying the proposed route of undergrounding the electric distribution lines, including gathering base map data (e.g., LiDAR and survey data of the expected route) and identifying any long lead time dependencies (e.g., land acquisitions, environmental sensitivities and permits). Scoping includes breaking out planned circuit segments into smaller, more manageable projects. Scoping is the first step necessary to provide visibility to the construction feasibility and possible execution timing.
2. Designing/Estimating: Designing the specific project to determine trench location, connection points, equipment details, materials needed, and all related details, such as circuitry and pull boxes. This design also provides specifics for the land rights needed and the drawings that are submitted for permits. The total project cost, including expected labor and materials, is calculated at this stage.
3. Dependencies: During this stage we may need to obtain land rights, environmental permits, construction contracts, encroachment permits from local counties, order long-lead materials, finalize construction cost estimates, and determine the construction schedule. The two longest lead dependencies often include obtaining 1) land rights and 2) environmental permits.
4. Construction: Executing the undergrounding takes place in two phases: 1) civil construction and 2) electric construction. Project schedules may be significantly impacted during civil construction for some of the following reasons: unanticipated weather, discovery of hard rock, and detection of unmarked existing utility infrastructure. Once civil construction is complete with conduit and boxes installed, then electric construction resources pull the cable through the conduit, splices segments together and re-connects the customers to the new underground system. Customer input to the timing of re-connection, material availability, weather and other risks can impact the electric construction schedule, as well.

As projects move through each stage, schedule certainty improves. Project schedules can change at any time from project dependencies, which may cause specific projects to move across years. Generally, if a project is not completed during the year that it was originally targeted for completion, it will continue through all the job phases and be completed in a subsequent year.

PG&E works closely with customers, governments, agencies, tribes, and regulatory officials to manage these issues within the program to minimize delays and optimize the efficiency of projects wherever possible.

SDG&E

CC Cost Make Up:

Each project goes through a six-stage gate process as follows:

Stage 1 – Project Initiation (duration ~1-3 months)

Stage 2 – Preliminary Engineering & Design (duration ~6-9 months)

Stage 3 – Final Design (duration ~3-5 months)

Stage 4 – Pre-Construction (duration ~1-2 months)

Stage 5 – Construction (duration ~3-4 months)

Stage 6 – Close Out (duration ~6-12 months)

The total duration of a project has an estimated duration of approximately 20 to 35 months.

SDG&E's CC per mile unit capital costs is made up of the following six major cost categories:

1. Labor (internal) – directs costs associated with SDG&E full-time employees (FTE), including but not limited to individuals from project management, engineering, permitting, environmental, and land management departments.
2. Materials – estimated costs of material used for construction including steel poles, wire, transformers, capacitors, regulators, switches, fuses, crossarms, insulators, guy wire, anchors, hardware (nuts, bolts, and washers), signage, conduit, cable, secondary wire, ground rods, and connectors.
3. Contractor – estimated costs for construction-related services, including civil construction contractors for pole hole digging, anchor digging and substructures, and street/sidewalk repair; electrical construction for pole setting, wire stringing, electric equipment installation and removals; vegetation management where required including tree trimming or removal, and vegetation removal for poles and access paths; environmental support services including biological and cultural monitoring; traffic control; and helicopter support for pole setting, wire stringing, and removals. SDG&E's contractor costs is an estimated average for both internal and contracted electric construction activities, where contract crews are estimated to account for approximately 50% of the construction costs typically completed in a year starting in 2023 versus the 75% that was in the previous estimate.
4. Overheads – estimated costs associated with contracted services not related to construction including engineering, design, project management, scheduling, reporting, document management, GIS services, material management, constructability reviews by Qualified Electrical Worker (QEW), staging yard leases/setup/teardown/maintenance, and permitting support throughout the entire lifecycle of a project, as well as services related to program management including long term planning and risk assessment.
5. Other – estimated costs associated with indirect capital costs. These costs are estimated to be approximately 22% of direct capital costs that accumulate on a construction work order. This includes administrative pool accounts that are not directly charged to a specific project, including internal labor vacation, sick, legal, and other expenses.
6. Financing Costs – estimated costs associated with the collection of AFUDC when a construction work order remains active. Most SDG&E jobs are active for approximately 6 to 10 months from the time the job is issued to construction until it is fully completed and the collection of AFUDC

charges stop.

CC Cost Drivers Update:

Costs can vary significantly from project to project for a variety of reasons, including engineering and design, land rights, environmental, permitting, materials, and construction. Below is a description of these factors and why the costs can vary from project-to-project.

Engineering & Design:

SDG&E collects LiDAR (Light Imaging Data and Ranging) survey data before the start of design and again after construction is completed. During the LiDAR data capture, other data including photos (i.e., ortho-rectified images of the poles and surrounding area, and oblique pole photos), and weather data is acquired. After collection of the raw LiDAR and Imagery data, it is processed to SDG&E's specification and includes feature coding and thinning of the LiDAR data, and selection and processing of the imagery data. The entire process for delivery to SDG&E's specification can take weeks to months depending on the size of the data capture. This LiDAR data capture is used to support the base-mapping, engineering, and design processes (Stage 1 and Stage 6).

Currently, the engineering and design of all CC projects are conducted by engineering and design consultants, and their deliverables are reviewed by a separate Owner's Engineering (OE) consultant to ensure compliance with SDG&E standards and guidelines. At this time, SDG&E does not have the resources to conduct the engineering and design required at this scale of work; however, there are assigned SDG&E full time engineering staff that provide oversight of all engineering and design consultants, including the OE. The engineering component of work relates to the structural analysis, including Power Line Systems – Computer Aided Drafting and Design (PLS-CADD) modeling, foundation calculations, or geotechnical studies. The design component includes the drafting, entering design units into SAP for material ordering and costing system, and building the job packages that are sent to construction. In some cases, one consultant can perform both the engineering and design function, and in others cases an engineering consultant collaborates with a design consultant. In all cases, SDG&E's Owner's Engineer will perform both engineering and design review support. Costs from consultants can vary depending on the size and complexity of the project, and due to various other factors including environmental constraints, land constraints, permitting requirements, or scoping changes that can occur from the start of design and throughout construction. The design stage (i.e., start of design to issuance of job package to construction) typically takes anywhere from six months to two years depending on the size and complexity of the project and the challenges with acquisition of land rights, environmental release, and/or permits. In some cases, our environmental releases cannot be released until we receive the permit from the agency as they may require additional environmental measure to be placed on the work and will need to be outlined in the environmental release.

SDG&E requires every pole be engineered using PLS-CADD software during the design phase and the post-construction phase. This software allows SDG&E to leverage LiDAR survey data (pre- and post-construction) and AutoCAD drawings, and to design the poles, wire, and anchors to meet General Order (GO) 95 Loading (Light and Heavy Loading) and Clearance Requirements, as well as to meet Known Local Wind requirements (e.g., 85 mph and in some cases 111 mph wind). SDG&E also requires its engineering and design contractors who use PLS-CADD software to have a California-registered Professional Engineer review and approve the final PLS-CADD model.

Land and Environmental**:**

SDG&E requires all projects to go through a land and environmental review process at each stage of the design process. These processes are predominantly supported with the help of land management and environmental service consultants but are overseen by SDG&E representatives in each respective department. The land process includes research of our land rights, interpretation, and may include support obtaining the proper land rights when required. Through the land rights design review process, SDG&E determines the land ownership of facilities (e.g., poles and wire) to determine if the scope of work is will stay within existing land rights or if new/amendment land rights would be necessary. These results are shared with the engineering, design, and environmental teams. Once the land rights are determined, environmental performs an assessment, determines the environmental impacts if any, and provides input to the design process to minimize and/or avoid environmental impacts. These land and environmental reviews can drive changes to the design and add time and cost to the project. For example, in many cases, SDG&E does not have the land rights to build the overhead CC design within its existing easement, or in some cases it only has prescriptive rights. In those cases, SDG&E has to amend or acquire the proper land rights, or redesign the project, if possible, to stay within the land and/or environmental constraints. If acquiring or amending land rights is required, this can take weeks to months depending on the property owner (e.g., private, BIA, State, Federal, or Municipality) and the level of change to the existing conditions.

Materials:

SDG&E's philosophy with CC, like SCE, is to install it in an open-crossarm configuration. In this configuration, the conductor is self-supporting and attached to insulators on crossarms at the structure. Where connections are necessary, insulation piercing connectors (IPCs) are used to avoid stripping the wire and causing damage to the conductor and negating the need to wrap the connection with insulating tape. SDG&E also requires the use of vibration dampers, where necessary, to mitigate conductor damage due to Aeolian vibration. SDG&E replaces most wood poles to steel, and in some cases replaces existing steel poles if they are not adequate to support the new wire (e.g., inadequate clearance and/or mechanical loading capacity). In many cases equipment is replaced during these reconductor projects if it is older, is showing signs of failure, and/or needs to be brought up to current standards. The reason to replace wood poles with steel is due to several reasons, including the fact steel is more resilient to fires than wood and is seen as a defensive measure, steel is a man-made material and the strength and dimensions are consistent and have much smaller tolerances than wood, and because many of SDG&E's wood poles are over 50 years old. In some cases, SDG&E may also need to relocate the pole line to an area where it is more accessible to build and maintain but will require obtaining a new easement. SDG&E also replaces wood crossarms with fiberglass crossarms, insulators with polymer insulators, and replaces switches and regulators as necessary. For transformers, SDG&E developed specific criteria for replacement. A transformer will be replaced if it is internally-fused regardless of age, if it's greater than 7 years old, if it has visual defects or damage (leaks, burns, corrosion, etc.), is less than 25 kVA, or if the transformer does not pass volt-drop-flicker calculation. SDG&E also replaces secondary wire that is either open (non-insulated) or "grey wire" (covered secondary wire where the insulation is grey in color). On most projects, there is a smaller underground job associated with the overhead work. This typically occurs when a pole feeds underground (aka a Cable or Riser Pole) and the new pole location may be too far from the existing position such that the existing cable, conduit, and terminations may not reach the new pole position. In these cases, a small underground job will be initiated to have the crews intercept the run of underground conduit, install a new handhole, install a new run of conduit and cable to the new pole location, and splice the cable in the new handhole to make the connection to the existing underground system.

