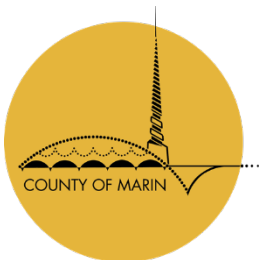# North Bay/North Coast
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Telecommunications Outage Report:

Northern California Firestorm 2017

A report on the telecommunications outages that affected Mendocino, Napa and Sonoma Counties in the wake of the devastating fires of 2017

Report Published: April 2018

Dedication

"This report is dedicated to the forty-four lives lost in the 2017 Northern California Wildfires and the many unnamed heroes whose bravery and action saved the lives of neighbors and total strangers."

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EXECUTIVE SUMMARY

Background

This report is based upon data collected from an on-line Telecommunications Outage Survey launched by the North Bay/North Coast Broadband Consortium (NBNCBC) in the aftermath of the 2017 Northern California wildfires.[1] The NBNCBC includes Marin, Mendocino, Napa, and Sonoma counties and is funded by a grant from the California Public Utilities Commission. The consortium is governed by an Oversight Committee consisting of Board of Supervisor members from each county. The stated purpose of the Telecommunications Outage Survey was "to assess and document the scope of the telecommunications outages that affected Mendocino, Napa and Sonoma Counties during the fires, both within and outside of burn areas."[2] The purpose of this report is to provide an overview on the state of services/infrastructure in the 3-county region and the impact any outages had on residents. There is no publicly available documentation of any previous telecommunications outages resulting from wildfires; thus, this report is the first of its kind and is intended to organize the survey data for future interpretation and analysis. Such documentation and data analysis form a critical component to ongoing efforts to secure reliable, diverse, and redundant telecommunications services and infrastructure in the wildfire impacted regions. This report will be shared with the California Public Utilities Commission, Federal Communications Commission, and elected federal, state, county, and local officials to advocate for policy, legislation, and decision making that can bring about positive change.

Telecommunications Outage Survey

The survey collected data on:[3]

- residential zip code location;
- details (if applicable) on any residential evacuation;
- power outages;
- landline, cellular, TV, and Internet telecommunication outages (includes provider info);
- length of time before services were restored;
- alternative sources/main sources of information during the crisis;
- impacts to residents on loss of such services including emotional response;
- level of understanding on technologies;
- personal stories;
- suggestions/comments for elected officials and the California Public Utilities Commission.

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[1] A copy of the survey is available to view here:
https://www.surveymonkey.com/r/Preview/?sm=UYik0OyWLAY3erFBPLvMwLnM8QGOPiV1IZw67FjvNgEGJehuIX9Ox4gcym8rKjJE
[2] While Marin County was not directly impacted by the 2017 wildfires, it is still a member of the NBNCBC and sponsors this report.
[3] The complete survey summary and survey methodology are detailed in Appendix A.

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The survey received 3,705 total responses from the three counties - 590 responses from Mendocino (16% of the total), 2,018 from Napa (54% of the total), 1,012 from Sonoma (27% of the total), and 85 from visitors in these counties at the time of the fire who reside elsewhere (2% of the total). Responses were received from 70 different zip code areas, or 83% of all zip codes in the 3-county area.

County	Loss of landline service for all zip codes in county	Loss of cellular service for all zip codes in county	Loss of internet service for all zip codes in county	Average of all three communications technologies service loss
Mendocino	66%	75%	54%	65%
Napa	67%	87%	73%	76%
Sonoma	64%	59%	70%	64%
3-county Total	66%	78%	69%	71%

Figure 1: Percentages represent the percent of all respondents who reported losing some to all service of their services. See the full data chart in Appendix B for all individual zip code data

Results show that in the 3-county area, 66% of residents lost landline services, 74% of residents lost cellular services, and 66% of residents lost Internet services with Napa County experiencing the most severe impacts. The 3-county average of service loss for these combined technologies is 71%. Many of these outages impacted residents that were geographically far from the actual burn areas.

Key Findings and Recommendations

A list of key findings and recommendations for telecommunications actions is included below. These recommendations are directed towards state agencies and officials, county agencies and officials, and last but not least, residents. Because this report is the first of its kind, next step recommendations have been provided to stimulate actions to find the most effective means to interpret this report. These recommendations vary, but are all a "piece of the puzzle" to securing a diverse and well designed telecommunications system.

State and CPUC

1.) Gaps in federal legislation for rural vs. urban telecommunications outage reporting

Key Finding:
The FCC administers all telecommunications outages data reported by providers. In order for the outage to be required to be reported, it must cross one of several thresholds for it to be

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considered an outage. Unfortunately, those outage thresholds do not uniformly apply the same to rural areas as they do to urban areas, leaving many rural outages to be unreported and unresolved and still subject to future telecommunications outages. Local public safety officials must be notified in "real-time" of these outages so that they can fulfill their public safety responsibilities.

Recommendation: Using the FCC's Network Outage Reporting System (NORS) framework, establish a California system with reporting thresholds that are efficiently tailored to include and account for all geographic regions in California and the demographics within each region. In addition, local public safety officials must be immediately notified of all telecommunications outages so they can fulfill their public safety responsibilities.

2.) **Lack of required reporting for telecommunications outages that occur as a result of a catastrophic disaster**

Key Finding:

Following a catastrophic disaster, federal legislation does not require a provider to report any telecommunications outages its network may have incurred as a result of the disaster, but instead, requests voluntary reporting to be made. Since the reporting is voluntary, data that are pivotal to public safety preparation for future disasters are not collected as often as they would be in the FCC's NORS.

Recommendation: Using the FCC's Disaster Information Reporting System (DIRS) framework, establish a California system that mandatorily requires providers to report any telecommunications outage their networks may incur as a result of a disaster or catastrophic event.

3.) **No state organized committee addressing redundant/resilient telecommunications planning for wildfires**

Key Finding:

There is a federal Network Reliability Steering Committee[4] that is comprised of,

> *"A key set of industry advisors on the health of the nation's communications networks. NRSC provides timely consensus-based technical and operational expert guidance and best practices to all segments of the public communications industry. Employing a proactive approach, it collaborates and holds quarterly public meetings with the FCC*

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4 http://www.atis.org/01_committ_forums/nrsc/

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and provides information to help minimize the number of agency rule-makings and mandates."(ATIS 2018)

Unfortunately, there is no state involvement in the process, creating concern that the federal committee may not be fulfilling California's needs by being time effective in addressing issues specifically in correlation to wildfire related telecommunications outages and finding best practices for time sensitive telecommunications planning.

> **Recommendation:** The CPUC should create a CA state administered Network Reliability Committee dedicated to finding redundant and resilient solutions and best practices for telecommunications networks that are suitable in every topographic region and helps prepare for future wildfires and other disasters. It is recommended to include members from both public and private bodies for diversity and to omit any special interests that could occur if the committee members were dominated by a specific sector or organization.

County Officials and Agencies

Key Finding:

It is evident there is not enough public attention or awareness directed towards telecommunications issues in the affected counties. There is a need in all public sectors for better telecommunications services. The communities view modernized telecommunications services as a necessity, similar to a utility. In regards to public safety, there is an immediate need for more reliable services during a disaster. Telecommunications is under very minimal public control; and, because telecommunications services failed during the 2017 wildfires and because public safety is highly dependent upon adequate telecommunications service, local action is necessary and highly recommended.

Below is a list of recommendations for actionable items all counties should consider taking to improve local control over their telecommunications networks. The intentions for these recommendations are not only to develop telecommunications for public safety reasons, but in all other economic sectors as well.

Recommendations:
1. Continue to encourage investment in telecommunications infrastructure - both private and public, to address and close the "Digital Divide".[5]
2. Develop a broadband strategic plan for each county with input from all stakeholders.
3. Increase education among communities on telecommunications related topics and events by improving communications through public meetings, regular BoS updates, etc.

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5 Digital divide: the gulf between those who have ready access to computers and the Internet, and those who do not.

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4. Elicit transparency and sharing of information between public safety officials and telecommunications providers.
5. Inventory and map all telecommunications infrastructure in county, including fiber routes and secured/unsecured fiber.
6. Find effective and strategic ways to protect telecommunications infrastructure in areas where possible and necessary (e.g. undergrounding, joint-trenching, etc.).
7. Review internal processes for all telecommunications related procedures and identify more efficient solutions to effectively deploy broadband through the counties - everything to help remove barriers and deploy more networks (dig-once policies, streamlined permitting, etc).
8. Coordinate efforts between public officials and regulatory agencies (CPUC, FCC) to solve major issues. Counties should participate in relevant CPUC and FCC proceedings.
9. Promote research dedicated towards identifying solutions for issues that equally address public and private telecommunications needs, utilizing existing data from this report and other sources, to assist research.
10. Explore all options to create a well-designed system that is redundant/resilient and properly prepares for future disasters (e.g emergency satellite backup on cell towers for basic functionality, cell tower roaming agreements; vegetation management; backup generators; etc.)
11. Form Public Private Partnerships between counties/local governments and providers/ILECs to coordinate goals and pursuits.
12. Improve public emergency training using all available communications devices and technologies (survey discovered ham radio operators were important during wildfires).
13. Require all public agencies to provide access to agency mailing lists for other public agencies to conduct disaster recovery related research, data collection, surveys, etc.[6]
14. Subsidize IoT research directed towards public safety and wildfire prevention.

Residents

Key Finding:

For the same reasons above, there is a high demand from county residents for improved telecommunications services. Residents are focused on finding solutions to better prepare for the next disaster, and fortunately, residents can play a significant role in helping improve local telecommunications governance. For example, the work conducted in this report derived primarily from public participation and wouldn't have been possible without the amount of responses received. Moving forward, residential participation is required to effectively spread awareness and more rapidly prepare communities for the next disaster.

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[6] Napa County utilized the public library patron list to distribute the Telecommunications Outage Survey and received nearly 1,000 responses in two days, eventually receiving over 2,000 responses total. Sonoma County attempted to do the same, but were unable to because of library policies directed against mass emailing patrons.

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During the 2017 wildfires, there were no forms of communications or technologies that worked better than the rest. Each method used for emergency notification played a crucial role in preparing residents for disaster. Technologies used by residents varied from many conventional methods to many non-conventional forms of communications. Regardless of the ways residents were notified, collectively the different methods played a major role in saving lives.

Below is a list of many recommendable ways residents can better prepare themselves, as well as help their community create a well-designed telecommunications network and improve other communications systems. It is recommended for residents to pursue each item on the list.

Recommendations:
1. Contact your provider and educate yourself about your communications technology. Ask them about redundancy and back-up options. Support providers who offer redundancy.
2. Prepare yourself as much as possible for future disasters by contacting local public safety for information. Explore various communications education and training; like the American Radio Relay League's (**ARRL**) Ham radio training and local groups such as MCARCS and MendoRadio.
3. Identify and adopt a diversity of forms of communications at home. Residents should not rely singularly on one method of communications, as not all are reliable; however, by diversifying methods, residents can increase the probability of being notified in the event of another catastrophic disaster.
4. Sign up for ALL alerts for which you can (e.g. Nixle, reverse 9-1-1, etc.).
5. Maintain a basic service wired landline phone if you are able. Although there is no guarantee it will work during a power outage, it could increase the chance of you getting notified of an emergency.
6. Maintain battery back-ups for VoIP and include a mobile charger and plug-in charger for cellular phones in your evacuation kit.
7. Have a portable radio and/or scanner with extra batteries.
8. Cooperate/help with finding solutions to major telecommunication issues (e.g. report unsafe conditions, allowing tree trimmers on property, pay attention to broadband-related legislation, etc.)
9. Identify and report unserved areas and communities requiring better broadband services to local agencies. This includes speed testing through the CPUC's CalSPEED software, available for free download on Android, iOS, PC, or Mac.
10. Research and adopt IoT devices that support at home public safety features and emergency management, such as, smart smoke detectors, listeners, smart batteries.[7]
11. Coordinate neighbors and establish a community governed notification system for emergencies. Get to know your neighbors and create community plans.

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[7] https://www.cnet.com/news/smart-smoke-detector-buying-guide/

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12. For any unserved communities, coordinate with neighbors to find solutions to extend Internet services to the community, utilizing public grants and services or private investment.

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INTRODUCTION

October 2017 Wildfires

The evening of October 8th began with five (5) concurrent wildfire events that would traumatize residents across Northern California as never before. Three of the four counties in the North Bay/North Coast Broadband Consortium (NBNCBC) (Mendocino, Napa, and Sonoma) were included in the widespread conflagration, with all three counties being issued Emergency Proclamations by Governor Brown and declared Adversely Affected by the Federal Emergency Management Agency (FEMA). In the 3-county area, 198,867 acres were burned by five fires[8] and impacted 20,402 households and 50,458 residents within the fire perimeters. In addition, 7,983 structures were reported destroyed and 619 severely damaged.[9]
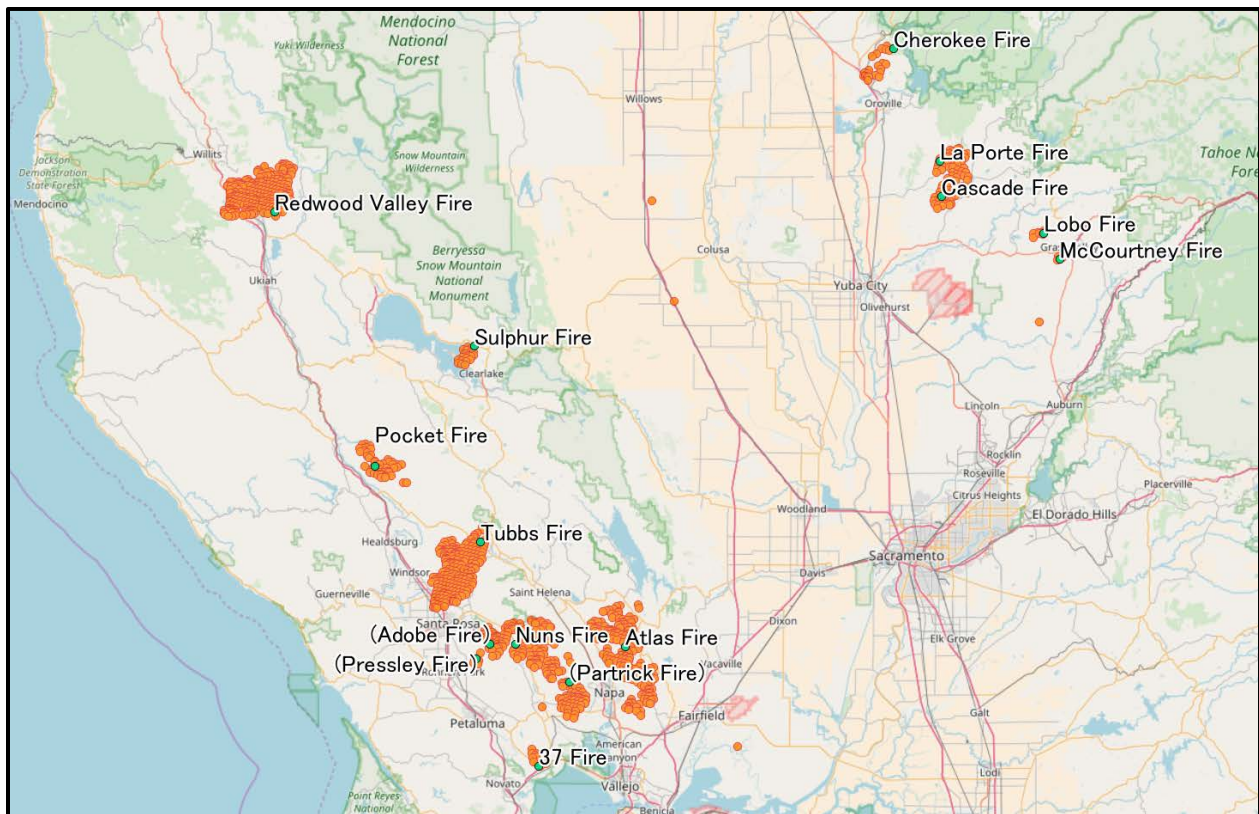
Figure 2: A map including all 2017 wildfires in the NBNCBC region (Source: 2017 Statewide Fire Map)

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[8] The Mendocino Lake Complex (36,523 acres); Pocket Fire in Sonoma (17,357 acres); the Tubbs fire in Sonoma and Napa (36,807 acres), the Nunns fire in Sonoma and Napa (56,556 acres which also included five other fires-Adobe, Norrbom, Pressley, Patrick, and Oakmont); and the Atlas Fire in Napa (and Solano) County (51,624 acres).
[9] See Appendix C for North Bay Fires 2017 statistics.