In 2021 and 2022, SDG&E experienced material supply chain issues, with CC materials as well as materials common to bare and CC. These supply chain issues were the result of various factors including impacts from COVID-19. In the case of CC, SDG&E currently sources the conductor from multiple suppliers; however, the associated materials such as piercing connectors and clamp dead-ends come from one supplier out of Europe and experienced significant delivery delays due to COVID-19 and issues with US Customs paperwork in 2021. In 2022 SDG&E had material delays with secondary conductor, 10 ft fiberglass guy strain insulators, transformers, guy grips, and fiberglass crossarms. SDG&E also experienced delays receiving other material due to COVID-19 supply chain disruptions and competition for the same materials used by other utilities including transformers and other materials common to various utilities across the country. Material delays can cause construction delays or cause construction to work less efficiently, thus impacting project schedules and costs. To mitigate material delays SDG&E's engineering and design team, as well as suppliers, work together to provide long term forecasting and ensures materials are ordered with enough lead time to receive the materials in time for construction, and when necessary, substituting material.

Construction:
One of the most significant variables, and most difficult to predict, is the civil portion of construction. The civil portion of a project includes the pole hole, anchor, and handhole digging and can vary significantly depending on several factors including accessibility (truck accessible versus non-truck accessible), soil conditions (rock versus soft soil), methods of digging (hand tools versus machine), and environmental constraints that may limit the method of digging or access protocols. For example, a 0.7 miles project completed a couple of years ago was on the side of a steep mountain side and all the material, equipment (pneumatic drill and hand tools), and crews had to be flown in and out every day for months. The civil crews encountered significant rock at most locations and the spoils from the digging had to be flown out due via helicopter to environmental concerns rather than spreading the spoils on location. Each pole and anchor were back-filled with concrete using helicopters because of the slope of the mountain and due to the significant mechanical loading due to winter storms (wind and ice loading). In contrast to this mountain side project example, SDG&E has had other projects that are truck accessible, that do not require concrete backfill and allow the spoils to be spread out on location.

Another reason costs can vary significantly from project to project is due to the time of year and location. SDG&E often deals with elevated fire weather conditions which requires a dedicated fire watch crew to be present at each location where there is work happening that can pose a fire risk. In some cases, SDG&E has multiple dedicated fire watch crews on a project as there may be multiple civil and electric crews working at different locations at the same time on the same project. Some locations are also so remote that the drive time from the staging yard to the site can take a significant amount of time out of each workday that the crew may work longer hours and/or over the weekend, including Sundays, thus increasing overtime hours for the construction crew and all other support services (e.g., traffic control, environmental monitors, etc.). In some cases, generators are used due to the remote nature of some customers and the lack of ties with other circuits in SDG&E's service area. Generators require special protection schemes, equipment, and resources to adequately plan, deploy, setup, monitor, and tear-down which increase the installation costs.

Lastly, construction costs can vary depending on the crew building the project and issues encountered during construction that were not anticipated during design. SDG&E currently uses four primary construction contractors who perform the electrical construction and typically sub-contract the civil work (e.g., pole hole, anchor, handhole digging), helicopter, traffic control and dedicated fire watch. SDG&E also uses internal electric construction teams who typically contract out the helicopter, traffic control, dedicated fire watch and civil work (pole hole and anchor digging). Based on SDG&E's experience with its traditional hardening program, in 2023 it is estimated that 50% of the construction work costs will be performed by contractors and 50% by internal crews. The costs between external and internal crews can vary depending on the work scope, location (rural versus very rural), methods of construction (e.g., truck accessible versus non-truck accessible), time of year (e.g., fire season and non-fire season, and wet versus dry conditions), and issues encountered during construction. Larger projects (typically 20 or more poles) that are not assigned to an internal crew are sent out to bid with the three prime electrical construction contractors and are often bundled with other projects on the same circuit to gain economies of scale. SDG&E has determined that its ideal bid size is 100-200 poles; however, some bids have been significantly greater and some can be much smaller. The size of bids can change significantly depending on the location of a project, time of year, and schedule of the project. SDG&E has seen changes with pricing due to competition for construction resources with the other utilities in the state and this can drive-up costs depending on the volume of work and timing with other projects statewide.

PacifiCorp

<u>CC Unit Cost Make Up:</u>

For purposes of this comparison, PacifiCorp has again aligned its costs into the six major categories. No changes were made in 2022 related to how costs are organized into the six main categories. PacifiCorp is basing the cost per mile on ten projects totaling about 33 miles of primarily spacer cable. These projects were placed in service during 2022; however, design, material procurement, permitting, and some construction may have taken place prior to 2022.

<u>CC Cost Drivers:</u>

PacifiCorp has identified eight main cost drivers for the installation of CC. The cost drivers are discussed below in terms of cost increases that have been experienced, highlighting how impactful these components can be on the overall project cost.

Access: PacifiCorp includes costs for required access to facilitate project construction in projects charged to the work order. These costs may include vegetation clearing, road construction, or other site preparation activities. These costs will typically be included in the contractor total for purposes of this cost analysis as this work is predominantly contracted. Additionally, these costs can also range significantly between projects based on the specific location and terrain where work is conducted. Projects that include significant off-road scopes tended to be most impacted, though this is somewhat offset by limited flagging costs.

Pole Replacement: PacifiCorp evaluates all poles for strength and clearance using PLS CADD on spacer cable projects. Poles are then selected for replacement for the following reasons: insufficient strength to accommodate CC, insufficient minimum clearance, relocation is required, or not constructible in the current state. Projects completed in 2022 averaged 25 poles per mile due to projects with larger conductor sizes, short spans on in-town projects, and two projects designed for double circuits. Additionally, nearly all poles identified are replaced with non-wood fire resistant materials (predominantly fiberglass) at a greater cost than like-for-like replacement with wood.

Construction Labor: In 2022, PacifiCorp continued to receive higher bid prices. Contractors reported needing to include incentives to attract adequate labor to complete projects. Increases in construction labor costs were the single largest driver in project cost increases. As of January 31, 2023, PacifiCorp has awarded approximately one third of the 2023 planned construction work scope and is forecasting that these higher costs will continue.

Post Construction Inspections: In 2022, it was recognized that the total amount of construction exceeded the capacity of internal staff to adequately inspect as the construction was taking place. Based on this, external construction inspectors have been hired to monitor construction, while it is taking place, and complete a formal inspection of each line segment as it is placed into service. While this comes at a higher cost per line mile, it assures that the completed project matches the design. This will be on ongoing addition to project costs.

Permitting: As included in the company’s 2021 Change Order, significant cost increases have been experienced for locations requiring access into seasonal wetlands and transmission under build projects. Future projects include environmentally sensitive areas that have been in NEPA or CEQA review with high environmental review costs. Additionally, projects scheduled for completion in 2023 have required cultural monitors for all ground disturbing activities and several re-designs to accommodate changes in current infrastructure layout requested by permitting agencies.

Materials: PacifiCorp experienced material cost increases on most commodity materials in 2022; however, this impact was limited for the group of projects in this analysis as much of the material was on order prior to 2022. Projects scheduled for completion in 2023 are expecting to experience more impact from these cost increases.

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Internal Labor and Overhead: Internal labor increased on a per mile basis while overhead costs decreased. This is largely driven by a shift in staff charging directly to projects they are working on rather than an overhead account. These should be viewed largely as offsetting cost shifts.

Design Type: In 2022, PacifiCorp rebuilt approximately 7 miles of overhead distribution lines with CC. While there are many factors impacting the projects overall costs, a cursory review indicates a lower cost per mile as compared to spacer cable, generally attributed to the lower cost of materials, shortened project timeline, and reduction in engineering and design requirements. However, some of these costs are offset by the increase in pole replacements required with using a more standardized product. Based on this one project, PacifiCorp expects that CC could be a cost-effective option in many locations but requires more experience to understand the cost variability.

Based on the cost drivers discussed above, PacifiCorp anticipates higher costs for projects in 2023 and beyond.

Bear Valley

CC Unit Cost Make Up:

BVES continues to contract out most of the work with an internal Field Inspector overseeing the whole project. The design consists of our contractor performing field visits, wind loading calculations, developing the design and assembling the material lists. BVES purchases the materials and its contractor does the construction. The overhead costs consist of BVES internal groups. The capital cost per circuit mile are based on a double circuits' area in 2022.

CC Cost Drivers:

CC unit costs decreased in 2022 compared to 2021. A higher percentage of poles were installed which support both 34.4 kV and 4 kV CC lines. These double circuit lines reduce installation and material costs. In addition, the construction crews have gained more experience installing CC and are more efficient.

Liberty

CC Unit Cost Make Up:

Liberty's CC program is still relatively new and limited in scope compared to the large utilities. Liberty first piloted CC projects in 2020 in select areas that already needed line upgrades because of asset age and condition, and later focused on projects that targeted short line segments in HFTD areas, had reliability issues, and were in remote areas. An average of recent CC projects amounted to less than one circuit mile per project and only a total of 20 miles of CC were installed over the last 3 years. Liberty's CC work is substantially less than, for example, SCE's approximate 1,000+ miles of CC installed each year. Liberty's CC unit costs vary depending on terrain, number of poles replaced, type of conductor installed, project design and permitting requirements, and amount of vegetation management work required for the job order. Liberty used the same cost categories as described in the 2022 WMP Update report and did not make any major changes to its CC program.

CC Cost Drivers:

Liberty's project life cycle ranges from 18-36 months depending on project scope and permitting complexity. There are many factors that may impact the total project life cycle and costs, including permitting and environmental requirements, easements, geography and terrain, and construction resource availability. Contractor costs for construction in its service area are a major cost driver for Liberty. Projects typically take longer to construct because of the mountainous terrain and require more costly construction methods like helicopter use and hand digging. Other cost factors include permitting, weather, and environmental restrictions that limit scheduling flexibility and reduce productivity, causing construction costs to increase.

Conductor Type: Liberty has two CC designs that vary depending on project site access and terrain. These include 14.4 kV delta Aerial Spacer Cable (ACS or spacer cable) and CC solutions at this voltage level. In addition, because some of Liberty's service area includes 12.5 kV grounded Wye system, Liberty has piloted the use of CC. Liberty selects the two different system options based on the installation and maintenance of the two solutions.

The ACS solution has two or three covered conductors supported by a steel messenger. The framing for

ACS includes brackets that hold the messenger under tension and for the current carrying conductors at full sag or zero tension. Installing and maintaining spacers requires a bucket truck; however, if accessibility is an issue, crews may require a bosun's chair to access the line adding to the costs.

The covered conductor solution includes various sizes of covered wire such as a 1/0, 2/0, or 397 kcmil AAC. The ACS solution projects have installed 1/0 AA wire with 1-052 AWA messenger and 1/0 AAC with 6AW messenger. Covered conductor is installed with framing similar to bare conductor wire in an open-crossarm configuration for framing and installation. CC is the preferred solution in areas with limited bucket truck access. Conductors are sized based on circuit load for both solutions. Wind and ice loading are major concerns in the Liberty service area and do not utilize conductors smaller than 1/0.

Location: A vast majority of Liberty's service area is in HFTD Tier 2 and Tier 3. In the initial phases of its covered conductor program, Liberty selected areas of its service area based on local knowledge of the wildland/urban interface, locations of high fire threat districts, remoteness of overhead lines, and the age and condition of the infrastructure. Areas were also chosen based on their accessibility and egress options during an emergency. Most of Liberty's covered conductor projects are in Tier 2 and Tier 3 at elevations between 6,200 to 7,500 feet over rugged, rocky terrain with limited seasonal access. Projects typically utilize helicopter pole sets, and crews are tasked with digging pole holes with pneumatic tools by hand versus trucks with augers. Pole holes take days versus hours to excavate, increasing labor hours and costs.

Pole and Asset Replacements: Most of the covered conductor projects Liberty has designed and constructed have required a significant number of pole replacements per circuit mile. When replacing existing poles, Liberty uses taller and larger class poles. This is due to new loads and increased weights of the covered conductor, as well as the age of existing infrastructure. Projects include installation of poles, insulators, crossarms, anchors (rock anchors), down guys, transformers, and switches.

Economies of Scale: Liberty has limited contract resources available during its construction period compared to the larger IOUs that have replaced thousands of circuit miles with CC. Liberty's contract costs are higher on a per mile basis than those of large IOUs, given Liberty's ratio of miles installed as compared to IOUs with significantly more miles installed. This factor has likely contributed to Liberty's higher CC cost per circuit mile.

Construction: Liberty's primary construction window is May 1 to October 15 due to weather and Tahoe Regional Planning Agency (TRPA) dig season restrictions. The construction window also coincides with seasonal tourism, a high number of RFW days, and during the typical fire season that further limits construction efforts and effects costs. These restrictions also constrain resources and add a premium on labor during construction season.

Vegetation Management: Liberty's service area is in a high elevation and mountainous terrain that is densely forested, averaging over one hundred trees per mile within maintenance distance of the conductor, given recent LiDAR data. Vegetation management inspectors and tree crews often need to access work sites on foot while carrying tools and equipment, resulting in much higher labor costs compared to typical work areas. In addition, due to the robust tree canopy in the Tahoe region, tree crew cost per circuit mile of construction has increased significantly due to SB 247 labor rate increases.

Tree removals and pruning costs are unique to Liberty's service area and will increase the overall CC project costs.

In 2022, Liberty experienced an approximate 20% decrease in CC costs compared to 2021. This cost decrease was mainly due to Liberty's use of internal construction crews instead of contractors in 2021. Additionally, 2022 projects required fewer helicopter pole sets and less hand-digging than 2021 projects.

Next Steps:
In 2023, the utilities will continue this workstream and further discuss and document CC recorded/estimated unit costs, undergrounding unit costs and cost drivers as well as assess adding initial unit costs for other alternatives. The utilities will also document any lessons learned.

Lessons Learned:
Introduction:
In the utilities' 2022 WMP Update decisions, Energy Safety identified an ACI for all utilities to provide goals and timelines for implementing lessons learned from the CC joint effectiveness study. Specifically, Energy Safety ordered all utilities to:

- Provide a concrete list of goals with planned dates of implementation for any lessons learned in the CC effectiveness joint study.
- Provide a table indicating which WMP sections include changes (compared to its 2021 and 2022 Updates) as a result of the CC effectiveness joint study. This should include, but not be limited to:
    - Changes made to CC effectiveness calculations.
    - Changes made to initiative selection based on effectiveness and benchmarking across alternatives.
    - Inclusion of REFCL, OPD, EFD, and DFA as alternatives, including for PSPS considerations.
    - Changes made to cost impacts and drivers.
    - An update on data sharing across utilities on measured effectiveness of CC in-field and pilot results, including collective evaluation.

As described in the sections above, the utilities are sharing and documenting information and lessons learned, and are driving to understand if best practices, common methods, and greater comparability can be established. Where utilities have made improvements based on this working group, they are described in the sections above. Importantly, consistent with the 2022 WMP Update filings, while not an objective of the working group, the utilities anticipated that there could be lessons to learn from one another such as construction methods, engineering/planning, execution tactics, etc. that could help improve each utilities' deployment of CC. Since the final decisions on the utilities' 2022 WMP Update filings and as part of each workstream meeting, the utilities have discussed whether or not there are lessons learned and if so, documented these and any plans the utilities have to implement those lessons. In the limited time the utilities have had in 2022 to meet this requirement, we have documented a few lessons learned; however, it is important to note that each utilities' CC program (the initial focus of this effort) had been previously established and was based on past benchmarking, research, testing, and lessons learned from other utilities including SCE (see, e.g. the Covered Conductor Compendium), i.e., many lessons learned were already incorporated into each utilities' CC program. Notwithstanding this, and considering the expansion of this working group, the utilities are committed to documenting lessons learned and plans to implement them.

Lessons Learned:
The utilities agree that it is helpful to share information, practices, and data across the utilities as this can lead to improvements in reducing wildfire risk, safety incidents, and the impacts of PSPS, and improvements with other utility objectives. In furtherance of this objective, and given that a simple table cannot provide the information in a readable format with the ACI requirements, the utilities describe their lessons learned for this working group by the required subject areas.

<u>CC Effectiveness Values</u>
Pursuant to the testing results and further analysis, SCE and PG&E modified their estimated effectiveness values for certain risk drivers since its 2022 WMP Update submissions and have implemented these changes. SDG&E refreshed its effectiveness analysis per previous methodology but have not yet incorporated the updated value in its decision making. SDG&E anticipates completing this by December 2023. Based on the other utilities' previous estimates, the testing results, and their own data, no changes to CC effectiveness values were warranted at this time. These changes are described above in the Estimated Effectiveness workstream. The changes to effectiveness values have and are being incorporated into RSE calculations which in turn will feed into the utilities' decision-making processes. These updated RSE calculations will also be incorporated into utilities' future filings such as RAMP, GRC, and as applicable the WMP. If additional changes are made to effectiveness values, the utilities will document those lessons learned.

<u>Data Sharing</u>
An update on data sharing across utilities on measured effectiveness of CC in-field and pilot results, including collective evaluation. The utilities have and continue to share information across all workstreams. During 2022, utilities provided updates on recorded effectiveness. These included presentations and overviews on data, dashboards, and areas of continued improvement. The utilities also discussed their CC efforts including any pilots and shared these experiences.

<u>Inclusion of REFCL, OPD, EFD, and DFA as alternatives, including for PSPS considerations</u>
As described in the New Technologies section of this report, the utilities will discuss and document data and methods that can be used to estimate the effectiveness of these technologies. This workstream is new and the utilities have identified a series of workshops to develop this workstream. To date, the utilities have not documented any lessons learned or changes from 2021 or 2022 for inclusion of new technologies.

<u>Cost Impacts and Drivers</u>
As described in the Cost section of this report, the utilities have provided an updated CC capital cost per circuit mile and document the cost changes and drivers. As explained in last year's report, each CC project is unique and will have different costs. Additionally, there are many factors that can increase costs including, for example, economies of scale, the mix of work across regions and differing terrain, contractor rates, permitting, resource constraints, and environmental restrictions. In 2022, the utilities provided updates with one another on these costs through presentations and overviews including trends, material price changes, and other cost-related information. Please see the Cost section in this report for further details the changes in cost impacts and drivers from last year's report.

<u>Changes made to initiative selection based on effectiveness and benchmarking across alternatives.</u>
The utilities have not made changes to initiative selection based on this joint IOU effort. The data and

information compiled has confirmed the utilities understanding that CC is effective at reducing wildfire risk and highly effective at reducing most contact from object and wire-to-wire risk drivers. The testing has also shown CC is effective at reducing other risk drivers as well. Should one or more utilities make changes to initiative selection as a result of this effort, we will document those lessons learned as well as plans to implement them.

Next Steps:
In 2023, the utilities will document all lessons learned across all workstreams and will develop plans to implement those lessons learned, as applicable.