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Wildfire Impact on Telecommunications

In addition to the widespread damage, lives lost, homes destroyed, businesses ruined and infrastructure burned, these counties experienced regional telecommunication outages which left many residents both near and far from the fire zones at a loss for critical fire information, often leading to distress and panic. In the entire 2017 Northern California wildfires' footprint, it is estimated that 160,000 wireline and 85,000 wireless customers lost service, including 11-15 Public Safety Answering points losing service. Over 340 cell sites were completely destroyed or damaged.[10]

During a disaster of this magnitude, any communications disruption has serious implications. The telecommunications outages affected residents in various ways that were all individually disconcerting for the public; but during evacuation, not having the ability to communicate or determine whether they or their loved ones were in harm's way was a priority issue.

Response to Wildfire and Recovery Efforts

The 2017 Northern California wildfires have had an impact statewide, causing public officials to race against time to find redundant and resilient solutions that can better prepare us for future disasters. This outage report and outage survey data can provide valuable information to public safety officials, elected representatives, the California Public Utilities Commission (CPUC), telecommunication providers, and the public on many aspects of this disaster as it unfolded. All efforts pursued by the NBNCBC, including the documentation of telecommunications outages, are intended to focus on finding solutions to major issues in California's telecommunications industry. While telecommunications is primarily a privately managed industry, public involvement is necessary to ensure the public's needs and safety are being incorporated into future planning efforts.

This report attempts to examine the extent and scope of this telecommunications outage, and to determine how far outside the actual fire zones telecommunications access and services were impacted. Content in the report is based upon data that were obtained from an online "outage survey" which became available to the public on October 25th, with the last response received on Dec. 12th (55 days). [11] All county residents were encouraged to take the survey, not just residents who were directly affected by the fires or in evacuation zones. Data from other sources, such as the Federal Communications Commission, the California Public Utilities Commission, and telecommunications providers are also incorporated into this report to provide context.

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[10] Verizon lost 100 sites; Sprint 55; T-Mobile 99; and AT&T 86. From the CPUC November 9, 2017 Report of Communication Carriers' Impact and Mitigations from October 2017 Fires by Karen Eckersley of the Communications Division. See Appendix D.

[11] The complete survey methodology and how results were analyzed can be found in Appendix A.

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NATIONAL AND NBNCBC HISTORY OF TELECOMMUNICATIONS OUTAGES

FCC Efforts

Telecommunications Outages are reported by providers and documented by the Federal Communications Commission (FCC). The data are analyzed by the FCC and delivered to a Network Reliability Steering Committee that provides industry best practices for redundant and resilient public safety networks. The purpose of collecting such data are explained in an article on the FCC website titled "Outage Reporting Systems"[12],

> *"Redundancy is one of the core concepts for public safety communications networks and it also contributes part and parcel to the resiliency - another core concept - of public safety networks, so that communications systems are always available to support the public safety user. This article addresses situations when communications fail. This includes situations where there are network failures that affect redundancy, but do not result in a loss of service to the end-user. It introduces the systems that are used by the Commission to document large scale outages and how these reports are used to form the basis for analysis of overall system performance. (Public Safety and Homeland Security)*

Both the FCC and the NBNCBC document telecommunications outages for a similar purpose and end goal - to create redundant, diverse and resilient public safety networks. While both agencies document the outages with similar reasoning, the difference between both efforts primarily lies in the accessibility of the telecommunications outage data after being reported, and also the reporting thresholds themselves.

According to the FCC,

> *NORS is the web-based filing system through which communications providers covered by the Part 4 reporting rules submit reports to the FCC....Accordingly, the FCC requires communications providers, including wireline, wireless, paging, cable, satellite VoIP and Signaling System 7 service providers to electronically report information about significant disruptions or outages to their communications systems that meet specified thresholds set forth in Part 4 of the FCC's rules (47 C.F.R. Part 4). Communications providers must also report information regarding communications disruptions affecting Enhanced 9-1-1 facilities and airports that meet the thresholds set forth in Part 4 of the FCC's rules. Given the sensitive nature of this data to both national security and*

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[12] https://www.fcc.gov/general/outage-reporting-systems

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commercial competitiveness, the outage data are presumed to be confidential. (Public Safety and Homeland Security)

Contrarily, the NBNCBC telecommunications outage data and report are made publicly available; however, the NBNCBC outage data are reported in response to different thresholds by consumers, rather than the providers, and could reflect differences between NBNCBC and FCC data.

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NBNCBC Telecommunications Outage Reporting Process

Since this is the first NBNCBC conducted outage report, the consortium does not have a history documenting regional telecommunications outages; however, NBNCBC member Mendocino County has coordinated their own process of documenting telecommunications outages. The Broadband Alliance of Mendocino County's (BAMC) method of documenting telecommunications outages progress in the following sequence of events listed below:

The telecommunications outage occurs.

The outage is recognized by residents though "word of mouth" and anecdotal evidence.	The outage is reported to Broadband Alliance of Mendocino County.

Research and data collection by BAMC

Public meetings are held that attract significant public appearance from public safety, county officials, schools, local business, tribal communities, residential communities, journalists, and more.	Additional data is obtained through surveys, documenting the affects of the telecommunications outages on the public.

Create and publish the telecommunications outage report

Based on data and research retrieved from the surveys and public meetings, BAMC formulates a Telecommunications Outage Report pertaining to the specified outage that occurred. The report provides an overview of the overall impact the telecommunications outage had on the entire community.	BAMC publishes the reports online and also shares the reports with state officials and the CPUC for consideration and political action. http://www.mendocinobroadband.org/data-and-reports/

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NBNCBC Historical Outages

NBNCBC member Mendocino County has documented two (2) previous major telecommunications outages from 2014[13] and 2015[14] that have negatively impacted communities, local agencies, and businesses. These reports were made publicly available and cited at the state level in CPUC documents and proceedings[15] and at the national level in a Government Accountability Report,[16] but it is unknown whether or not they were registered or documented outages at the FCC. In addition, NBNCBC member Sonoma County has also experienced (but not documented) at least two (2) major outages that had widespread impacts including loss of 9-1-1; and again, it is unknown whether or not these outages were reported and documented at the FCC due to the confidentiality of the provider's reports. All of the previous outages in Mendocino and Sonoma occurred when there was no accompanying disaster and where the power grid was not affected (prior to the 2017 wildfires).

Following the 2014 and 2015 outages, AT&T completed their North Coast network upgrades in 2016.[17] These upgrades promised to provide,

> *"Geographic diversity to over 91% of the fiber in the North Coast....These improvements allow our network to be self-healing when a fiber cut occurs, and will help protect phone and internet services for consumers and businesses in the North Coast from outages."*

The network upgrade plan also included 9-1-1 Call Center Diversity meaning,

> *"The vast majority of 911 Call Centers in the region are on diverse fiber pathways to protect against outages. The new fiber line, once completed, will bring the last remaining 911 Call Centers in Humboldt and Mendocino Counties onto diverse wire centers with protected fiber pathways."*

AT&T's publically announced upgrades in 2016 provided a reassuring feeling to the region that widespread outages were now a "thing of the past". Unfortunately, the severity of the 2017 wildfires was unpredictable; and to nobody's fault, AT&T's upgrades did not take under consideration for catastrophic wildfires to occur.

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[13] http://www.mendocinobroadband.org/wp-content/uploads/Incident-Report-from-county-website.complete.pdf
[14] http://www.mendocinobroadband.org/wp-content/uploads/Outage-Report-as-approved-11216-by-BoS.pdf
[15] 2015 Outage Report cited by CPUC Commissioners in their Alternate Proposed Decision in R 11-12-001 page 8,9 and 12; http://www.mendocinobroadband.org/wp-content/uploads/Infrastructure-review-alternate-decision.pdf; Data from outage report reflected in Decision 16-12-066 Dec. 15th, 2016 on Rural Call Completion issues, other call completion issues, and call initiation issues including lack of 911 access and dial tone, page 108-112; 112-120.
[16] GAO 16-167 Internet Protocol Transition, page 12
[17] See AT&T press release to Board of Supervisors dated Sept. 1, 2016 and included in Appendix E.

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AT&T is the dominant Incumbent Local Exchange Carrier (ILEC) in our three counties[18] and owns most of the fiber infrastructure. Other carriers (including mobile providers) lease AT&T fiber for their services and backhaul, meaning that most of the end-user services - even if provided by other providers (phone, internet, cellular, cable, TV) are *still* dependent on the AT&T infrastructure. The lack of a competitive "multi-carrier" fiber environment limits alternative options communities specifically seeking redundant and diverse networks, and puts a greater responsibility on AT&T in 1) actively working to bring rural networks up to the same resiliency standards as urban networks, and 2) committing to working with public safety within these counties so that they can be better prepared during times of crisis.

The wide geographic scope of the outages and extent of services lost which resulted from the fires implies that *additional work* needs to be accomplished to assure the telecommunications networks in the region are more diverse, reliable, and resilient; as, public safety is dependent.

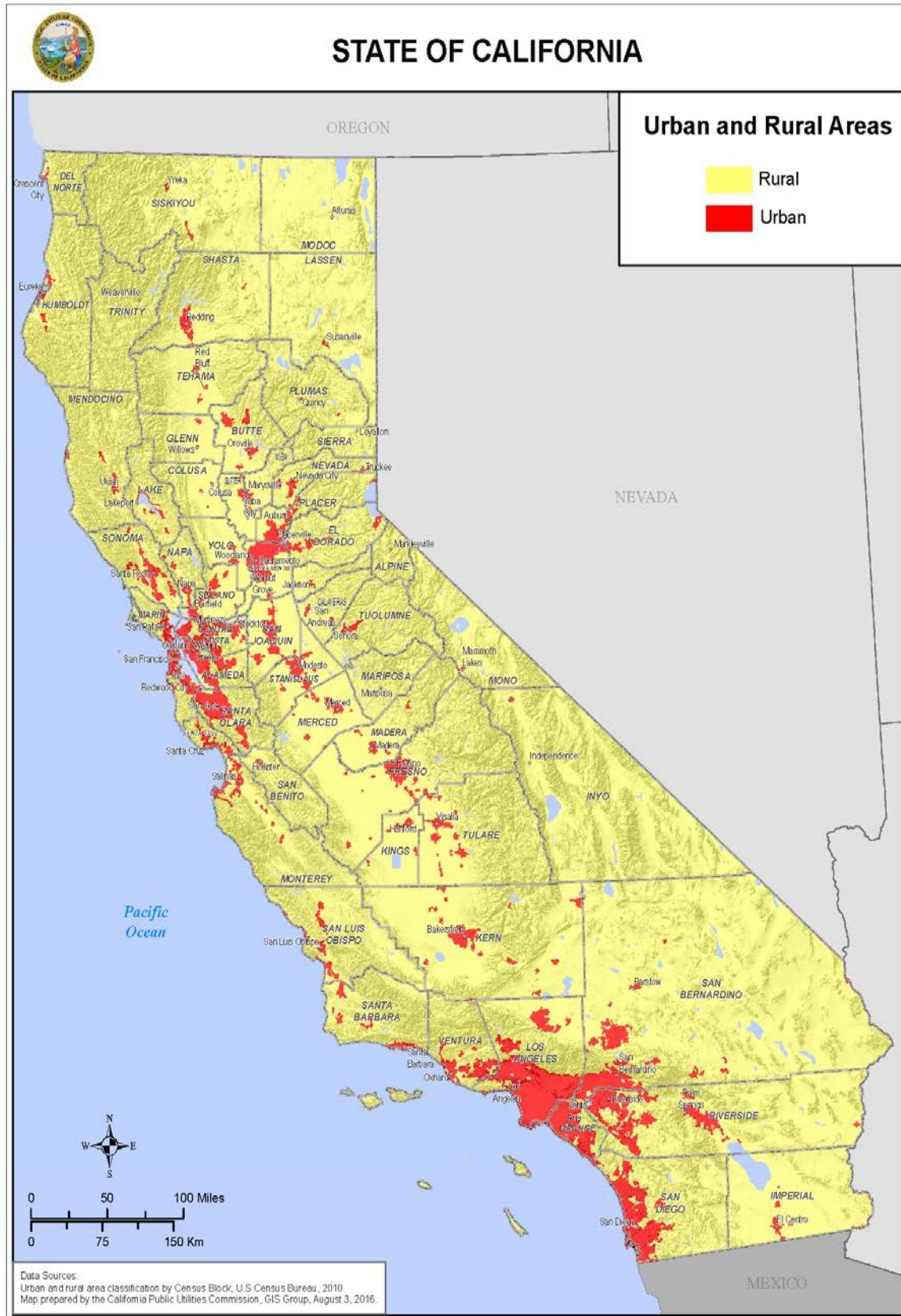## Rural-Urban Digital Divide and NBNCBC Political Action

There is a well-known rural-urban digital divide, where rural areas do not have access to modern telecommunications services which are available more commonly in urban and suburban areas. Homes in rural areas usually manage to subscribe to some sort of connectivity (cellular, satellite, fixed wireless); however, the services often have data caps, are expensive, and would be considered "under-served" for broadband by many metrics, including the FCC standards. For example, satellite internet, common for rural areas and may be the most likely to stay up and running during disasters, is expensive and not even considered "broadband" according to CPUC speed metrics.

Political efforts previously pursued by Senator Mike McGuire in California to establish outage reporting requirements to include rural low density areas and find alternatives for emergency reporting when phone calls can't connect due to telecommunications outages have been unsuccessful.[19] Additionally, in a letter sent to the California Public Utilities Commission on behalf of the Mendocino County Board of Supervisors dated November 10, 2014, the importance of reporting and documenting telecommunications outages in low-density rural areas are crucial for many reasons; however, public safety is the primary reason.[20]

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[18] See Appendix F for the ILEC map
[19] https://leginfo.legislature.ca.gov/faces/billTextClient.xhtml?bill_id=201720180SB566
[20] http://www.mendocinobroadband.org/wp-content/uploads/Incident-Report-from-county-website.complete.pdf

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SURVEY RESULTS

Response Overview

The online survey received 3,705 total responses from the three (3) counties - 590 responses from Mendocino (15.9% of the total), 2,018 from Napa (54.5% of the total), 1,012 from Sonoma (27.3% of the total), and 85 from visitors in these counties at the time of the fire who reside elsewhere (2.3% of the total). Accounting for county population densities, these returns represent a .7% return for Mendocino, a 1.4% return from Napa, and a .2% return for Sonoma.
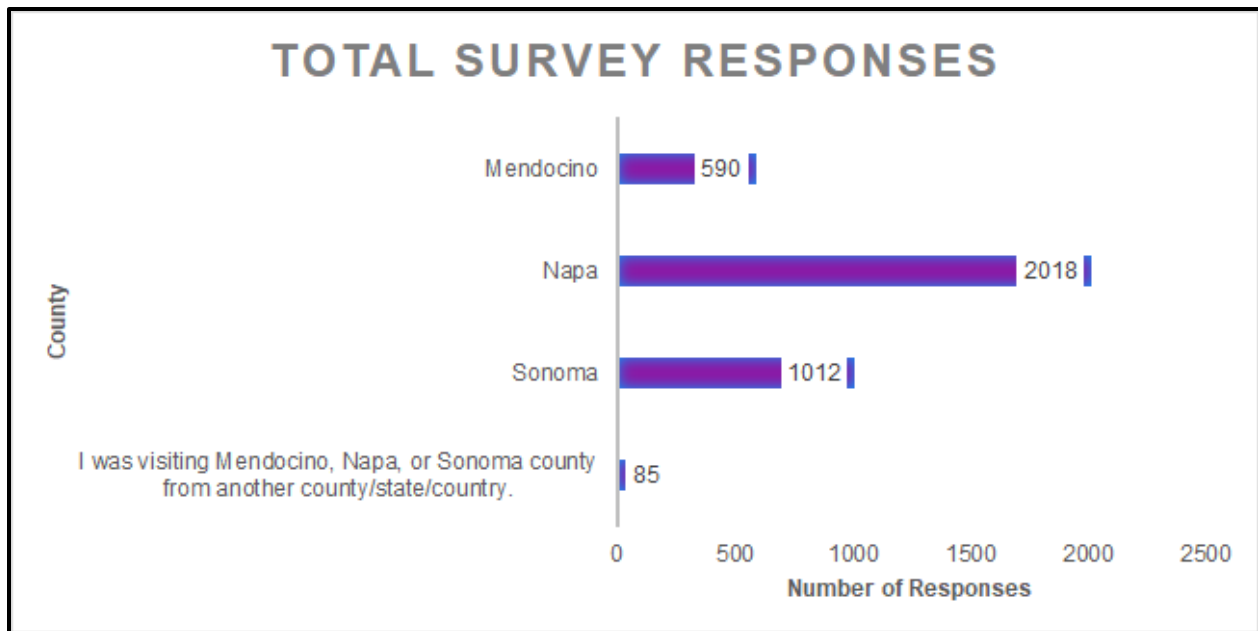

Figure 3: This chart indicates the total number of responses from each wildfire affected county in the NBNCBC region (Source: Firestorm Mendocino-Napa-Sonoma Telecommunication Outage Survey Issued by North Bay North Coast Broadband Consortium)

Responses were received from 26 of the 28 zip codes in Mendocino County, all 12 of the zip codes in Napa County, and 32 of the 44 zip codes in Sonoma County. Collectively, this data represents responses from 70 different zip code areas, or 83% of all zip codes in the 3-county area.