Conclusion:
This joint IOU report provides descriptions of the progress the utilities have made to better understand the long-term effectiveness of CC and its ability to reduce wildfire risk and PSPS impacts (and, in comparison to alternatives) as well as CC M&I practices, new technologies, and lessons learned. The utilities have made progress on this effort and describe plans for 2023 to conduct a large number of workshops to further understand the data and analyses that have been compiled, identify best practices for CC M&I, assess new technology effectiveness and the sharing of practice and implementation strategies, and discuss methodologies that can be employed across all utilities to improve comparability. The utilities look forward to continuing these efforts in 2023 and providing future updates.

Appendix G
Liberty's 2023 AFN Plan

Liberty Utilities (CalPeco Electric) LLC (U 933-E)

Liberty's Plan to Support Populations with Access and Functional Needs ("AFN") During PSPS

January 31, 2023

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EXECUTIVE SUMMARY

During extreme weather conditions, utilities may temporarily turn off power to specific areas to protect the safety of their customers and communities, enacting a Public Safety Power Shutoff (PSPS). To support individuals with access and functional needs ("AFN") during a PSPS, each of the joint investor-owned utilities ("IOUs")[1] developed its respective 2023 AFN PSPS Plan ("AFN Plan" or "Plan") with assistance from regional and statewide AFN stakeholders representing a broad spectrum of expertise. In 2023, this Plan leverages Federal Emergency Management Administration's ("FEMA") Developing and Maintaining Emergency Operations Plans Comprehensive Preparedness Guide ("CPG") 101 6 Step Process.[2]

The IOUs have established a partnership and have committed to continuing to work closely with the AFN Collaborative Council[3] and the AFN Core Planning Team[4] to seek guidance and address the "why," "who," "what," and "how" to support individuals with AFN before, during, and after a PSPS to mitigate risk.

Liberty acknowledges and gives sincere thanks to the AFN Collaborative Council, Joint IOUs, and AFN Core Planning Team for their guidance and commitment in development of the 2023 AFN Plan template.

WHY

As climate conditions change, wildfires have become a year-round threat. When wildfire conditions present a safety risk to their customers and communities, electric utilities may execute a PSPS as a measure of last resort.

A PSPS, although necessary, disrupts the everyday lives of impacted individuals, including those with AFN. The purpose of this Plan is to mitigate the impact of PSPS on individuals with AFN.

WHO

The Joint IOU Statewide AFN Advisory Council[5] and AFN Core Planning Team developed a definition of Electricity Dependent individuals[6] that this Plan seeks to support. That definition remains unchanged from 2022.

Electricity Dependent Definition: Individuals who are at an increased risk of harm to their health, safety, and independence during a Public Safety Power Shutoff for reasons including, but not limited to:

- Medical and non-medical

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1 San Diego Gas & Electric (SDG&E), Southern California Edison (SCE), and Pacific Gas & Electric Company (PG&E).

2 For details on how to develop and maintain Emergency Operations Plans, visit: [Developing and Maintaining Emergency Operations Plans Comprehensive Preparedness Guide (fema.gov).]

3 See Appendix [A] for members of the AFN Collaborative Council.

4 See Appendix [B] for members of the AFN Core Planning Team.

5 Please see Appendix B for a list of the members of the Joint IOU Statewide AFN Advisory Council.

6 IOUs will strive to implement this proposed definition contingent on operational feasibility and in alignment with AFN identification requirements with the CPUC's PSPS decisions. See e.g., D.21-06-034, pp. A8 – A9; D.20-05-051, p. A8; D.19-05-042, pp. A12-A14, A20-A21. The IOUs will continue to collaborate with AFN stakeholders to refine this definition as appropriate.

- Behavioral, mental, and emotional health
- Mobility and movement
- Communication

Liberty has made progress in identifying the individuals with AFN across its service territory, identifying 6,288 customers through collaborative outreach with local community-based organizations (CBOs), focusing on program enrollment (CARE, Medical Baseline), and promoting self-identification. Liberty will continue these efforts in 2023.

WHAT and HOW

Through participation in the AFN Collaborative Council and AFN Core Planning Team, Liberty stays informed of the various IOUs' goals, objectives, and potential opportunities for enhancements in 2023. Liberty learns from feedback and best practices shared by other IOUs. The overarching goal is to mitigate impacts of a PSPS on individuals with AFN served by the IOUs through improved customer outreach, education, assistance programs, and services.

INTRODUCTION

In accordance with the California Public Utilities Commission ("Commission" or "CPUC") Decision ("D.") 21-06-034 Phase 3 OIR Decision Guidelines, and leveraging Federal Emergency Management Administration's Developing and Maintaining Emergency Operations Plans Comprehensive Preparedness Guide, the Joint IOUs worked collaboratively with the AFN Core Planning Team to implement the "Whole Community" approach to develop an overarching Joint IOU Statewide strategy to meet the diverse needs of individuals with AFN.

The California IOUs will file their respective 2023 AFN Plans with the CPUC by January 31, detailing their programs to support people and communities with AFN before, during and after a PSPS. Each IOU will also provide the CPUC with quarterly updates regarding progress toward meeting established objectives and the impact of efforts to address this population before, during and after a PSPS, while optimizing opportunities for consistency where possible. Liberty will work throughout the year to engage local AFN stakeholders and share applicable information about Liberty's available programs and services.

1.1 Subject Matter Experts (Engage the Whole Community)

According to FEMA Step 1: Engaging the Whole Community in the Planning. Engaging in community-based planning—planning that is for the whole community and involves the whole community—is crucial to the success of any plan.

On September 14, 2022, the IOUs introduced this effort at the broader Q3 Joint IOU Statewide AFN Advisory Council meeting, invited participation, and subsequently held a kick-off meeting with Core Planning Team members on October 14, 2022. The 2023 AFN Core Planning Team is comprised of 13 organizations representing the diverse needs of the AFN community.

Joint IOUs	San Diego Gas & Electric
	Southern California Edison (SCE)
	Pacific Gas & Electric (PG&E)
AFN Collaborative Council (per the Phase 3 OIR PSPS Decision):	California Foundation for Independent Living Centers (CFILC)
	California Health & Human Services (CHHS)
	California Office of Emergency Services (Cal OES)
	Disability Rights California (DRC)
	Disability Rights Education & Defense Fund (DREDF)
	State Council on Developmental Disabilities (SCDD)
AFN Core Planning Team	American Red Cross
	Bear Valley Electric Service, Inc.
	California Department of Developmental Services (CDDS)
	California Foundation for Independent Living Centers (CFILC)

	Center for Accessible Technology (C4AT)
	Deaf Link, Inc.
	Disability Action Center (DAC)
	Disability Policy Consultant
	Interface Children & Family Services 211
	Liberty
	North Los Angeles Regional Center (NLACRC)
	Redwood Coast Regional Center (RCRC)
	San Diego Regional Center (SDRC)

As a key component of engaging the whole community in planning, the IOUs will continue to solicit feedback from the AFN Collaborative Council, the Joint IOU Statewide AFN Advisory Council, each utility's Regional PSPS Working Group[7] and other regional and statewide AFN experts such as community-based organizations, healthcare partners, and durable medical equipment providers. These groups serve as a sounding board and offer insight, feedback, and input on the IOUs' customer strategy, programs, and priorities. Regular meetings identify issues, opportunities and challenges related to the IOUs' ability to mitigate the impacts of wildfire safety strategies, namely PSPS. Liberty attends the AFN Collaborative Council and Joint IOU Statewide AFN Advisory Council meetings to remain informed of AFN expert feedback and learn from IOU best practices.

1.2 PURPOSE, SCOPE, SITUATION OVERVIEW, AND ASSUMPTIONS

1.2.1 Purpose/Background - WHY

During extreme weather or wildfire conditions, electric utilities may proactively turn off power for public safety as a measure of last resort. While PSPS events disrupt the lives of customers, the purpose of Liberty's plan is to mitigate the impacts on AFN customers through improved customer outreach, education, assistance programs and services.

Liberty looks forward to further development of its AFN plan throughout 2023 and will focus on building foundational connections and expanding existing networks within its communities to improve awareness and support of AFN needs. After progress in 2022, Liberty continues to leverage local resources and establish relationships to support the AFN population throughout its service territory and will make informed improvements through observing practices of the larger IOUs and agencies.

Liberty continues to seek improvement in data collection and analysis despite its information systems' limitations. Liberty completed improvements to its customer information system to record additional AFN categories of customers and is working to improve its outage management system

[7] These working groups convene at least quarterly to share lessons between the impacted communities and the IOUs per D.20-05-051.

integration. System improvements have been a significant area of focus since 2021 and are expected to continue through the proposed enterprise-wide Customer First project implementation in 2023.

1.2.2 Scope - WHO

The Joint IOUs, Liberty and the CPUC recognize the definition of AFN as defined by the California Government Code §8593.3: "individuals who have developmental disabilities, physical disabilities, chronic conditions, injuries, limited English proficiencies, who are non-English speakers, older adults, children, people living in institutional settings, or those who are low income, homeless, or transportation disadvantaged, including but not limited to, those who are dependent on public transit and those who are pregnant."[8]

Acknowledging that the California Government code definition of AFN is broad, the CPUC authorized the IOUs to follow the FEMA 6 Step Process by engaging the whole community through the Joint IOU Statewide AFN Advisory Council to create a common definition of "Electricity Dependent."

Therefore, the IOUs use this common definition to help inform new enhancements to programs and resources that are currently available.

Electricity Dependent: Individuals who are at an increased risk of harm to their health, safety and independence during a Public Safety Power Shutoff, for reasons including, but not limited to:

- Medical and non-medical
- Behavioral, mental, and emotional health
- Mobility and movement
- Communication

Examples of Electricity Dependent include, but are not limited to:

- **Medical and non-medical:**
  - Respiratory equipment: oxygen, respirator, inhalation therapy, apnea monitoring, suction, machines, airway clearance, airway clearances, vests, cough assistive devices, hemodialysis
  - Nutritional equipment: gastric feed tube, specialized diet meal preparation equipment (*e.g.*, feeding pumps, blenders)
  - Heating/cooling equipment: refrigeration, body temperature regulation
- **Behavioral, mental, and emotional health:**
  - Powered equipment supporting regulation of emotional behaviors (*e.g.*, sensory lights)
- **Mobility and movement:**
  - Positioning equipment: lift, mobility tracking system, power wheelchairs, in-home chair lift, electric beds
- **Communication:**
  - Augmentative communication devices (*e.g.*, tablets, wearables, eye gaze), alert systems
  - Powered equipment for hearing or vision support

8 D. 19-05-042.

1.2.3 Situational Overview

According to FEMA Step 2: Understand the Situation. Understanding the consequences of a potential incident requires gathering information about the potential AFN of residents within the community.

"Understand the situation" continues with identifying risks and hazards. This assessment helps a planning team decide what hazards or threats merit special attention, what actions must be planned for, and what resources are likely needed.

The Core Planning Team in 2022 identified a key risk of PSPS that continues in 2023:

- Individuals with AFN are unable to use power for devices or equipment for health, safety, and independence due to a PSPS.

During the planning process, the AFN Core Planning Team emphasized that the needs of individuals with AFN extend well beyond medical devices alone and that the risks are as diverse as the population. Liberty recognizes the impacts of PSPS are dynamic and is committed to supporting customers before, during, and after a PSPS.

1.2.3.1 AFN Population and Identification

Liberty has made progress in identifying AFN individuals through collaborative outreach with local CBOs, focusing on program enrollment (CARE, Medical Baseline), and promoting self-identification. Liberty identifies the following customers as AFN:

- Customers enrolled in the following programs:
  - California Alternate Rates for Energy ("CARE")
  - Medical baseline ("MBL"),[9] including life-support
- Older adults
- Customers who self-identify

Figure 1 below accounts for the number of customers identified as AFN in Liberty's service area.

[9] Per D. 21-06-034, identification efforts include "persons reliant on electricity to maintain necessary life functions including for durable medical equipment as assistive technology." *Id.* at pp. A8-A9.

Figure 1. Joint IOU Access & Functional Needs Individuals[10]

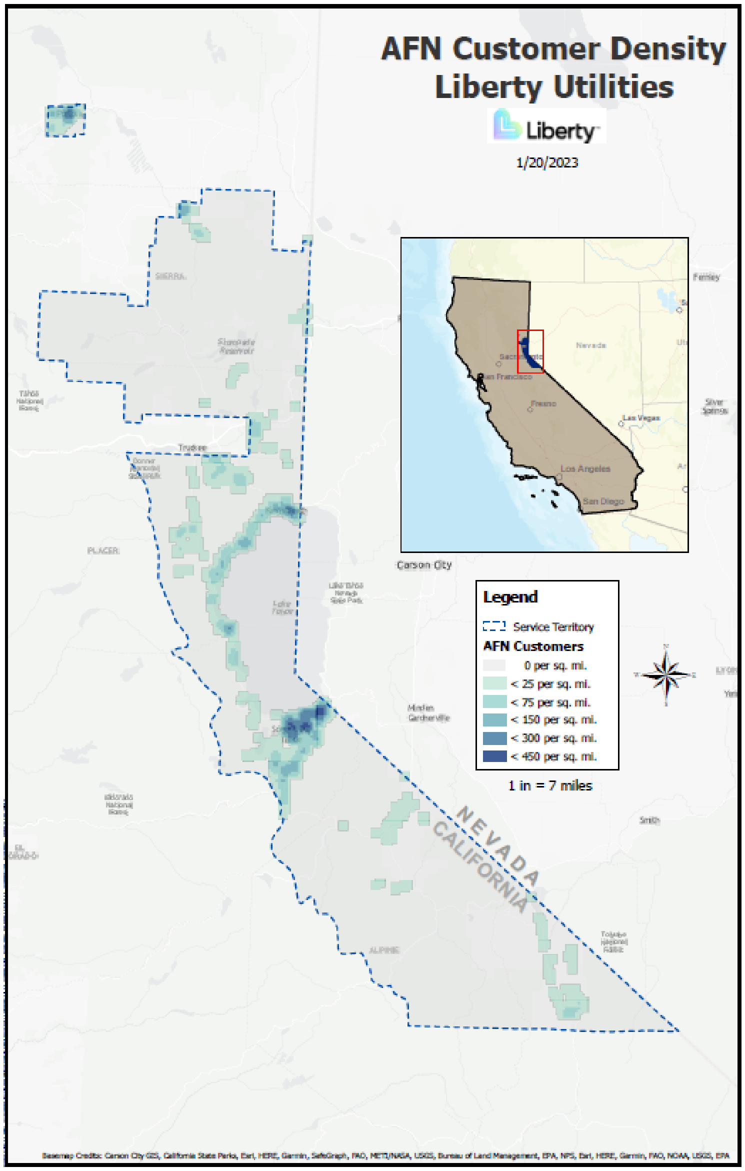
	MBL Individuals	Individuals Identified as AFN (Beyond MBL)	Percentage of Individuals Identified as AFN based of Total Residential Customer Base*
Liberty	**Total:** 185	**Total:** 6,103	14%

* Percentages are approximate.

Liberty developed an AFN density map, shown in Figure 4 below, which allows quick identification of geographical areas that have larger populations of AFN individuals. These maps enable Liberty to strategize geographical resource allocations, such as staffing of customer resource centers for customers experiencing a PSPS.

10 Data pulled in early January 2023. Total residential customer base utilized was 44,142.

Figure 2. Service Area Map of Customers with AFN



In 2023, Liberty will continue identifying Electricity Dependent individuals above and beyond those enrolled in the Medical Baseline Allowance Program, through direct outreach to customers in Liberty's service area and collaborative opportunities with local partners.

As data tracking continues to improve, Liberty will gain more visibility into the AFN customer population. Liberty established the ability to track AFN categories of customers beyond MBL in its CIS, including the following categorical identifiers:

- Customers enrolled in low-income programs;
- Customers with a physical, intellectual, or developmental disability;

- Customers with a chronic condition or injury;
- Customers identified with limited English proficiency;
- Customers in households with older adults/children; and
- Homeless/transportation-disadvantaged customers.

The first phase in integrating this functionality focused on identifying elderly and low-income customers. The data flow between Liberty's information systems poses challenges that Liberty continues to navigate to support this new functionality in providing accurate data.

As part of Liberty's recent and ongoing system improvements, improved ability to map AFN customers in its geographic information system ("GIS") was marked as an area of focus in 2022's AFN plan and has been implemented. This initiative has been ongoing since 2021, and Liberty's outage management system ("OMS") also increased visibility into AFN categorical identification of customers in 2022.

Customer Research and Surveys

In 2022, Liberty employed MDC Research to execute two surveys to measure the public's awareness of messaging related to wildfire preparedness and safety. Customers were surveyed at random, via phone or web. Surveys were conducted in English and Spanish.

Between June 13, 2022, and June 29, 2022, 324 customers completed surveys. Between November 3, 2022, and November 19, 2022, 325 customers completed surveys. Liberty added several questions to the Wildfire Messaging Awareness Survey regarding resource awareness and satisfaction in terms of AFN populations.

Notable customer survey findings include:

- Among those reporting that they rely on electricity for medical needs, 41% are aware of additional notices from Liberty.
- One percent of surveyed customers reported Spanish as their preferred language, and 97% of respondents stated it would not be helpful for them or somebody in their household to receive communications in another language.
- Liberty remains the primary source for wildfire preparedness information, and vegetation management and personal preparedness are the most common messages remembered.
- 60% of customers surveyed reported being aware of the ability to update contact information with Liberty, 75% of whom reported having done so.
- 38% of customers say they would first turn to the Liberty website for information about a PSPS event, and 87% of customers understand the following statement about PSPS: "for areas at a higher risk of fast-spreading catastrophic wildfires, the utility will proactively shut off power during extreme and dangerous weather."
- Outreach and engagement satisfaction results demonstrated trending increases in satisfaction overall, showing 43% of customers reporting being satisfied with the amount of information and outreach they received compared to 29% and 35% in 2021 pre-season and post-season surveys, respectively.
- Out of the 325 customer surveys in November 2022, 41% reported being satisfied with the amount of information and outreach received about "what to expect in the event of a PSPS" compared to 32% and 39% in 2021 surveys.

In addition to customer surveys, MDC Research conducted CBO interviews to request feedback and gather suggestions on the most effective approaches to PSPS communication within the community. Each survey included four completed CBO interviews.

Notable CBO interview findings include:

- CBOs expressed a willingness and ability to share Liberty PSPS preparedness information to the community during typical interactions, holding events, sharing online resources, through social media, and by handing out printed materials provided by Liberty.
- English and Spanish are the primary languages required for effective communication in the communities Liberty serves.
- CBOs reported regularly engaging with Liberty for general community engagement.

Additional survey information used to inform Liberty's 2023 approach in effectively reaching customers includes findings that email remains the most remembered channel for wildfire preparedness communication. According to survey results, Liberty's website is considered the clearest and most useful resource for information about wildfire preparedness. TV news and email remain the most common sources of PSPS communication, and mention of social media increased from 18% in June 2022 to 26% in November 2022.

In 2022, Liberty implemented additional survey content focused on AFN resources and awareness. Liberty plans to continue to explore the availability of existing resources and identification of gaps that may exist through further discussions and expansion of relationships with agencies, cities, counties, and local organizations.