Geographical Extent of the Outages

This report will focus on whether three (3) telecommunication services in particular - landline telephone, cell phone, and internet remained functional during this crisis; and how the geographic scope of the outages as can best be determined. As the outage survey collected information on the respondents status of telecommunications services during the fires *at their residence*, the provider they subscribe to, and the location of their residence, the data can

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demonstrate the geographic extent of the loss of telecommunications services (and who the service belongs to) in the counties for the zip codes that respondents represented.

Survey results indicate that the telecommunication outages were widespread and well beyond the boundaries of the actual burn areas. This is a familiar pattern experienced in previous outages as well, in which telecommunications are impacted well beyond the geographic boundary of where the initial incident occurs, whether it is a fire or other factor which results in damaging the telecommunications infrastructure.

Data Complications

Each of the (3) telecommunications services experienced their own data complications, or, not enough available data, creating barriers to conduct a complete analysis on the geographic scope of the outages. While specific complications for each service are explained in detail in each) section, all (3) services had common complications which include:

1.) **Restricted access to provider proprietary information**
Certain information and data regarding the effects the wildfires which impacted providers' telecommunications infrastructure and services is governed by the private sector, thus data has to either be already publicly available, obtained through data collection and research, or formally requested from the private companies by a public agency. The private companies are not legally obligated to provide information that is proprietary; hence, there are restrictions on the availability of data that can affect the accuracy of this report.

2.) **Lack of responses from all zip codes**
The survey was distributed through various sources of outreach, and attempted to receive responses from every zip code within each county. Certain zip codes received more responses than others, and there were several zip codes where no responses at all were received.

3.) **Measurability of "Other" responses for provider identification**
The respondents were given the option in the three service-related questions to identify their service provider. If their provider was not listed as an answer choice, they could respond freely under "Other." Responses in the "Other" category fluctuated and were not uniform enough to quantify effectively. The responses from these sections can be seen in Appendix G; however, the data are not incorporated into any analysis or graphs.

4.) **Timeline of wildfires**
During the overall length of time between the beginning and end of the wildfires, a variety of events occurred during the wildfires' timeline which could potentially correlate to the respondents' telecommunications outage experiences, ultimately causing bias in the data. Since the survey didn't ask residents about their experience at a *specific* time in the overall timeline, but rather their experience at *any* time in the timeline, bias can reflect in the data due to this reason.

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GIS mapping using data showing the progression of the wildfires over time in conjunction with the data collected in the survey could allow more accurate correlations to be made and provide easier visualizations for the actual "story" which occurred.

5.) Concurrent power outages during wildfires

As power and telecommunications outages are significantly interrelated, the power outages created variable bias in the analysis of the overall extent of the telecommunications outages. A respondent could have experienced both a power outage and a telecommunications outage, either independently and at separate times, or at the same time and in conjunction with one another. During the wildfires, power outages could have been short term or long lasting, respectively allowing, or not allowing, residents to measure the immediate impact on their telecommunications services independently. The respondent could have experienced a power outage for the entire timeline of the wildfires and not be able to measure the status of their telecommunications service, or, a respondent could have experienced a "break" between the power and telecommunications outages, allowing them to measure the status of their telecommunications service.

Thus, to analyze the telecommunications outages independently and more accurately, any respondents who specifically experienced a power outage and *didn't know* if their services were impacted, were omitted from the independent analysis of telecommunications outages; however, since power and telecommunications outages are significantly interrelated, a section in this report is dedicated solely to analyzing the impact of the power outages on residents.

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LANDLINE OUTAGES

Landline Trends, Dependency, and Access

For over a decade, traditional landline services have undergone major transitions. According to Figure # 4, current trends indicate landline phones are decreasing in use among consumers while cellular use has been steadily increasing, gradually replacing landline technology.[21] The transition from landline to cellular technology has occurred differently in urban/suburban areas versus rural areas. In urban/suburban areas where telecommunications infrastructure is developed and can deliver various alternatives to landline service, residents often discontinue their landline service subscriptions. However, in rural areas, where telecommunications infrastructure delivering modernized services is lacking and cellular service availability is lacking/unreliable, residents rely more heavily on their landline service as a form of communication;[22]
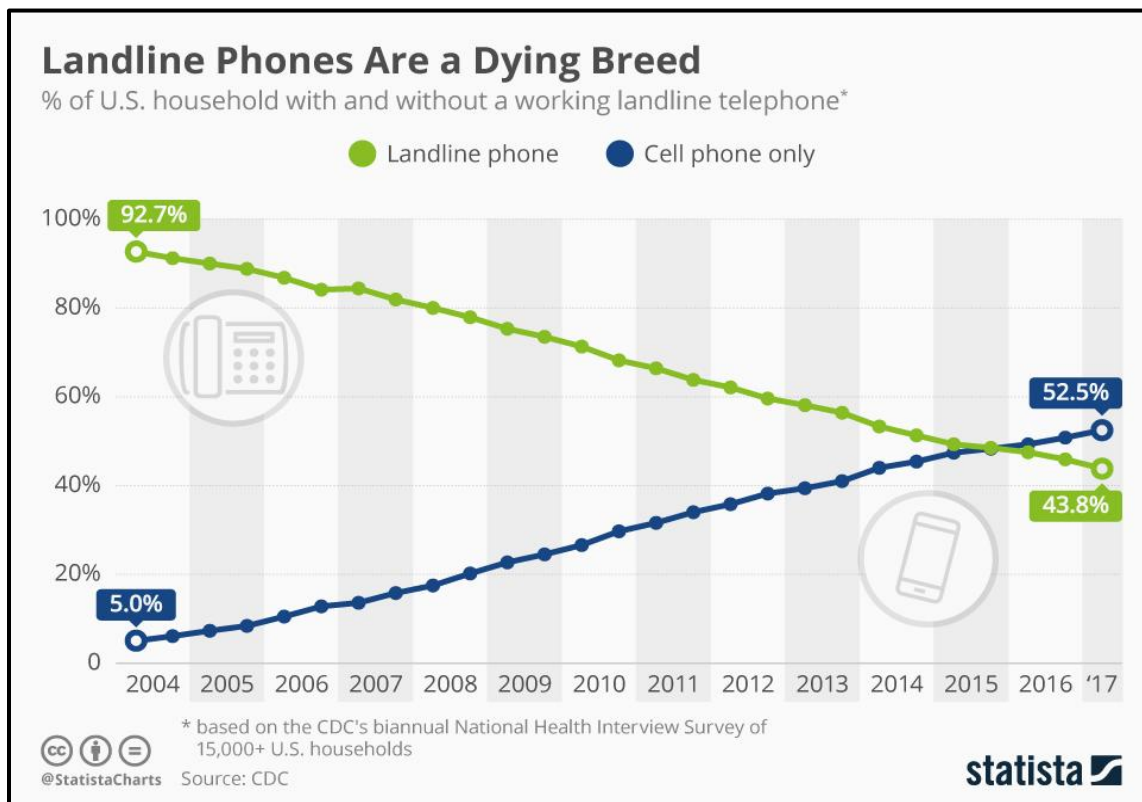

Figure 4: The chart indicates a gradual decrease/increase of landline/cellular adoption over time. Source (Centers of Disease Control and Prevention, 2018)

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[21] https://www.statista.com/chart/2072/landline-phones-in-the-united-states/
https://www.cdc.gov/nchs/data/nhis/earlyrelease/wireless201712.pdf
[22] Referencing FCC data shown in Figure # (Cellular Overview)

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The table below presents additional reasoning why consumers unsubscribe or don't subscribe at all to landline phone service.[23] National data continues to show a significant percentage (81%) of the population forgoes landline services because they solely rely on cell phones for all calls.

Reasons why U.S. consumers have no landline phone 2017	
Why don't you have a landline phone?	**% of Respondents**
I don't need a landline phone/I use my cellphone for all calls	81%
It has never occurred to me to buy one	7%
I have no connection at home	3%
For me, the telephone is too expensive	12%
For me, the connection/monthly charge is too expensive	20%
I don't want to have a landline phone at home	20%
Other	2%
Don`t know	1%

Figure 5: (Source: Statista 2017)

POTS vs. VoIP

Landline phone service over the last 100 years has historically been the primary form of communication, serving as the main tool for public safety to reach every connected home in the event of an emergency. During the wildfires, many communication technologies were impacted and were unable to operate due to the power outages and infrastructure damage, leaving many residents disconnected; however, some but not all residents who had landline service were fortunate to be able to receive reverse 9-1-1 calls in order to be notified to evacuate their homes and/or communicate. The technology transition from Plain Old Telephone Service (POTS) to Voice over Internet Protocol (VoIP), largely invisible to the public's eye, can be a source of confusion. POTS is "voice-grade telephone service employing analog signal transmission over copper loops"[24]; and, VoIP is a digital "technology that allows you to make voice calls using a broadband Internet connection instead of a regular (or analog) phone line."[25] Added to this confusion is the term "landline," which has historically meant POTS lines, but can now mean both POTS and VoIP. Technically, a landline is simply "... a phone that uses a metal wire or optical fiber optic telephone line for transmission as distinguished from a mobile cellular or fixed

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[23]https://www-statista-com.ezproxy.lib.calpoly.edu/statistics/713547/reasons-us-consumers-have-no-landline-phone/
[24] https://en.wikipedia.org/wiki/Plain_old_telephone_service
[25] https://www.fcc.gov/general/voice-over-internet-protocol-voip

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wireless line, which uses radio waves for transmission."[26] However, in many people's minds, "landline" means the copper POTS network which is traditionally very reliable.   Aggressive marketing of "landlines" by providers sometimes plays into this false idea, as residents transition from their copper wired landlines to a VoIP yet "technically still a landline" service.

  There have also been national efforts to transition landline services by decreasing the footprint of POTS and expanding that of VoIP. According to the FCC[27],

> *On November 29, 2017, the FCC released a Report and Order (R&O), Declaratory Ruling, and Further Notice of Proposed Rulemaking (Further Notice) addressing (1) retirement of landline copper lines and (2) replacement of legacy services (i.e., traditional Plain Old Telephone Service, also known as "POTS") with next-generation service, such as Voice over Internet Protocol (VoIP). (Consumer and Governmental Affairs)*

Though VoIP services have major benefits over using POTS, including its capability of transmitting higher capacity and bandwidth for consumer use, understanding both the advantages and disadvantages of VoIP and POTS are pivotal in preparation for future emergencies. The FCC identifies some disadvantages of VoIP on their website,

> **What are some disadvantages of VoIP?**
>
> *If you're considering replacing your traditional telephone service with VoIP, there are some possible differences:*
> - *Some VoIP services don't work during power outages and the service provider may not offer backup power.*
> - *Not all VoIP services connect directly to emergency services through 9-1-1. For additional information, see VoIP & 911 Advisory. (Consumer and Governmental Affairs)*

In addition to the FCC's list of disadvantages, another disadvantage of VoIP services is that IP networks allow for increased consolidation of equipment and facilities, which means when an outage occurs (whether through accident or human software coding errors), the outage can potentially last longer and affect more people across a wider geographic area than legacy networks.[28] On October 4th, 2016, phone service on Level 3's network experienced an outage that lasted for nearly an hour and a half across the U.S. The disruption was caused by a technician making a simple clerical error. The FCC claimed it was the largest ever reported

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[26] Wikipedia definition https://en.wikipedia.org/wiki/Landline
[27] https://www.fcc.gov/fcc-adopts-new-technology-transitions-rules-and-invites-comment-proposed-elimination-outreach
[28] https://www.fiercetelecom.com/telecom/fcc-finally-specifies-cause-2016-level-3-network-outage

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outage in NORS, affecting approximately 29.4 million interconnected VoIP users and approximately 2.3 million wireless users. Collectively, 111 million calls failed to complete.

According to the FCC, some VoIP services are less reliable during a disaster because they are dependent on the power grid; VoIP and fiber landline telephone systems generally don't have the same ability as copper lines to maintain service indefinitely when there is a power failure. If the household is equipped with an in-home battery backup, VoIP and fiber systems may provide up to eight hours of standby service. In the past, POTS has remained operational during a power outage because the copper landlines are not dependent upon electricity and are provided their own power by the telephone provider. Landline providers have generators in their Central Offices which powers the POTS public switched telephone network, allowing the copper wires to continue providing service.

 The ongoing transition from POTS to VoIP has meant the traditional all copper telephone network is now a hybrid of both copper and fiber technologies, and during a power outage may become nonfunctional. Copper typically still connects central switching offices to individual households, but central offices are connected to each other via fiber.   During the wildfires, some residents were able to continue making calls within their dialing prefix, but not outside their dial prefix. This meant that their ability to connect to 9-1-1 may also have been impacted. Combined with the lack of clarity around what exactly IS a landline (it can be both POTS and VoIP) means that there is no single answer as to why some landlines continued to remain in service while others failed to various degrees (see details below).

2017 October Wildfire Landline Outage Overview

In the Telecommunications Outage Survey, a question asked about the status of the respondent's landline service *at their residence* during the wildfires. According to Figure 6, 66% of 3,447 NBNCBC respondents[29] have a landline phone, which is above the 2017 national percentage[30] (43.8%) of population who have a landline phone. When respondents without a landline phone are filtered out, 72% of the remaining 2,270 respondents experienced loss of some landline function while the majority (46%) said they lost all function. 16% of the respondents could not say whether their landline still worked or not (many respondents evacuated their homes).