Accessibility Webpage and Feedback

Liberty has improved the accessibility of its website. Improvements in 2021 include the addition of 211 resource information on the web, as well as development of a self-identification tool for AFN customers in both Spanish and English. Improvements in 2022 include Spanish translation enabled on the Liberty website and development of a series of videos describing actions to take before, during and after PSPS in Spanish.

Success Measures and Metrics

Liberty mentioned development of key performance indicators to measure impacts of PSPS in the 2022 AFN plan. These indicators include identifying the percentage of AFN individuals who were aware of what support and resources were available to them during PSPS and the percentage of AFN individuals who reported being satisfied with the level of utility communication regarding PSPS preparedness and event updates. Although Liberty did not enact a PSPS event in 2022, allowing for surveys of CRC attendees, AFN-specific questions were included in the pre-season and post-season WMP survey efforts to expand the utility's understanding of AFN awareness and effectiveness of communications.

Notable AFN-specific findings from the most recent survey included:

- 81% of customers can be considered as able to identify as AFN.
- 88% of AFN customers surveyed reported taking action to prevent or prepare for a wildfire.
- 70% of AFN customers reported awareness of wildfire safety communications, 43% of whom reported awareness of Liberty communications.

- 39% of AFN customers surveyed reported Liberty's website as the resource they would turn to for PSPS information.
- 45% of AFN customers reported being satisfied with availability of resource in community for wildfire safety information.
- 41% of AFN customers reported being aware of additional PSPS notices for those with medical need.
- 2% of AFN customers and 6% of non-AFN customers reported awareness of AFN self-identification in November 2022, compared to 4% and 7%, respectively, in June 2022.

Additional methods to gauge effectiveness in AFN support include monitoring self-identification tool utilization, as well as tracking AFN attendance at community resource center ("CRC") locations during PSPS events.

1.2.4 Planning Assumptions

- For most PSPS events, notification is provided in advance of the power shutoff.
- Effective support of individuals with AFN requires a whole community (*e.g.*, utilities, CBOs, non-profits organizations, government agencies) approach.
- PSPS may happen concurrently with unrelated emergencies (*e.g.*, active wildfires, cyber-attacks, technological hazard incidents).
- The scope of PSPS can increase or decrease as weather conditions are monitored across Liberty's service territory.

1.3 Operational Priorities - WHAT

According to FEMA Step 3: Operational priorities – specifying what the responding organizations are to accomplish to achieve a desired end-state for the operation.

The goal of the AFN Plan is to mitigate the impacts of a PSPS on Liberty's AFN customers through improved customer outreach, education, assistance programs and services. Key objectives for 2023 include:

- Identify individuals who identify as Access and Functional Needs.
- Execute communication plan that considers survey feedback on successes and areas of opportunity.
- Identify accessibility improvements in resources, tools, and communications.
- Cultivate new partnerships and expand existing partnerships with the whole community.
- Continue to investigate resources with state, community, utility to minimize duplication.
- Collaborate to support the needs of individuals with AFN before, during, and after any PSPS.

1.4 Plan Development

According to FEMA: Step 4: Plan Development Develop and Analyze Courses of Action – This step is a process of generating, comparing, and selecting possible solutions for achieving the goals and objectives identified in Step 3.

The IOUs have worked to deliver consistent services and resource offerings; however, the delivery and eligibility will likely be different by service area.

Goals identified to meet the key objectives for 2023:

Communications/Offerings

- Increase targeted communication to critical customers and AFN groups specifically in terms of wildfire preparedness information.
- Increase information sharing around available customer programs and resources, directly correlating the benefit of program enrollment in terms of PSPS communication and AFN identification.
- Continue to expand on information-sharing efforts with CBOs and local partners to reach AFN audiences.
- Consider feedback gathered in WMP pre-season and post-season survey waves to inform customer and partner communication approach.

Resources

- Continue to explore transportation and paratransit agency services throughout service territory and communication of available resources to customers. Continue to seek opportunities to offer support to avoid placing burden on local CBOs and/or CRC site hosts.
- Seek opportunities to increase accessibility and awareness of PSPS preparedness materials, workshops, and assistance program availability.

Metrics

- Increase tracking of customer journey and escalations during PSPS event through call centers and CRC locations.
- Integrate meaningful metrics into quarterly updates, *i.e.*, percentage of identified AFN customers, WMP survey results when available, and number of outreach events.

AFN Self-Identification

- Continue to improve efforts associated with identification of additional individuals who identify as AFN through a focus on program communication, internal awareness, and integration into business processes where possible.
- Explore collaboration opportunities to increase AFN self-identification with local partners (*e.g.*, healthcare providers, CBOs, collaborative outreach, etc.).

1.5 Plan Preparation and Review

According to FEMA Step 5: Plan Preparation, Review, and Approval – This step is a process of preparing the document and getting it ready for implementation.

In January 2023, the Joint IOUs provided members of the AFN Collaborative Council and AFN Core Planning Team a draft AFN plan for their review. As a result, each of the IOUs will file its respective 2023 AFN Plan with the CPUC by January 31, detailing its programs to support individuals and communities with AFN before, during, and after PSPS. Liberty maintains awareness of this process and considers feedback shared with the AFN Core Planning Team in the creation of the 2023 AFN Plan.

1.6 Plan Implementation

According to FEMA Step 6: Implement and Maintain the Plan – This step is the final step which is an ongoing process of training personnel to perform tasks identified in the plan, exercising, and evaluating plan effectiveness, and revising and maintaining the plan.

Upon filing the AFN plan, Liberty will implement new and maintain existing goals and objectives as specified in the Plan. Additionally, Liberty will provide quarterly updates on progress made.

1.7 Research and Surveys

In 2023, Liberty will continue conducting and/or participating in listening sessions and working groups with local governments, tribes, and critical facilities; webinars for customers and communities; wildfire and PSPS awareness studies; feedback via digital channels; PSPS table-top exercises; and notification message testing. For more information on customer surveys, please see section 2.3.

1.8 Success Measures and Metrics

In 2023, Liberty plans to use the Key Performance Indicators ("KPIs") that were developed with the AFN Core Planning Team for the 2022 AFN Plan. These KPIs seek to measure the impacts of PSPS on individuals with AFN, awareness of support programs, and satisfaction of services offered when a PSPS is enacted. Liberty looks to collect information on these key performance indicators through CRC attendees in the event Liberty enacts a PSPS event. Liberty has not enacted a PSPS event to date.

Key Performance Indicators:

1. The percentage of individuals with AFN who were aware of what support and resources were available to them during a PSPS.
2. The percentage of individuals with AFN who were able to use necessary medical equipment to maintain necessary life functions for the duration of any PSPS that affected them.
3. The percentage of individuals who utilized mitigation services who reported they were satisfied with the level of support.

While Section 1 is a high-level overview of Liberty's vision, the details of Liberty's AFN Plan can be found in Section 2. Liberty will continue to remain informed of IOU progress throughout the state and look to improve AFN support where services and partnerships are available.

2. CONCEPT OF OPERATIONS

2.1 Preparedness/Readiness (Before Power Shutoff)

2.1.1 AFN Identification Outreach

Liberty plans to execute AFN identification outreach through a variety of channels throughout 2023, including CBO outreach and targeted customer outreach to encourage AFN self-identification, customer program enrollment, and increased awareness of AFN resource availability. More information on customer preparedness outreach can be found in section 2.1.6.

2.1.2 AFN Support Resources

211 Care Coordination & Referral Service

Liberty has engaged 211 contacts and plans to continue collaboration throughout 2023. 211 offers support to residents in most counties Liberty serves, excluding residents in Sierra and Plumas Counties. Liberty implemented a webpage dedicated to 211 customer resource information during 2021. Liberty does not currently participate in 211 Care Coordination contracts; however, 211 partnership continues to be an area of further exploration in 2023 where available. In 2022, new relationships were established with Connecting Point in Nevada and

Placer Counties, resulting in 211 inclusion in tabletop exercises and an update of Liberty information to the 211 website.

Resource Planning and Partnerships

Throughout 2022, Liberty expanded CBO and agency partnerships in terms of AFN-specific outreach and inclusion in Liberty preparedness efforts. Liberty looks to further explore and expand partnerships throughout 2023.

Liberty investigated resources throughout the service territory to establish relationships with Meals on Wheels providers to provide funding for shelf stable food items to be distributed to Liberty clients, supporting PSPS preparedness. Liberty received positive responses and provided support in Markleeville, Coleville, North Lake Tahoe/Truckee, and Loyalton. Liberty plans to pursue this effort in 2023 and further expand network of Meals on Wheels contacts.

2.1.3 Back-Up Power

On February 11, 2022, Liberty filed an application for its Customer Resiliency Program ("CRP") with the Commission. The proposed CRP includes a behind-the-meter ("BTM") battery storage program that will be offered to Liberty's critical needs customers, including MBL, critical facilities, and large commercial ("A3") customers. The BTM program will be structured as a resiliency-as-a-service ("RaaS") in which customers pay a monthly fee to participate in the program. For MBL customers, Liberty will provide this service at a significantly lower rate ($10/month), and for MBL customers who also qualify for Liberty's low-income CARE rate, the RaaS will be free. Liberty will own and operate the battery systems.
In 2021, Liberty sent a survey to MBL customers, which yielded a 30% response rate and an overwhelmingly positive response to the CRP. The results indicated a small subset of medical baseline customers live in a multi-dwelling home, where an installed battery might not be feasible. Liberty plans to provide resources to these customers to assist with having their own portable system or another alternative solution.

2.1.4 Customer Assistance Programs

Medical Baseline Allowance Program

Liberty's MBL program provides an increase in the baseline allowance to qualified residential customers.

Liberty performs program outreach through bill inserts; radio, social media, and digital advertisements; community events; targeted outreach at mobile home parks and multi-family dwellings; and collaboration with CBOs.

Energy Saving Assistance ("ESA") Program

Liberty offers the ESA program to eligible income-qualified customers to provide energy-efficient home improvements at no cost to the customer.

Liberty performs program outreach through bill inserts; radio, social media, and digital advertisements; community events; targeted outreach at mobile home parks and multi-family dwellings; and collaboration with CBOs.

California Alternate Rates for Energy

Liberty offers a 20 percent CARE discount to qualified low-income primary residential customers who receive their energy directly from Liberty or through a sub-meter, such as in a mobile home park or an apartment complex.

Liberty performs program outreach through bill inserts; radio, social media, and digital advertisements; community events; targeted outreach at mobile home parks and multi-family dwellings; and collaboration with CBOs.

PSPS Offering Additions

In 2022, Liberty procured grocery gift cards to offer support to CARE or MBL customers in the event of an active PSPS through CRC locations and is also prepared to support alternative lodging for critical MBL customers as needs are communicated by community partners or MBL customers.

COVID / Financial Assistance

Liberty continued to assist residential customer by enrolling eligible customers in the COVID-19 relief payment plan to support the management of arrearages. Liberty will apply approximately $905,000 to 2,062 residential customers from the 2022 California Arrearages Payment Program.

Liberty has established new residential disconnection protections, which include capping the number of residential disconnections to 2%, eliminating residential security deposits and restoration feeds, and offering benefit programs and 12-month payment plans prior to disconnection.

2.1.5 Emergency Operations Centers

Emergency Operations Centers are in both the South Lake Tahoe and North Lake Tahoe offices. Liberty can manage events partially or fully via virtual Incident Command with paperless Incident Command System ("ICS") forms, job descriptions, event documentation, and electronic meeting venues. Staff members are trained to perform their roles in both formats.

Preparation Exercises

In preparation for wildfire season, Liberty will conduct a Public Safety Partner Workshop on March 23, 2023, a tabletop exercise on May 25, 2023, and a full-scale exercise on June 22, 2023. The full-scale exercise and the planning meetings leading up to the exercise will include Cal OES, CPUC, CAL FIRE, and OEIS, along with other public safety partners, including government, critical facilities, and the AFN community.

Training

Liberty employees receive annual Emergency Management Plan training. Instruction includes specific training on the roles and responsibilities of each functional area in support of the ICS. Emergency response exercises are executed annually, so employees gain practice in the use of the plan, as well as test the plan for effectiveness. Liberty also participates in regional exercises to train employees and exercise the Emergency Management Plan and will participate in emergency exercises and training with state and regional OES and county emergency offices.

Additional PSPS CRC Staff training was developed and implemented in 2022 for CRC Representative and CRC Lead positions. This training program provided a thorough overview of PSPS criteria, activation, and execution expectations for involved roles. Disability sensitivity content was integrated into the training program to support AFN individuals during a PSPS event.

2.1.6 PSPS Preparedness Outreach and Community Engagement

CBO Outreach

Liberty seeks opportunities to provide PSPS preparedness information through established CBOs throughout the year. Liberty sent out PSPS preparedness information, materials, and web resource information to CBO contacts via email on May 31, 2022. This effort was also used as an opportunity to update contact information for CBOs for notification during PSPS events. Liberty also continues to grow and expand CBO networks throughout its service territory, providing materials and resource information for CBOs to share with the communities they serve.

Liberty has held and participated in multiple outreach events to access AFN communities with Spanish-speaking support on-site through collaboration with local CBOs and partners. Liberty aims to expand CBO relationships throughout 2023 by continuing to share outreach opportunities for dissemination to clients and pursuing collaborative opportunities to reach AFN audiences. Liberty shares available resources and materials with organizations through in-person or virtual meetings and includes local CBOs in preparedness planning exercises.

Liberty also participates in community collaborative groups in both South and North Lake Tahoe with the goal of being an involved partner in community conversations, establish new connections, and provide applicable information on available assistance programs and PSPS preparedness information to local networks.

AFN Customer Outreach

Liberty executes customer outreach to share information about customer programs (CARE, ESA, MBL) and PSPS awareness through a variety of methods, including community events, website resources, social media, bill inserts, targeted outreach to multi-family dwellings and mobile home parks, radio ads (multicultural media), digital ads, print ads, and through call center staff. AFN identification and available resource communication will continue to be a focus in 2022.

As a result of customer and CBO 2022 Wildfire Outreach Surveys conducted by MDC Research on behalf of Liberty, areas of focus for 2022 include increased messaging regarding preparation of emergency kits and readiness. Suggestions provided by customer and CBO feedback highlight the effectiveness of increased use of email and local media and driving website traffic to existing PSPS information. More information on survey results and findings can be found in section 2.3.1.

Development of additional materials related to AFN self-identification and available resources was an area of focus for Liberty in 2022.

Customer recall increased significantly between the recent two wildfire outreach surveys in 2022 in terms of emergency services communications. Liberty will consider ways to further partner with local organizations and emergency services to reach customers more effectively.

Utilizing CBO networks and targeted customer program outreach, including multi-family housing, community events, and direct mailings, are an identified area of opportunity to expand customer communications in terms of AFN identification and increased customer awareness of available resources.

2022 outreach events included:

- March 10, 2022 – Liberty presented at the Mi Pueblo Outreach Event in South Lake Tahoe, targeting limited English proficiency AFN customers. Presentation topics focused on available customer assistance programs and PSPS awareness/preparedness education.
- March 19, 2022 – Liberty presented at the Walker General Store Outreach Event in Coleville*,* targeting a rural community with a significant elderly population. Presentation topics focused on available customer assistance programs and PSPS awareness/preparedness education.
- April 13, 2022 – Liberty presented at the Bijou Woods Outreach Event in South Lake Tahoe, targeting a multi-family housing community. Presentation topics focused on available customer assistance programs and PSPS awareness/preparedness education.
- May 11, 2022 – Liberty collaborated with a CBO that serves a variety of AFN customers at the Sierra Community House Health fair, targeting outreach for a limited English proficiency population. Outreach topics focused on available customer assistance programs and PSPS awareness/preparedness education.
- May 14, 2022 – Liberty attended Timberfest in Loyalton, a low-income area, targeting outreach for the elderly.
- June 6, 2022 – Liberty collaborated with a CBO that serves a variety of AFN customers at the Portola Wellness Center Outreach Event, targeting low-income customer outreach. Topics focused on available customer assistance programs and PSPS awareness/preparedness education.
- August 15, 2022 – Liberty presented at the Loyalton Senior Center to target elderly and low-income outreach. Presentation topics focused on available customer assistance and PSPS awareness and PSPS preparation education.
- August 20, 2022 – Liberty targeted low-income outreach at Tahoe Verde mobile home park, which was recently converted from a master-metered structure to individual meters. Outreach focused on available customer assistance programs and PSPS awareness/preparedness education.
- September 7, 2022 - Liberty presented information at a Hung-A-Lel-Ti community meeting in Markleeville, targeting tribal residents for outreach on customer assistance and PSPS awareness/preparation education.
- September 8, 2022 – Liberty participated in the Sierra Community House Backpack Giveaway in Kings Beach, a collaborative outreach event with CBOs and a variety of

additional assistance agencies, including Health and Human Services. Liberty outreach at this event targeted limited English proficiency populations.

- September 17, 2022 - Liberty attended The Veterans' Mini Stand Down in South Lake Tahoe, a collaborative event with other agencies hosted by the local American Legion to reach local veterans regarding available assistance programs.
- October 12, 2022 – Liberty attended the Sierra Community House Health Fair, a collaborative outreach event with CBOs and a variety of additional assistance agencies including Health and Human Services.
- October 14, 2022 – Liberty attended the Community Hub Fall Fest Outreach Event, a collaborative event with Local First 5 - El Dorado County and variety of other assistance agencies, including Health and Human Services. Outreach focused on available customer assistance programs and PSPS awareness/preparedness education.
- October 21, 2022 – Liberty attended in the Barton health fair, participating in collaborative outreach with a local healthcare provider and a variety of other agencies and CBOs to reach customers regarding available assistance. Outreach targeted limited English proficiency populations.
- November 18, 2022 – Liberty provided PSPS awareness/preparation education at the Coleville Senior Center, targeting elderly outreach.
- December 3, 2022 – Liberty participated in a Men's Health Seminar at a local Senior Center in South Lake Tahoe, targeting outreach on available customer assistance programs and PSPS awareness/preparedness education for AFN populations.

Tribal Engagement

Liberty maintains a working relationship with the Washoe tribal community, the only tribal community in Liberty's service territory. Liberty includes the Washoe Tribe as an essential public safety partner and has worked closely with tribal contacts regarding PSPS event preparation and the establishment of a CRC on tribal land during a potential PSPS event in September 2021. Liberty acknowledges the unique needs of tribal residents and will continue to develop a supportive relationship in 2023. Liberty presented directly to Hung-A-Lel-Ti community residents in 2022 to discuss PSPS preparedness information and available program assistance. Liberty also held an in-person meeting with local Washoe community supervisor to discuss the importance of electricity dependent customer awareness of the Medical Baseline Program, benefits of enrollment, and to provide applications for dissemination after discovering a low number of identified medical customers in the community that conflicted with previous conversations in terms of community needs.

Marketing and Communications

Liberty has developed the following communications outreach plan to notify AFN customers of pertinent PSPS status updates, including ongoing proactive education.