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[29] See the zip code spreadsheet for a complete listing of individual zip codes for each county with all data for landline service losses in Appendix B.
[30] Reference Figure #

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Did your place of residence lose landline phone service during the wildfires?	Responses	
I don't have a landline	34.15%	1177
Yes I lost landline because my house burned down	1.89%	65
Yes I lost all landline service and my house did not burn down	30.46%	1050
Partial loss - local calls only went through	2.70%	93
Partial loss - long-distance calls only went through	0.52%	18
Partial loss- Quality degraded significantly	1.57%	54
No my landline worked as normal	18.39%	634
I don't know if I lost my landline service or not	10.33%	356
	Answered	3447

Figure 6: (Source: Firestorm Mendocino-Napa-Sonoma Telecommunication Outage Survey Issued by North Bay North Coast Broadband Consortium)

As shown in Figure 7, there are two primary POTS landline providers in the market of the 3-county region: AT&T and Frontier (formerly Verizon) with the larger share of subscribers by AT&T (1,136 for AT&T versus 74 for Frontier). Comcast is also the main cable provider of landline services. The outage data showed:

- 61% of AT&T landline subscribers reported a loss of their services, while 39% said their services worked as normal.
- 77% Comcast landline subscribers reported a loss of their services, while 23% said their services worked as normal.
- 85% Verizon/Frontier landline subscribers reported a loss of their services, while 15% said their services worked as normal.
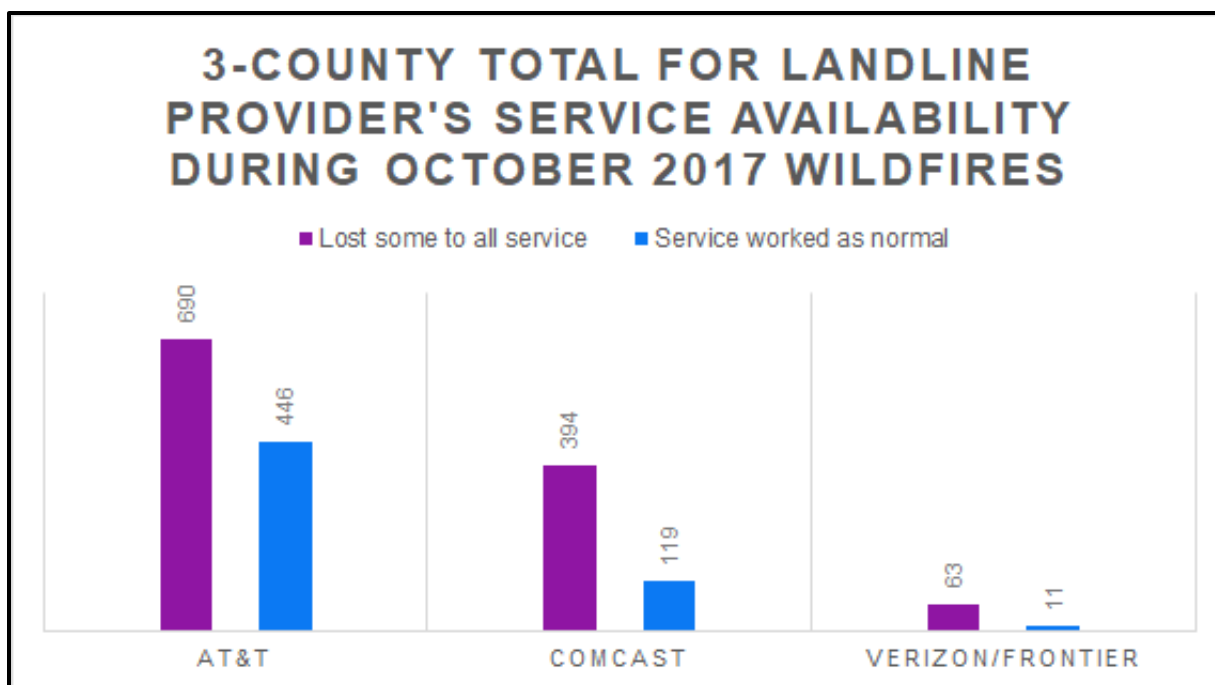
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Figure 7: (Source: Firestorm Mendocino-Napa-Sonoma Telecommunication Outage Survey Issued by North Bay North Coast Broadband Consortium)
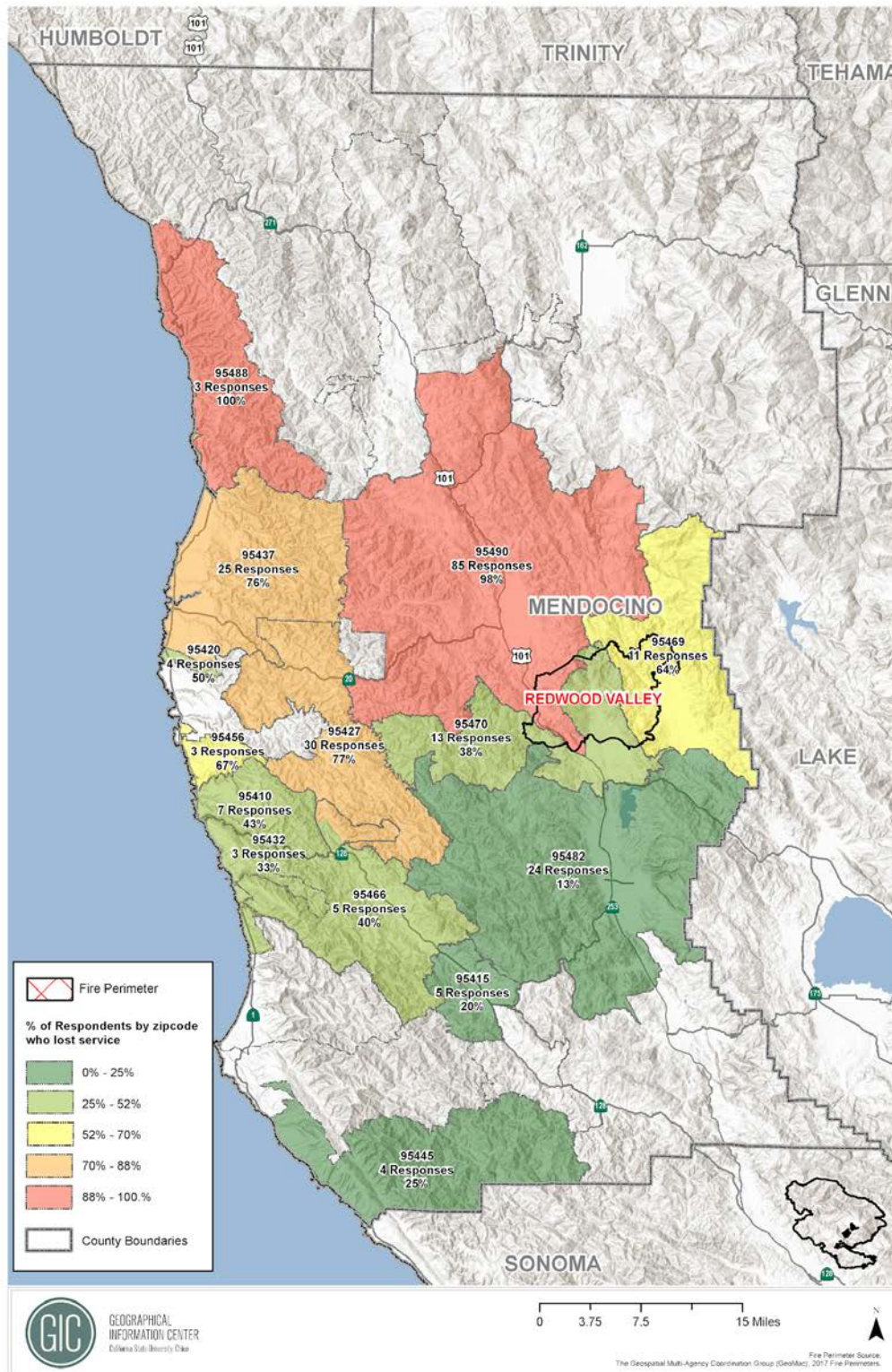
Geographic Extent of the Loss of Landline Service

In the 3-county region, 66% of respondents claimed to have lost some to all landline service; and more precisely, 66% of the respondents reporting losing some to all landline service in Mendocino, 67% in Napa, and 64% in Sonoma. This section of the report attempts to examine the extent and scope of the landline outage, and to determine how far outside the actual fire zones landline access and services were impacted. In the maps below, data shows that the landline outages occurred regionally across 38/70 zip codes[31].
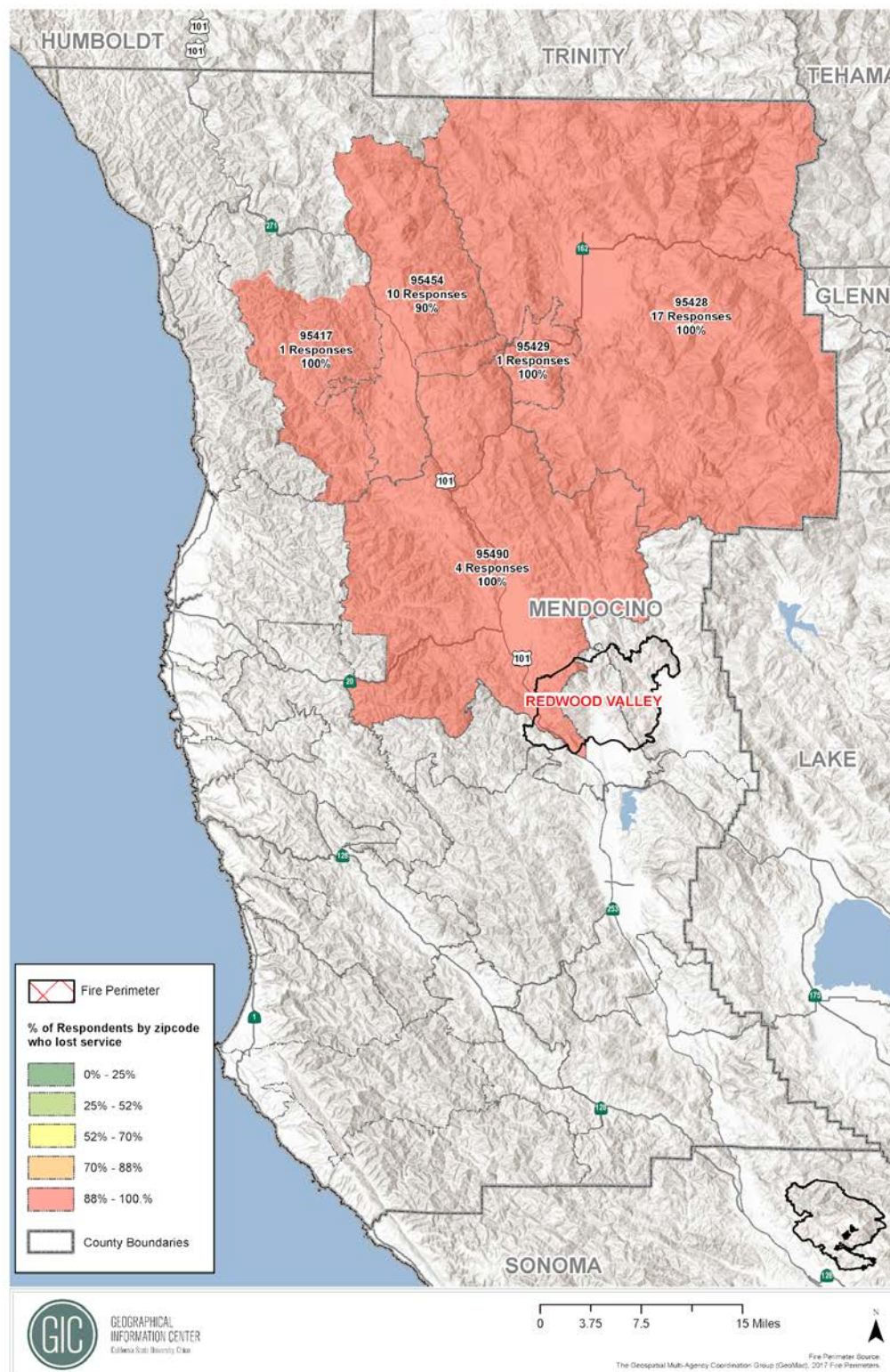
Interestingly, some areas close to the fire sometimes maintained landline services while others much farther away failed completely - an example of this scenario is shown by the outage survey results. In Ukiah, Mendocino County, which is only 10 miles from where the devastating Redwood Valley fire burned, 28/31 respondents from Ukiah claimed to have maintained their landline service. By contrast, in the town of Covelo, which is over 57 miles from the Redwood Fire, all 17 responses from Covelo indicated a loss of landline service. As shown in the maps, data implies that the landline outages occurred well beyond the immediate fire-impacted areas.

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[31] See the zip code spreadsheet for a complete listing of individual zip codes for each county with all data for landline service losses in Appendix B.
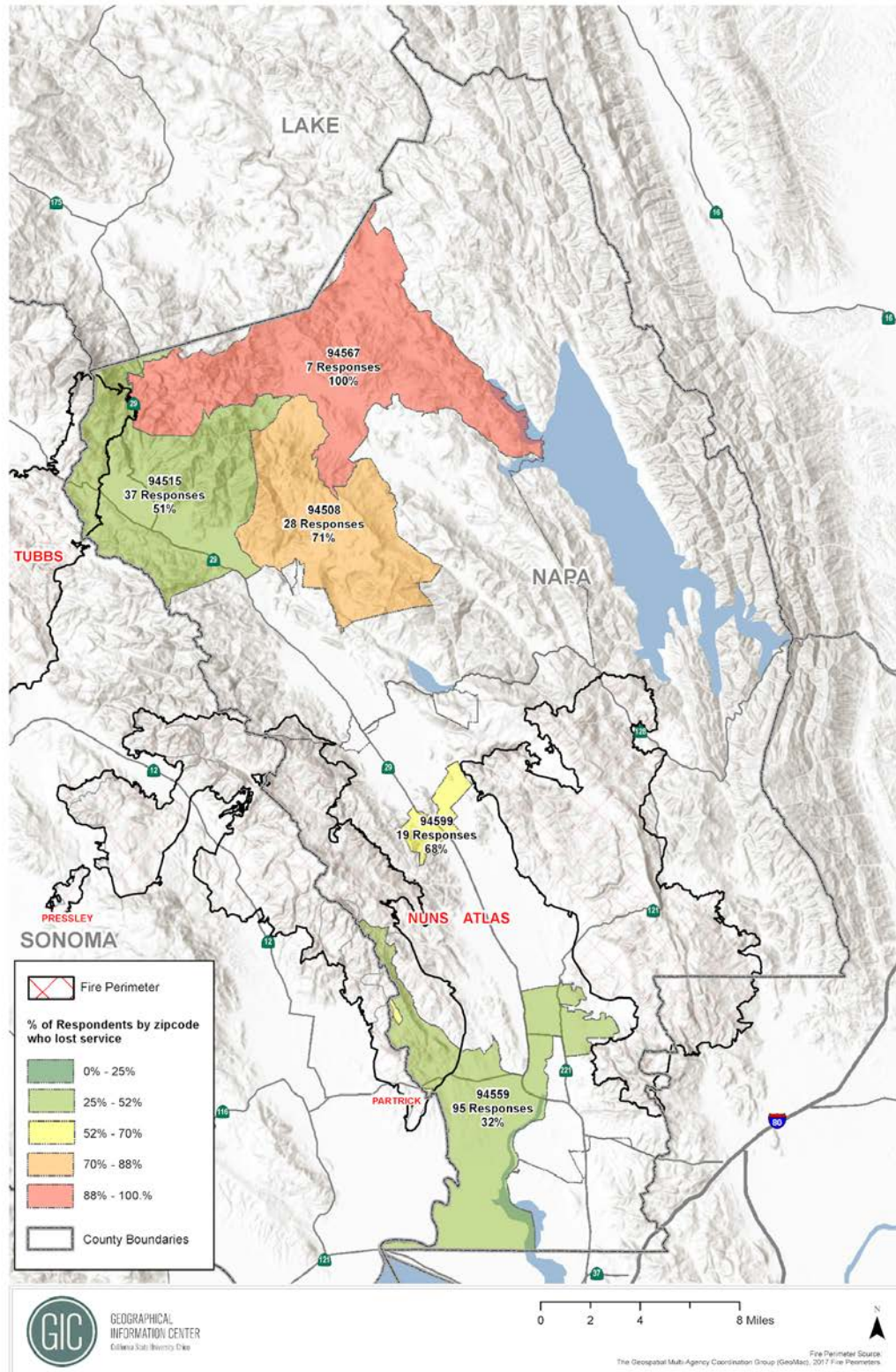
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MENDOCINO County - AT&T Landline Service Lost in 2017 Fires

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MENDOCINO County - Frontier/Verizon Landline Service Lost in 2017 Fires

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NAPA County - AT&T Landline Service Lost in 2017 Fires

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NAPA County - Comcast Landline Service Lost in 2017 Fires

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SONOMA County - AT&T Landline Service Lost in 2017 Fires

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SONOMA County - Comcast Landline Service Lost in 2017 Fires