Liberty will continue to engage AFN customers throughout the year, and especially during wildfire season, to educate them on the PSPS determination and notification process and how customers can prepare for prolonged de-energization through the following channels:

- Community meetings: Liberty will host and attend community meetings throughout its service territory to educate customers on the PSPS determination and notification process and preparing for PSPS events. When applicable, Liberty will co-host meetings with public safety partners and AFN advocacy groups.
- Toolkits: Liberty will distribute PSPS educational pamphlets, flyers, and checklists in accessible formats. Toolkit information is available in English, Spanish, French, German, Chinese, Vietnamese, and Tagalog.
- Website: Liberty will publish and maintain PSPS web copy outlining Liberty's determination and notification process and detailing ways for customers to prepare for PSPS events, including information specific to AFN populations.
- Social media: Liberty will post content to Facebook and Twitter notifying customers of Liberty's PSPS determination and notification process.
- Customer email: Liberty will distribute an email notifying customers of Liberty's PSPS determination and notification process.
- Bill insert/mail: Liberty will distribute a bill insert/mailer notifying customers of Liberty's PSPS determination and notification process.

Throughout 2022, Liberty assessed and enhanced communication accessibility. Notable areas of focus during 2022 were additional Spanish language support and increasing AFN self-identification awareness. Liberty shared AFN self-identification information through bill inserts, emails, and direct mail in 2022, and developed paper versions of the AFN self-identification web forms for increased accessibility.

Translations

Liberty call centers provide customer access to bilingual (Spanish and English) customer service representatives. Call center representatives also have access to additional translation services, supporting customer communication in over 200 languages.

A notable improvement in 2022 was the implementation of Spanish language translation on Liberty's website and development of Spanish language PSPS preparedness videos.

2.1.7 Community Resource Centers

Liberty has established an internal working group comprised of representatives from a variety of departments including Emergency Management and Wildfire Mitigation to focus on CRC planning. The group meets regularly to develop plans, determine priorities, and execute required action for CRC preparedness in 2023. This internal group continues to develop a thorough approach to CRC execution and collaborates externally with community stakeholders.
Liberty plans to provide snacks, water, device charging ability, Wi-Fi, ADA-accessible restrooms, resource information, Liberty customer service staff (including bilingual representation when possible), portable cell phone chargers, and blankets at CRC locations. CRC locations present a unique opportunity for program enrollment, PSPS preparedness information sharing, and AFN identification. Liberty plans to provide information on CARE, ESA, and MBL programs at each CRC. PSPS toolkit information will be shared in English and Spanish at CRC locations.

Unique community needs have also been considered in CRC planning, including a water truck for agricultural areas. Ice delivery has also been included in the planning process, and both services were successfully executed during Liberty's potential PSPS event in September 2021. Liberty will continue to build relationships and solicit feedback and suggestions on community PSPS support from local organizations and customers. Refrigeration needs for medication are also considered in CRC planning based on feedback gathered from local CBOs.

Liberty has agreements with seven CRC locations throughout its service territory and is actively pursuing additional locations.

2.2 PSPS Activation (During –Emergency Operation Center activated)

MBL Customer Communication

To identify MBL customers for an event, Liberty identifies MBL customers with accounts in the potentially impacted PSPS zone. The MBL notification sequence is as follows:

1. Everbridge notification (providing text, email, and voice push notifications, with receipt verification capability)
2. If no positive contact, phone call to customer from customer service representative.
3. If no positive contact, physical site visit to the residence.
4. If no positive contact, door hanger notification left at the residence.

To contact MBL customers behind master-metered accounts, Liberty consults a list of master-metered locations to determine if these meters are in the PSPS de-energization zone. Each master meter has a database that provides behind-the-meter information. From this database, Liberty can identify MBL customers and what units they occupy. The communication steps utilized for MBL customer contact also apply to master-metered MBL customer contact.

PSPS Notifications

Liberty will notify AFN customers before, during, and after a PSPS through the following channels (posted and updated as needed):

Everbridge alerts: Liberty will distribute an alert through the Everbridge system notifying customers of the status of the PSPS. The Everbridge system consists of a three-part alert: first a text is sent, then an email, and lastly a call.

CBOs: Liberty will notify CBOs that serve AFN populations of the status of the PSPS and request that they distribute the alert to their contact list. CBOs may include:

- Homeless shelters
- Food banks
- Special needs programs

Critical facilities and infrastructure: Liberty will notify critical facilities and infrastructure of the status of the PSPS and request that they distribute the alert to their own AFN contact lists. Critical facilities and infrastructure include:

- Police stations

- Fire stations
- Emergency operations centers
- Schools
- Jails and prisons
- Public health departments
- Medical facilities, including hospitals, skilled nursing facilities, nursing homes, blood banks, health care facilities, dialysis centers, and hospice facilities
- Facilities associated with automobile, rail, and aviation transportation for civilian and military purposes
- Telecommunication companies

Website: Liberty will publish an alert to its customer-facing website notifying customers of the status of the PSPS. Microsites are made available in both English and Spanish during a PSPS event.

Social media: Liberty will post content to Facebook and Twitter notifying customers of the status of the PSPS.

Customer email: Liberty will distribute an email to AFN customers notifying them of the status of the PSPS. An enhancement in 2021 includes Spanish language messaging within PSPS customer emails.

News release and public service announcements: Liberty will distribute a news release and/or a public service announcement to local media outlets alerting customers of the status of the PSPS. In 2021, Liberty added multicultural media outlets to lists of media contacts utilized for PSPS notification.

Customer service representatives (CSR): Liberty will arm CSRs with information and resources for AFN customers during a PSPS.

Content intended for customers will be translated and disseminated in English and Spanish when possible.

2.3 Recovery (After - Power has been restored)

Customer Support/Notification

Liberty will continue to expand partnerships with local organizations to remain aware of customer needs before, during, and after PSPS events. Liberty will notify AFN customers after a PSPS through the same channels utilized during a PSPS event described in section 2.2. These channels include Everbridge alerts, communications to CBOs and critical facilities, updates to the Liberty website, posts on social media, customer emails, and news releases. Content intended for customers will be translated and disseminated in English and Spanish when possible.

After-Action Reviews and Reports

After-action reviews (AARs) with company leadership and the Incident Management Team are conducted after an exercise and/or event. Exercise and event AARs are documented in

Homeland Security Exercise and Evaluation Program (HSEEP) format. AARs include an improvement plan that assigns actions and tracks items needing improvement.

Customer Surveys

Liberty will continue its pre-season and post-season wildfire outreach survey efforts in 2023 to gather information about wildfire awareness and inform communications plans. Additionally, in the event of an active PSPS event, CRC attendance documentation will provide a means of surveying impacted customers and recording key performance metrics.

Conclusion

Liberty will continue look for opportunities to enhance outreach effectiveness and expand CBO networks across the service territory, such as informing partners of program changes, sharing accessibility improvements as applicable, and acting as a participative member of community outreach events. Liberty prioritizes identifying and engaging with AFN populations in its service area and will continue working with local governments, public safety organizations, tribal communities, representatives of AFN communities, and CBOs to communicate with AFN customers in compliance with guidelines in R.18-12-005.

Appendix A
Core Planning Team Participants

CORE PLANNING TEAM PARTICIPANTS

Name	Organization	Title
Kelly Brown	Interface Children & Family Services 2-1-1	Community Information Officer
Tracey Singh	American Red Cross	Pacific Division Disability Integration Advisor
Tawny Re	Bear Valley Electric Service, Inc.	Unknown
Chris Garbarini	California Department of Developmental Services (CDDS)	Unknown
Tamara Rodriguez	California Department of Developmental Services (CDDS)	Officer, Emergency Preparedness & Response
Dan Okenfuss	California Department of Developmental Services (CDDS)	Public Policy Manager
Dan Heller	Deaf Link, Inc.	President
Kay Chiodo	Deaf Link, Inc.	CEO
Carolyn Nava	Disability Action Center (DAC)	Executive Assistant
June Isaacson Kailes	Disability Policy Consultant	Disability Policy Consultant
Kate Marrone	Business and Community Development Manager	Liberty
Malorie Lanthier	North Los Angeles County Regional Center	IT Director
Fred Keplinger	Redwood Coast Regional Center	Emergency Management Coordinator
Tiffany Swan	San Diego Regional Center (SDRC)	Community Services Home and Community Based Services Specialist
Alexandra Green	The Center for Accessible Technology (C4AT)	Legal Counsel
Melissa Kasnitz	The Center for Accessible Technology (C4AT)	Legal Counsel

Appendix B
Collaborative Council Participants

COLLABORATIVE COUNCIL PARTICIPANTS

Name	Organization	Title
Paul Marconi	Bear Valley Electric Services	President & Treasurer
Roseana Portillo	Bear Valley Electric Services	Senior Policy Advisor
Sean Matlock	Bear Valley Electric Services	Emergency Resource Manager
Tawny Re	Bear Valley Electric Services	Unknown
Robert Hand	California Foundation for Independent Living Centers (CFILC)	Interim Executive Director
Vance Taylor	California Governor's Office of Emergency Services (Cal OES)	Chief, Office of Access and Functional Needs
Anne Kim	California Public Utilities Commission (CPUC)	Regulatory Analyst
James Cho	California Public Utilities Commission (CPUC)	Program Manager
Moustafa Abou-taleb	California Public Utilities Commission (CPUC)	Safety Policy Division
Andy Imparato	Disability Rights California (DRC)	Executive Director
Jordan Davis	Disability Rights California (DRC)	Attorney
Karen Mercado	Disability Rights California (DRC)	Senior Administrative Assistant
Susan Henderson	Disability Rights Education & Defense Fund (DREDF)	Executive Director
Edward Jackson	Liberty	President, California
Kate Marrone	Liberty	Business and Community Development Manager
Matthew McVee	PacifiCorp	Vice President, Regulatory Policy
Pooja Kishore	PacifiCorp	Renewable Compliance Officer
Aaron Carruthers	State Council on Developmental Disabilities (SCDD)	Executive Director
Brian Weisel	State Council on Developmental Disabilities (SCDD)	Legal Counsel