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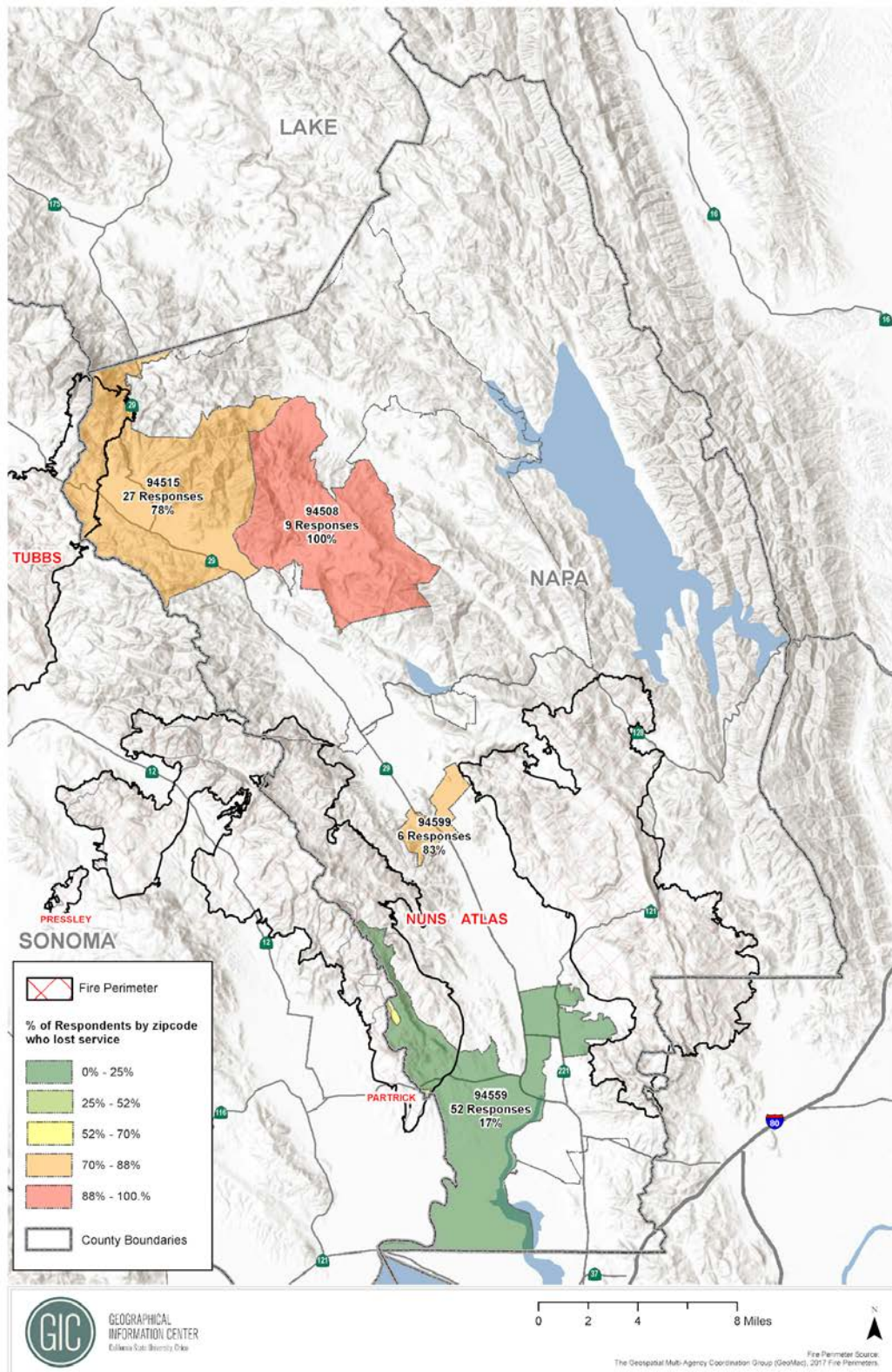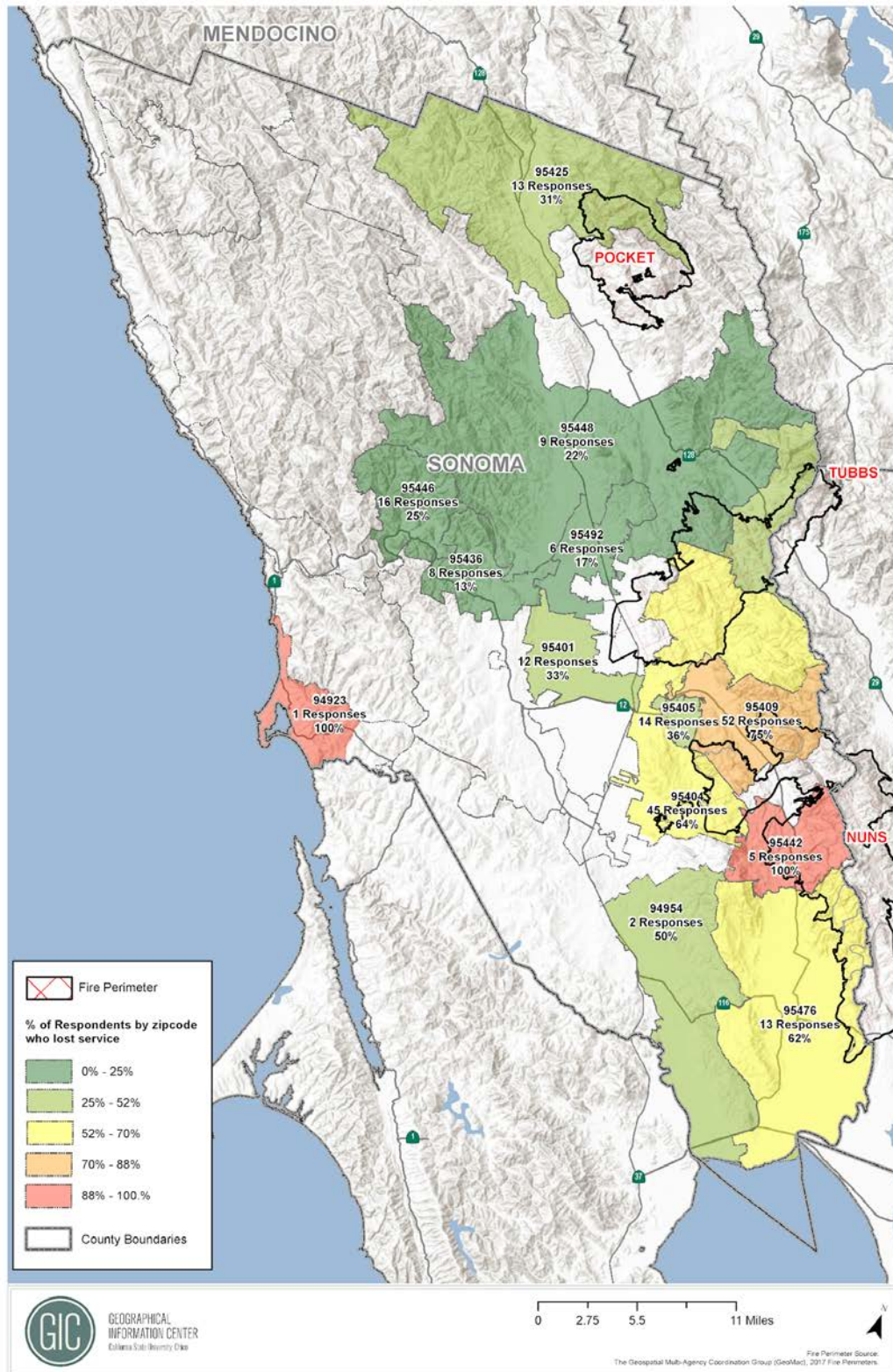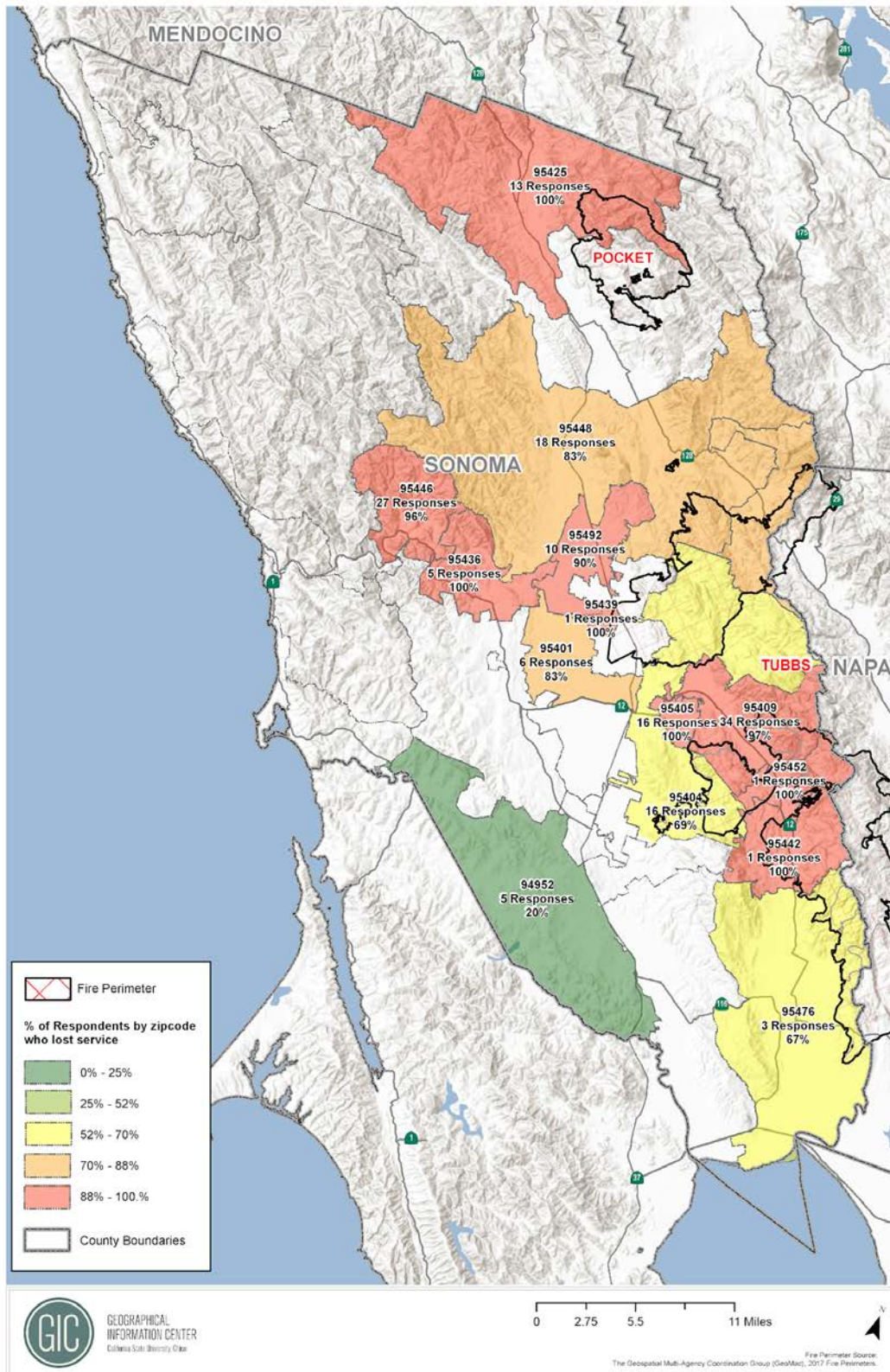
Landline Data Complications

In addition to the data complications mentioned in the introduction of this report that apply to all three services, data complications pertaining only to landline services are listed in this section. The data provides challenges to conclude the complete geographic extent of the loss of landline services due to multiple factors, including:

1. **Landline Service Marketing Confusion**
   Marketing by providers has the potential to add confusion, as VoIP services are marketed as "landlines," which do not operate the same as traditional landline service transmitted over copper networks, and customers may or may not understand the difference between them;

2. **Power Grid and Telecommunications**
   The complex relationship between the power grid and telecommunications networks caused VoIP "landline" services to fail while some traditional copper landlines were unaffected; and, as a result of some customers not knowing the difference between POTS versus VoIP, they were unsure whether their service went out as a result of the power outage or disruption in the actual landline service.

Were you aware that if your landline service changed from copper to fiber/wireless technology that your landline telephone service would not work in the event of a power failure?	Responses	
Yes I was aware of this.	15.4%	513
No I was not aware of this.	84.6%	2,826
	Answered	3,339

Figure 8: (Source: Firestorm Mendocino-Napa-Sonoma Telecommunication Outage Survey Issued by North Bay North Coast Broadband Consortium)

Survey results also indicate that many residents were not aware of the implications of the technology transitions. In Figure 8, the responses to the survey question show 85% of the 3,339 responses were not aware their VoIP services would not function during in a power failure while 15% were aware. Further, in Figure 9, the question regarding back up battery use resulted in 28% of the respondents saying, "I don't know anything about my phone, I just hope it works when I need it." Meanwhile, only 4% of the respondents ordered the optional back-up battery for their VoIP services.

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If your landline phone changed from copper-based to fiber/wireless based, did you order the optional battery to power your modem/router in the event of a power outage?	Responses	
Not applicable; I don't have a landline	31%	1049
Not applicable; as far as I know, my landline is/was still all copper	19%	646
I did order the optional battery	4%	125
I did not order the optional battery	16%	535
Not applicable; I have a home solar system or generator	2%	55
I don't know anything about my phone - I just hope it works when I need it	28%	925
	Answered	3,335

Figure 9: (Source: Firestorm Mendocino-Napa-Sonoma Telecommunication Outage Survey Issued by North Bay North Coast Broadband Consortium)

Restoration of Landline Service

The Telecommunications Outage Survey asked a question about the duration of time before residents' landline services were restored. Excluding the responses from those who replied "Not Applicable", "I don't know", and "I don't know because I didn't have power", the remaining 1,106 respondents who experienced a cellular outage reported the duration of time before their landline service was restored. From the data, 4.43% of the respondents reported having service restoration within 12 hours, 7.14% within 24 hours, 24.14% within 2 days, 23.06% within 3 days, 13.29% within 4 days, 21.25% longer than 4 days, and 6.69% were still waiting for their service to be restored at the time they took the survey.
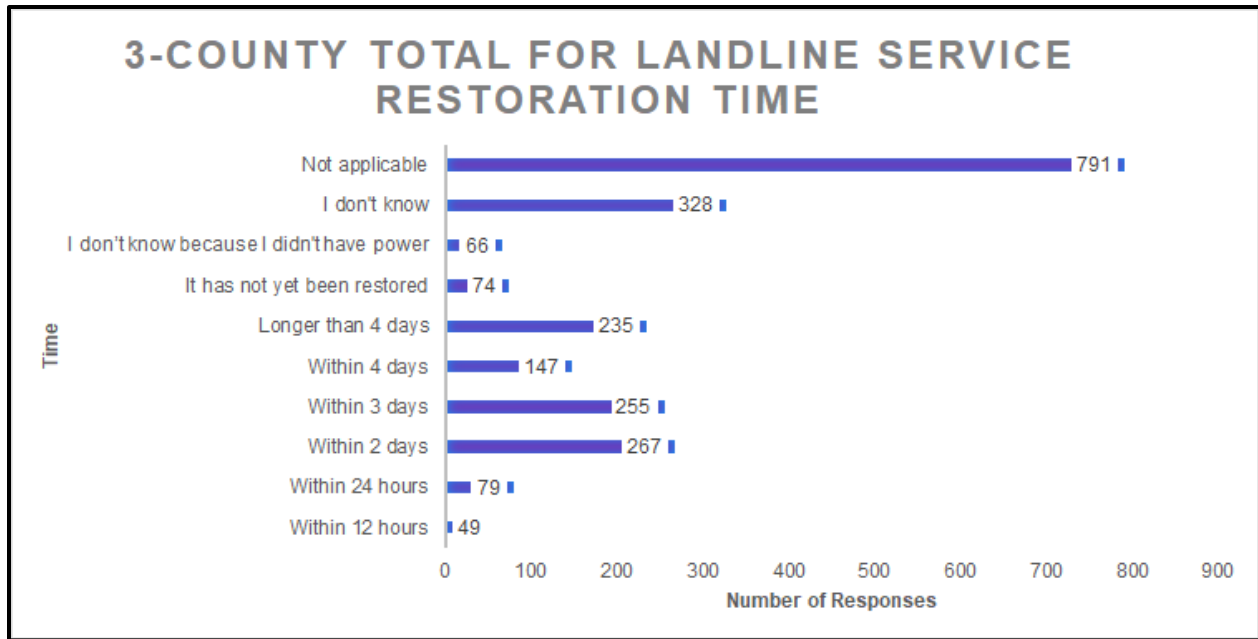
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Figure 10: (Source: Firestorm Mendocino-Napa-Sonoma Telecommunication Outage Survey Issued by North Bay North Coast Broadband Consortium)

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CELLULAR OUTAGES

Cellular Trends, Dependency, and Access

Based on recent data published by Pew Research Center, nationwide mobile phones have become more important as Americans become increasingly dependent on digital information (contacts, personal data, email, etc). According to the FCC website regarding 911 Wireless Services,

> "It is estimated that about 70 percent of 911 calls are placed from wireless phones, and that percentage is growing. For many Americans, the ability to call 911 for help in an emergency is one of the main reasons they own a wireless phone."

Looking at data shown in Figure (#)[32] which was included in the FCC's 2018 Broadband Deployment Report, there is 100% cellular coverage (at 5/1 Mbps) in **urban** areas for all three wildfire affected Counties. In **rural** areas, there is an average of 95% coverage. Combining rural and urban areas, the 3-county area has an average of 98% cellular coverage according to FCC data. The data in Figure # helps illustrate "normal" cellular service speeds and penetration percentage in each County's rural and urban areas.

FCC URBAN/RURAL CELLULAR PENETRATION				
County	**Urban Areas**		**Rural Areas**	
	Population	**% of Pop. with Mobile LTE 5 Mbps/1 Mbps**	**Population**	**% of Pop. with Mobile LTE 5 Mbps/1 Mbps**
Mendocino County	47,737	100.00%	39,925	88.00%
Napa County	122,062	100.00%	19,775	99.80%
Sonoma County	434,533	100.00%	67,598	98.70%

Figure 11: (Source: FCC 2018 Broadband Deployment data)

This section is intended to demonstrate the importance of cellular access in emergency situations. The data included is intended to provide perspective on what cellular services are "normally" available in the affected Counties before the wildfires occurred. The information is presented to

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[32] The FCC data are carrier self-reported and could reflect bias in the data, which would require further validation to ensure accuracy (eg. Ground-Truth Testing)

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compare previous services to the data collected from the outage survey in hopes of provoking discussion on the impact the wildfires had on cellular service.

2017 October Wildfire Cellular Outage Overview

In the Telecommunications Outage Survey, a question asked about the status of the respondent's cellular service *at their residence* during the wildfires. According to Figure #, 99.37% of the NBNCBC respondents[33] have cell phones, which is above the national percentage[34] (52.5%) of population who have cell phones; and, out of the 99.37% of residents who have cell phones, 4.05% do not have cell phone connectivity at their homes. Further, out of the 2,990 respondents[35] who reported on impacts (if any) to their normal cellular service, 78% reported they lost some to all service and 22% reported their cell phone worked as normal at their residence during the wildfires.

Did you lose normal cellular service at your residence?	Responses	
I don't have a cell phone	0.63%	21
I don't normally have cellular service at my residence	4.05%	134
My cellular service worked as normal	20.13%	666
I lost all cellular service	46.15%	1527
I lost most service (greatly degraded, reduced to text messages, no calls, slow speeds)	15.93%	527
I lost some service (slightly degraded, could make calls still)	8.16%	270
I don't know	4.96%	164
	Answered	3309

Figure 12: (Source: Firestorm Mendocino-Napa-Sonoma Telecommunication Outage Survey Issued by North Bay North Coast Broadband Consortium)

Since data on what specific service speeds (Mbps) respondents were actually receiving before and during the fires were not collected, there is no effective way of comparing the actual impact of the fires on cellular services using the data presented. The FCC reported that an average of 98% of the three counties normally have access to 5/1 Mbps cellular service; and by comparing the data, we can conclude 78% of the (98%) population that normally has access to cellular

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[33] See the zip code spreadsheet for a complete listing of individual zip codes for each county with all data for cellular service losses in Appendix B.

[34] Reference Figure #

[35] After filtering out the 21 respondents who do not have a cell phone, the 134 respondents who do not have service at their home, and the 164 respondents who did not know if their cell phone worked or not, the remaining 2,990 respondents reported on impacts (if any) to their normal cellular service.

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service with 5/1 Mbps reported losing some to all of their normal service. Correspondingly, 22% of that 98% who have access to cellular 5/1 Mbps service reported their service working as normal.

In addition, out of those 2,990 respondents, 2,807 respondents reported the providers they subscribe to for service. The survey found that, of those that responded, Verizon and AT&T services have the most subscribers in all three counties, together accounting for 82.65% of the 2,807 responses. The data in Figure 13 show which providers' service worked and which were negatively impacted during the fires. In all three Counties, 75% of Verizon's network lost some to all service while 25% performed as normal. Meanwhile, 82% of AT&T's network lost some to all service, while 18% performed as normal. The status of other providers services during the fires are illustrated in the figures below.
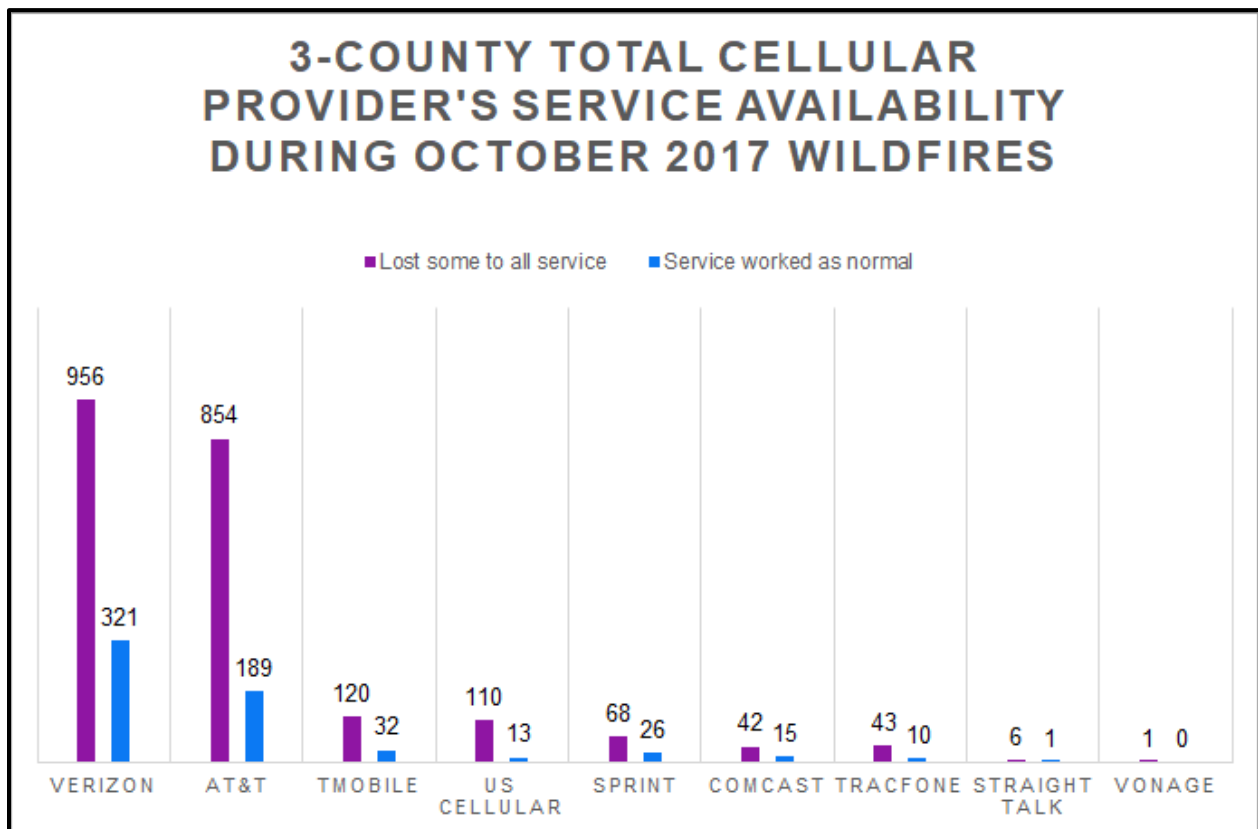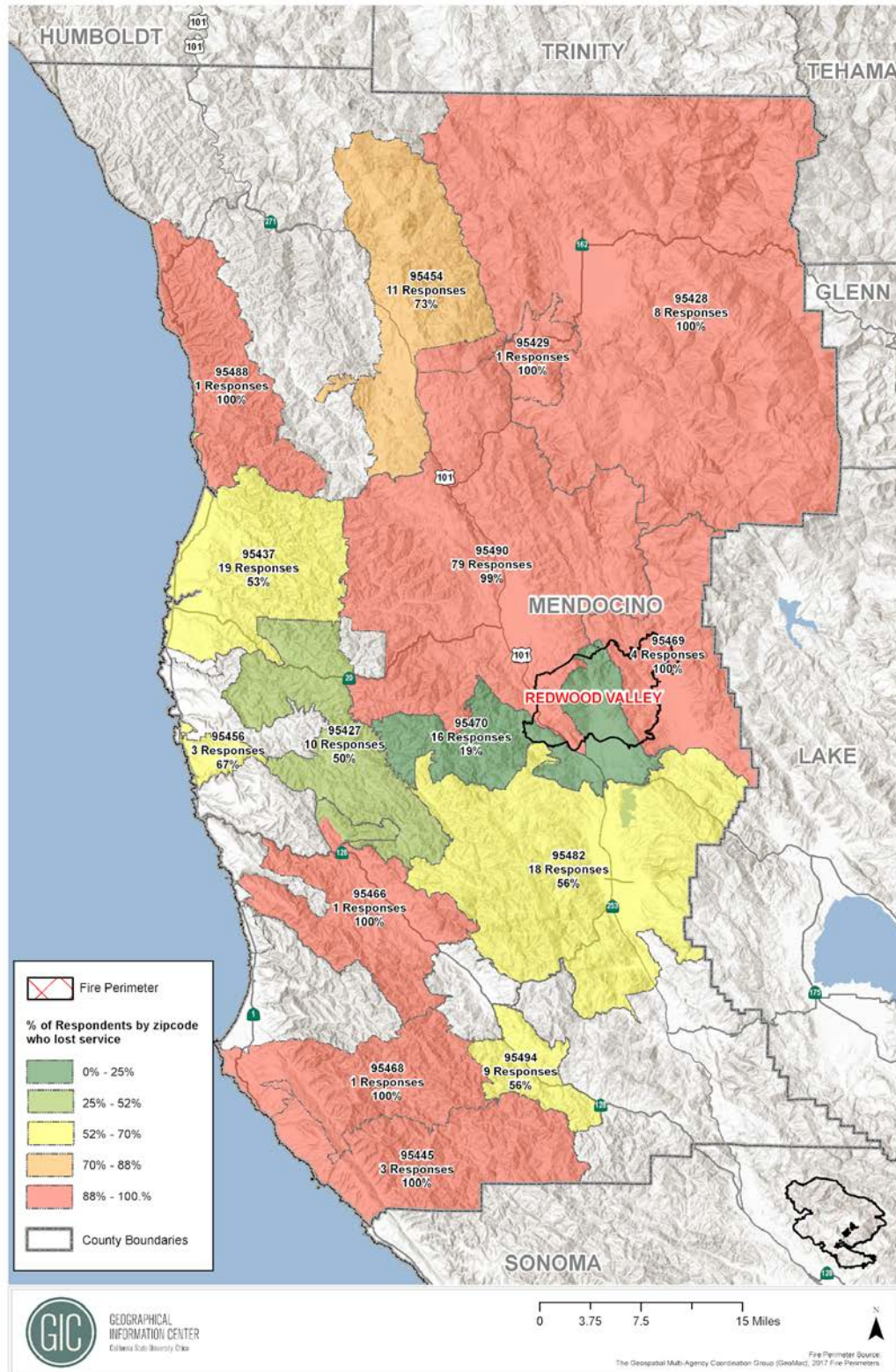

Figure 13: (Source: Firestorm Mendocino-Napa-Sonoma Telecommunication Outage Survey Issued by North Bay North Coast Broadband Consortium)

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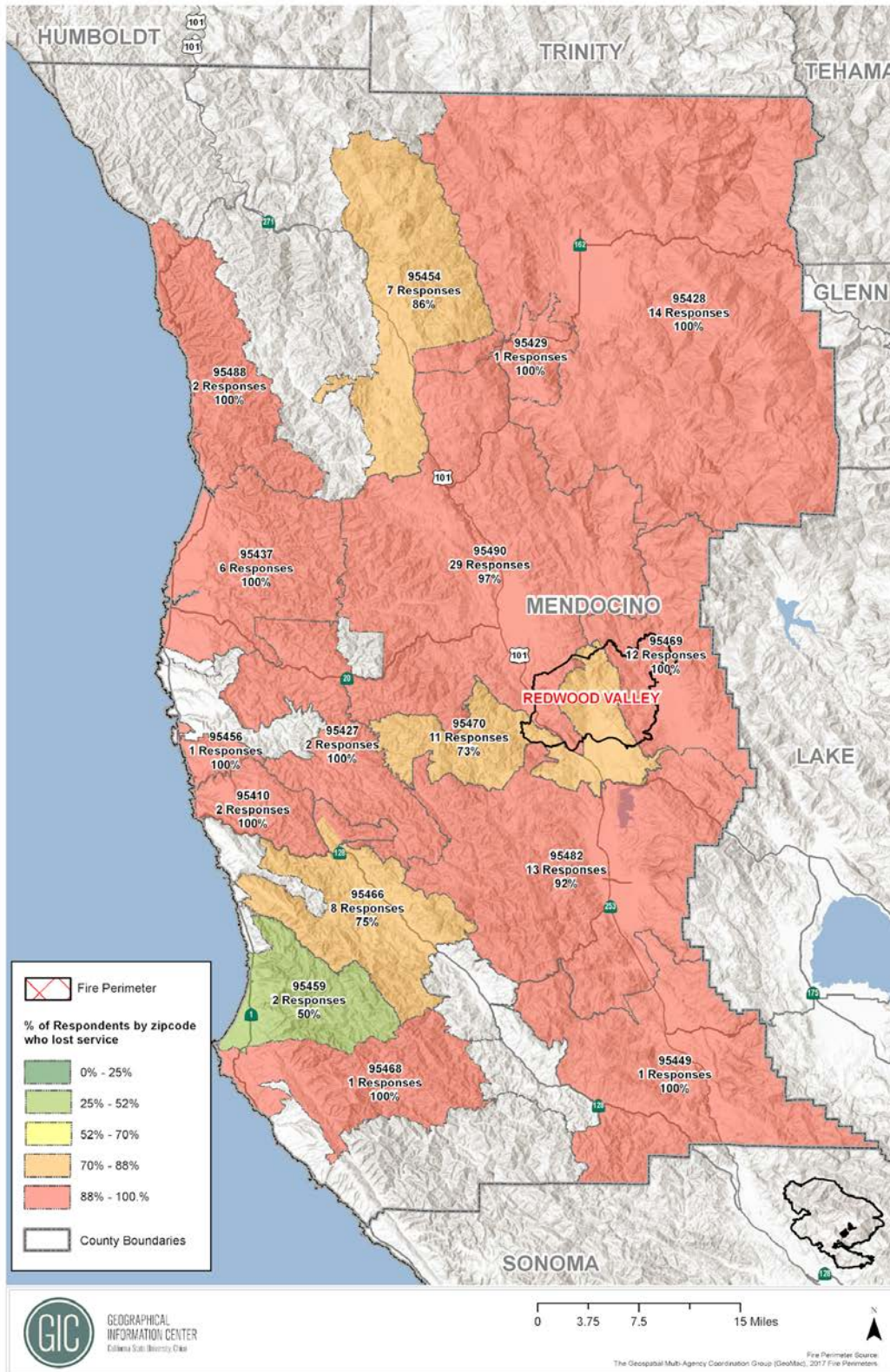## Geographic Extent of the Loss of Cellular Service

In the 3-county region, 78.1% of respondents claimed to have lost some to all landline service; and more precisely, 75.4% of the respondents reported losing some to all landline service in Mendocino, 87.5% in Napa, and 58.6% in Sonoma. This section of the report attempts to examine the extent and scope of the cellular outage, and to determine how far outside the actual fire zones cellular access and services were impacted. In the maps below, data show that the cellular outages occurred regionally across 60/70 zip codes[36].

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[36] See the zip code spreadsheet for a complete listing of individual zip codes for each county with all data for cellular service losses in Appendix B.
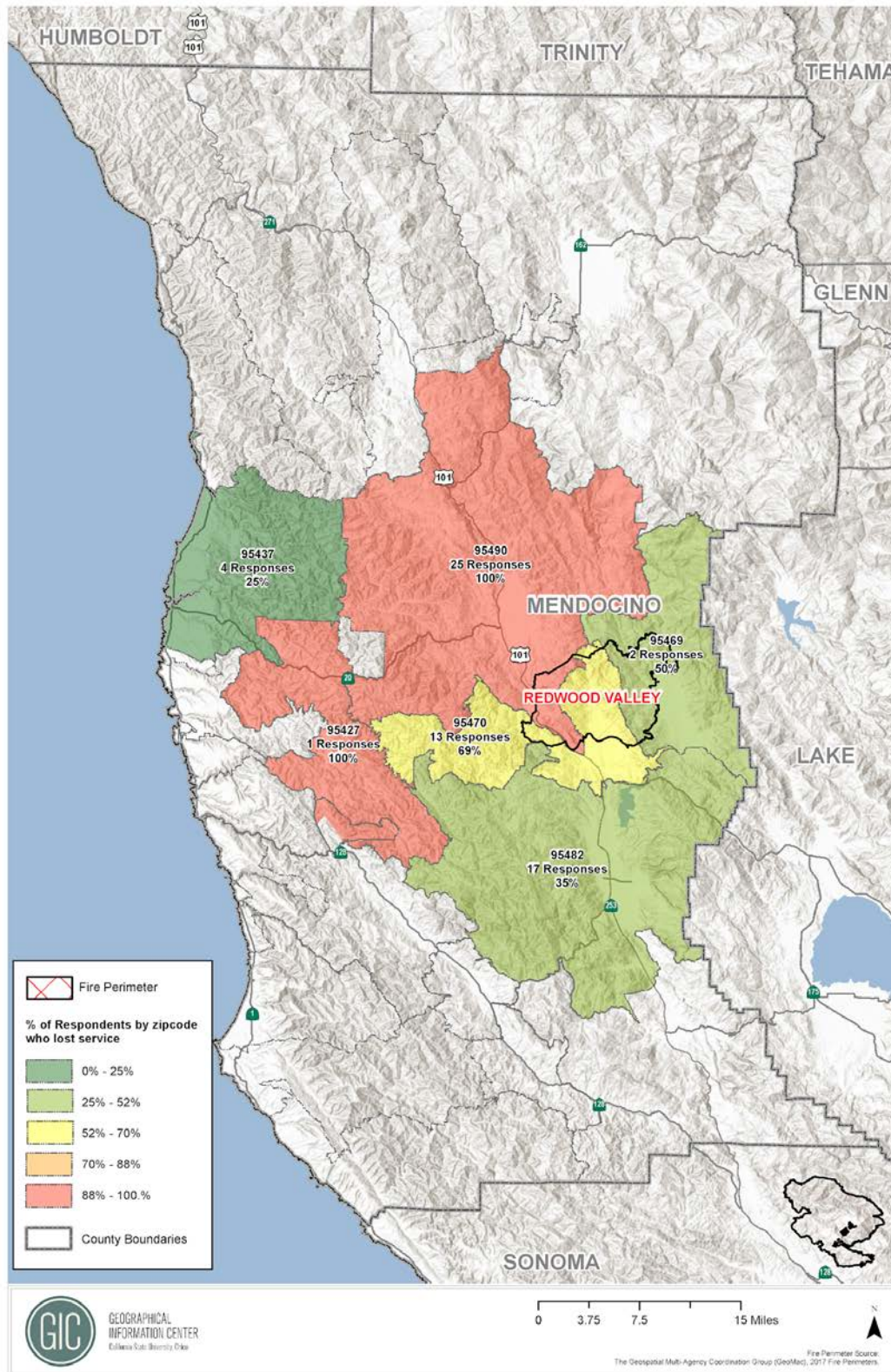
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MENDOCINO County - Verizon Cellular Service Lost in 2017 Fires

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MENDOCINO County - US Cellular - Service Lost in 2017 Fires

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MENDOCINO County - AT&T Cellular Service Lost in 2017 Fires

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NAPA County - AT&T Cellular Service Lost in 2017 Fires

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NAPA County - Verizon Cellular Service Lost in 2017 Fires

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SONOMA County - Verizon Cellular Service Lost in 2017 Fires

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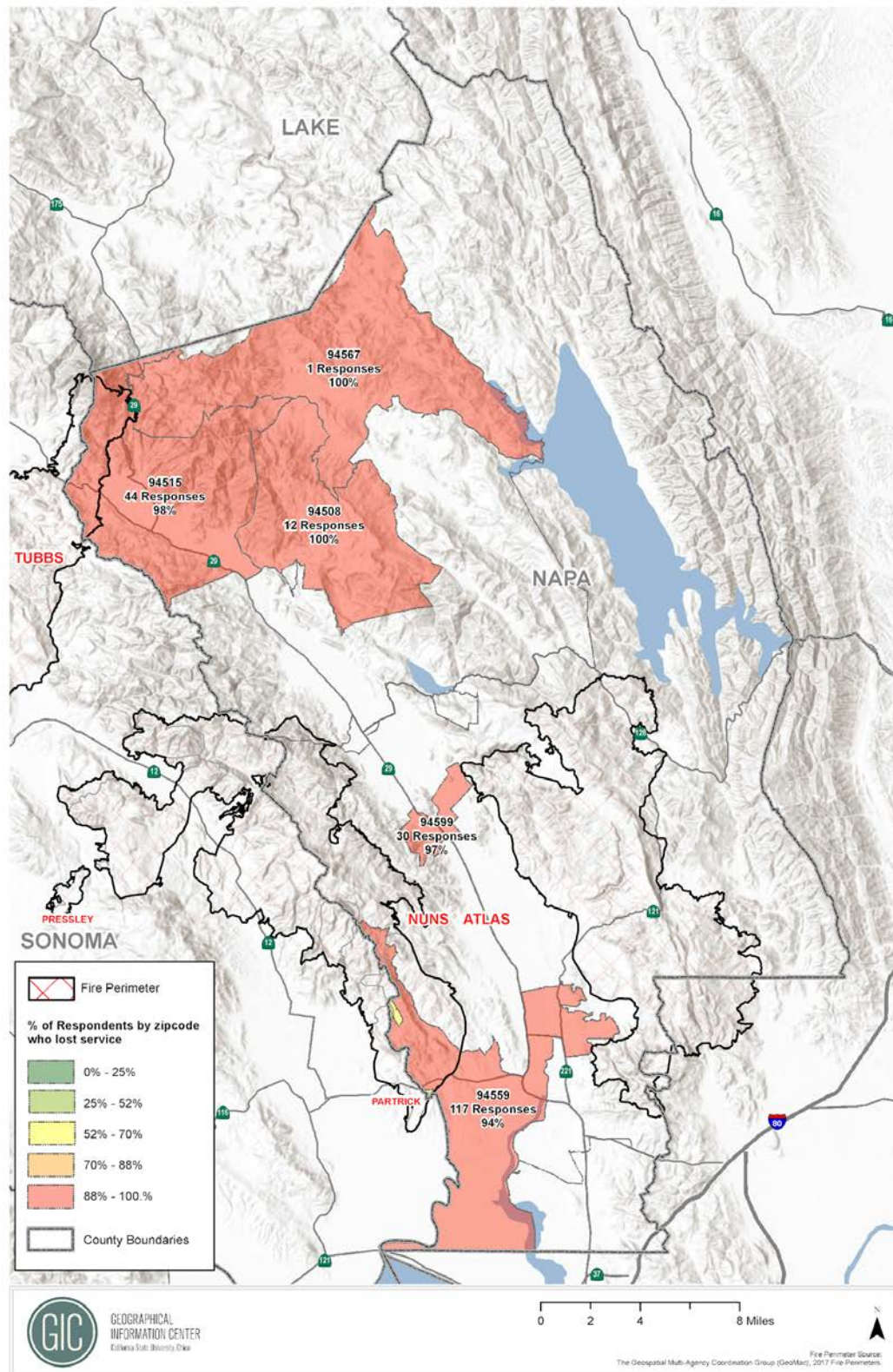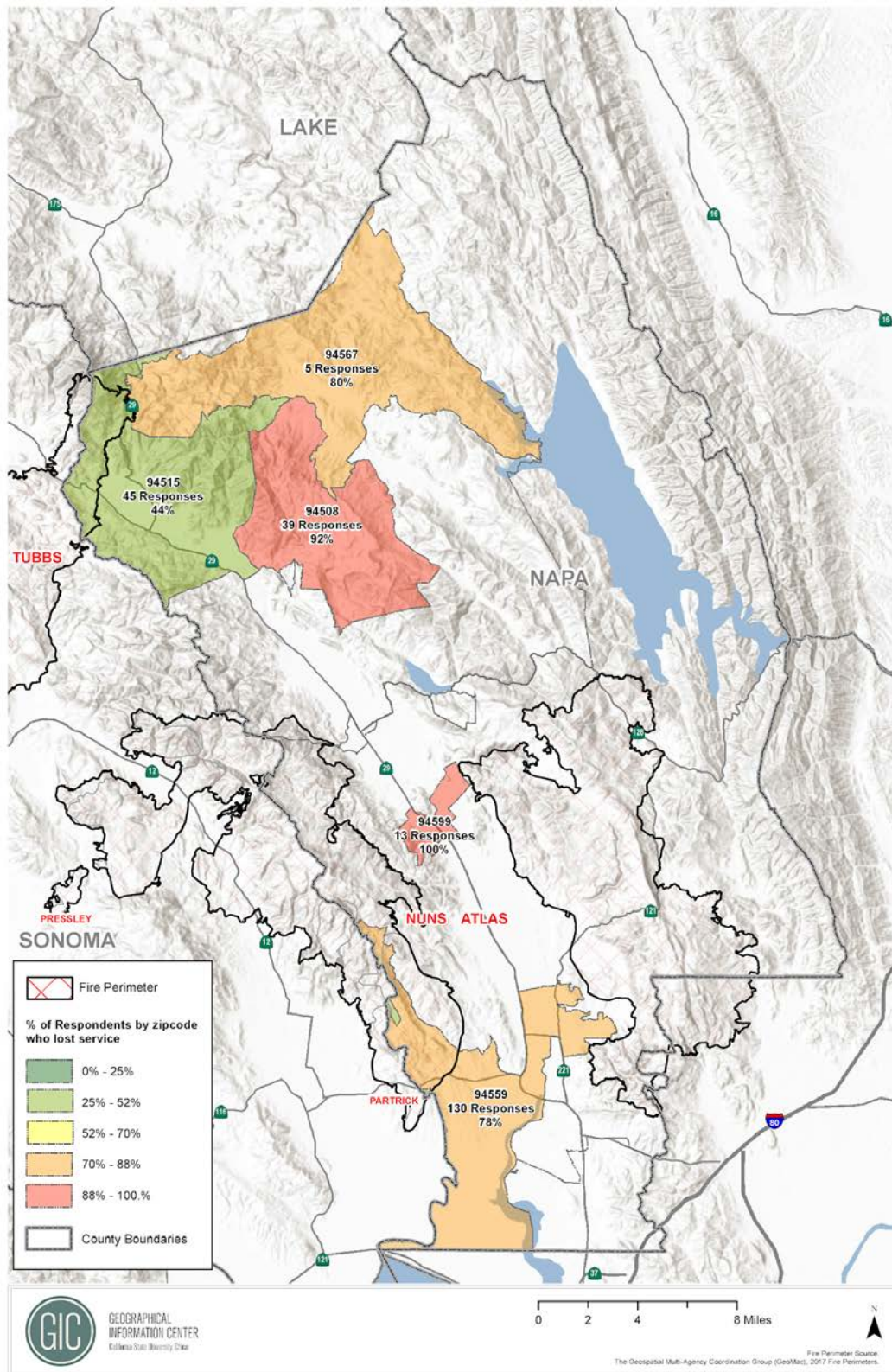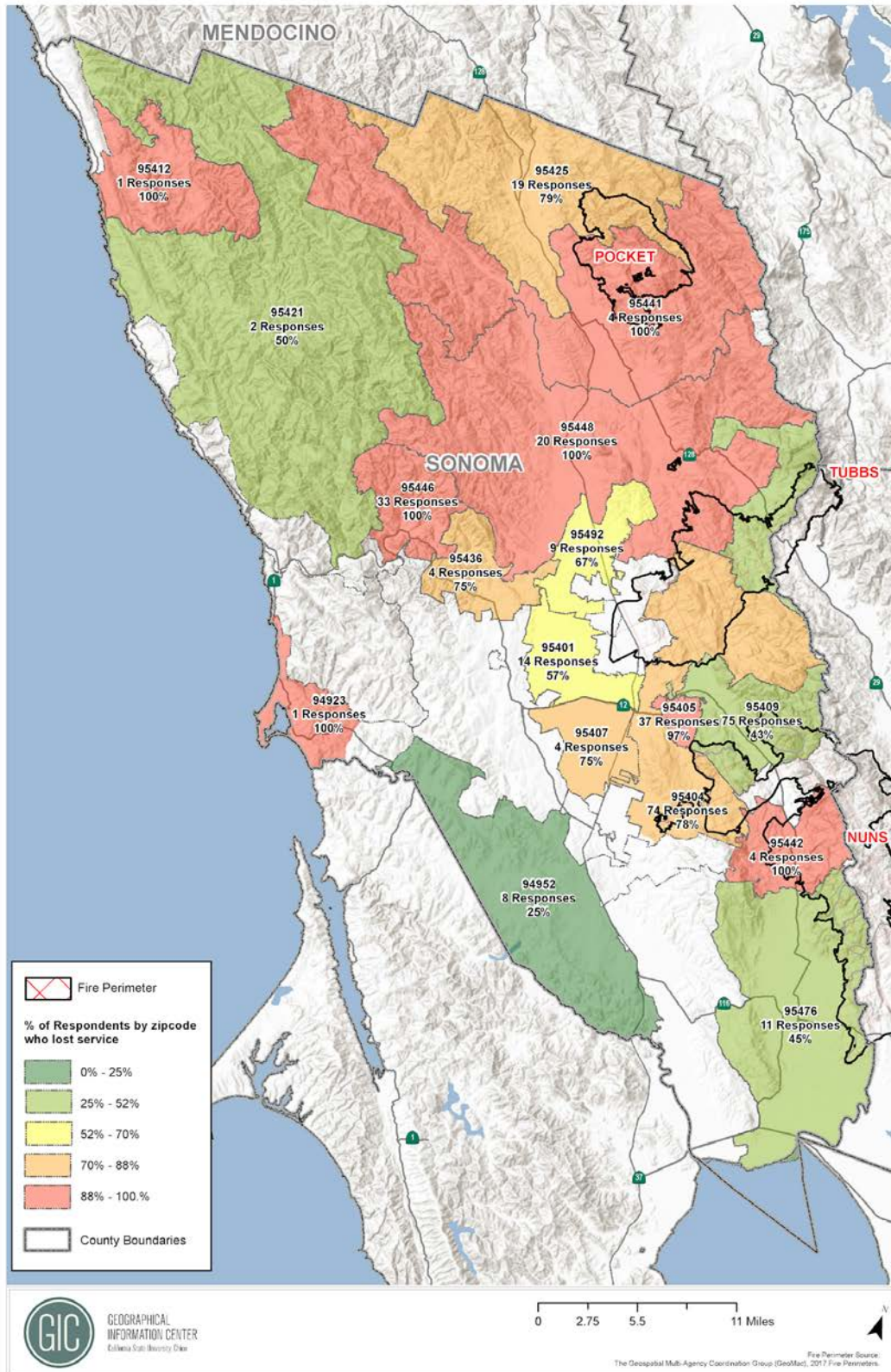
SONOMA County - AT&T Cellular Service Lost in 2017 Fires
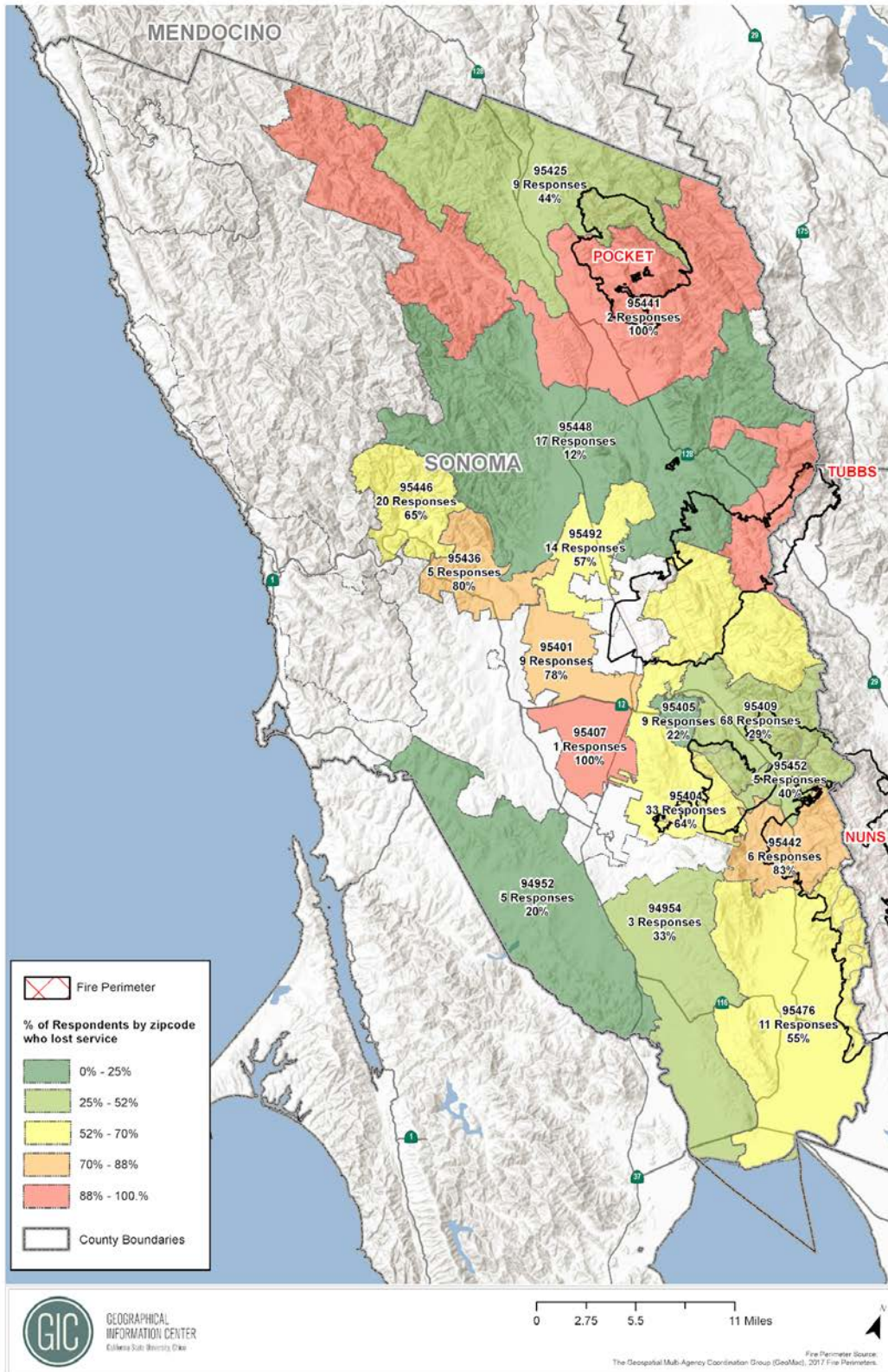
Cellular Data Complications

In addition to the data complications mentioned in the introduction of this report that apply to all (3) services, data complications pertaining only to cellular services are listed in this section. The data provide challenges to conclude the complete geographic extent of the loss of cellular services due to multiple factors, including:

1.) **Residential areas that normally do not have cellular service**
   If the data responses originate from residential areas where cellular coverage does not normally exist, also known as "dead zones", then survey data for residential cellular coverage during the fires cannot be compared to show the impact the wildfires had on normal cellular services. For example, in the small town of Comptche in Mendocino, there were 35 responses and 33 of them owned cell phones, but 17 of these 33 do not normally have service at their home.

   While the data cannot be used to measure the impact the fire had on normal services, the data can be used to help identify areas of the counties that normally do not have cellular coverage and are in need of such services.

2.) **Variety of providers and unknown facility/infrastructure locations**
   Corresponding to the previous topic, there are a multitude of providers offering various services connected to infrastructure (e.g. cell towers) in widespread locations across the three counties unknown to the public. While the data can be requested from the private companies, the providers are not legally obligated to share the information; and, since there are a multitude of providers, bias can be reflected in the data if not all providers decide to share data. In addition, the survey data correspond to a multitude of providers offering various services, thus bias could be reflected from missing or overlooking data.

3.) **Cellular service during evacuation**
   There are not enough data to conclude the location of service availability for those evacuated since directions of evacuation were widespread. The data indicate, of the respondents who actually evacuated their homes, 92% were able to take their cell phones with them and 59% said that their cell phones worked at the time of their evacuation. These percentages could have changed as cell towers and other infrastructure burned and cellular services subsequently failed.

Restoration of Cellular Service

The Telecommunications Outage Survey asked a question about the duration of time before restoral of service. Excluding the responses from those who replied "Not Applicable" and "I don't know", the remaining 2,255 respondents who experienced a cellular outage reported the duration of time before their cellular service was restored. From the data, 3.55% of the respondents reported having service restoration within 12 hours,
6.61% within 24 hours, 23.95% within 2 days, 26.83% within 3 days, 17.38% within 4 days, 19.69% longer than 4 days, and 2% were still waiting for their service to be restored at the time they took the survey. These results are similar to that seen for landline service restoration.

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In the free response sections near the end of the survey, 2,142 responses were collected and categorized.[37] Of those responses, 70.63% discussed communications during the fire and how they communicated with others during the fire. The categorized data do not reflect positive nor negative experiences with communications; but instead, shows the general topics for what respondents were discussing in their responses.

From the survey data, it was noted that 78.1% of the three Counties lost some to all cellular service during the scope of the fires and 21.9% their services worked as normal. If losing some to all cellular service can be considered a negative experience, then the free responses discussing the category of communications and cellular service may have a majority of negative experiences concerning cellular services.
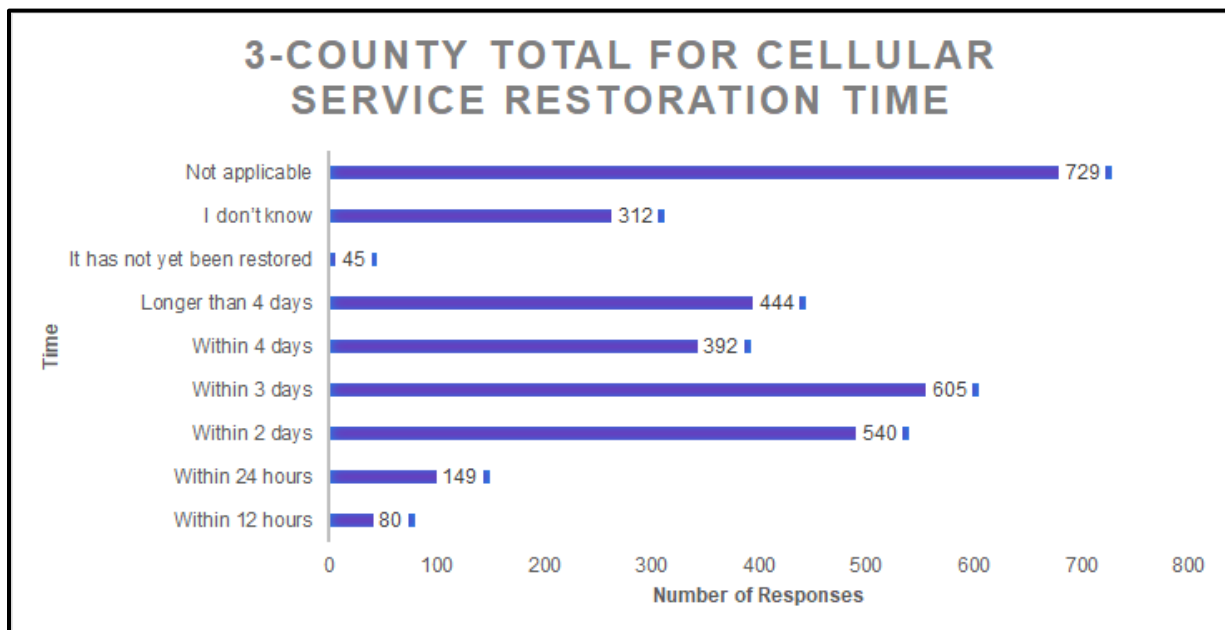

Figure 14: (Source: Firestorm Mendocino-Napa-Sonoma Telecommunication Outage Survey Issued by North Bay North Coast Broadband Consortium)

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[37] See methodology in Appendix A.

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INTERNET OUTAGES

Internet Trends, Dependency, and Access

In the past decade, internet use in the United States has grown significantly. Studies have shown that U.S. consumers primarily access the internet through their smartphones. According to Statista[38],

> Recent research shows that Americans spend the majority of their daily *mobile online time* on apps. Smartphone users in the U.S. spent 85.7 percent of their mobile online time on apps, and tablet users spend about 76.5 percent of their time. The most *popular app among U.S. smartphone* audiences is Facebook with about 80 percent user reach. *(Statista 2017)*
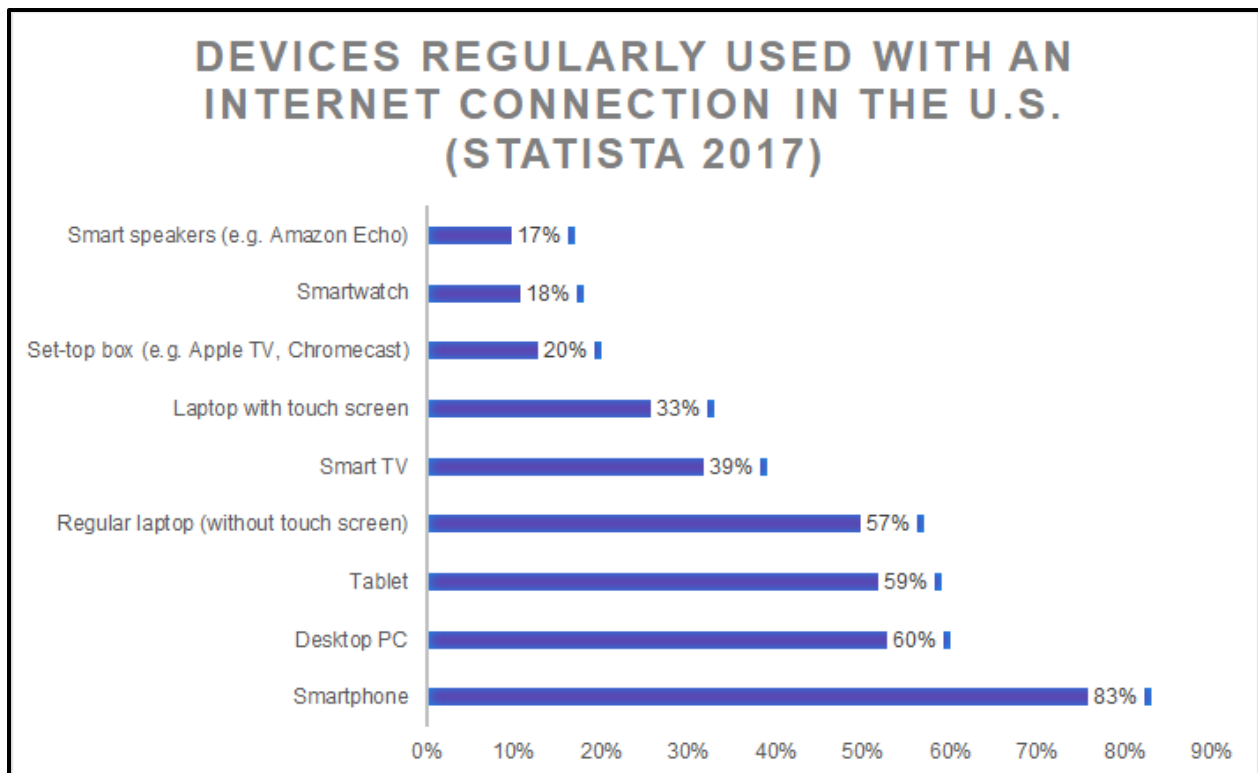

Figure 15: (Source: Statista 2017)

During the wildfires, internet access was crucial for residents to stay informed on wildfire updates. Wildfire information could be found across social media, on public agency websites, in news articles, radio and live news video streaming. During the fires, a public Facebook group tiled "Santa Rosa Firestorm Update Public Group"[39] was created and the total amount of members in the group have steadily increased since the fires began. Today the group still exists,

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[38] https://www-statista-com.ezproxy.lib.calpoly.edu/topics/2237/internet-usage-in-the-united-states/
[39] https://www.facebook.com/groups/586292148428439/

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and over 60,000 members are still active in the group. Residents use the Facebook group to support the community in fire response and recovery by helping other members find: lost family members and pets, housing solutions, donation centers, emotional support groups, jobs, business recovery resources, and many other facets pertaining to the continuing impacts the wildfires have on our communities.

The Internet of Things (IoT) and Public Safety

While social media has dominated the market regarding consumers use of the internet, the internet has an infinite horizon for other potential uses and applicability - modernly described as **"The Internet of Things" (IoT)**. Defined by Gartner Research,

> *The Internet of Things (IoT) is a network of dedicated physical objects (things) that contain embedded technology to communicate and sense or interact with their internal states or the external environment. The connecting of assets, processes and personnel enables the capture of data and events from which a company can learn behavior and usage, react with preventive action, or augment or transform business processes. The IoT is a foundational capability for the creation of a digital business.(Gartner 2017)*
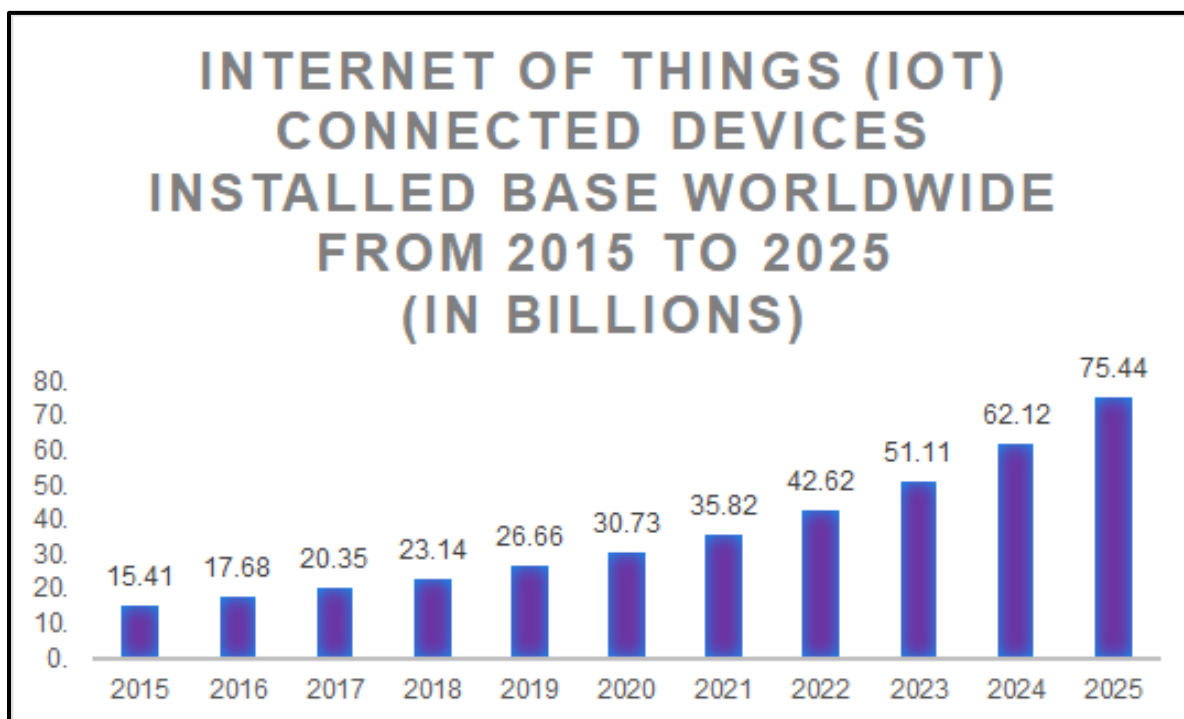

Figure 16: (Source: Statista 2017)

The applicability of IoT is used in many sectors, from healthcare, to education, to agriculture, to smart grids, virtual power plants, smart homes, intelligent transportation, smart cities - the list goes on. In relation to this report, IoT has been gradually increasing its footprint in public safety.

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In an editorial titled "The Internet of Things: What the IoT Means for the Public Sector"[40], ISACA, a "nonprofit, independent association that advocates for professionals involved in information security, assurance, risk management and governance"[41], explains the importance of IoT to public safety,

> *Emergency response happens in real time. IoT not only provides the necessary communication and up-to-date information required to execute that response, it enhances the way first responders and emergency managers are able to use those necessary assets. (ISACA 2017)*

Furthermore in the same editorial, case studies were presented where the IoT was utilized in emergency management. Both case studies involved public safety agencies which faced barriers to deploy IoT technologies and later sought out partnerships with organizations that could assist in deployment. ISACA concluded from the case studies,

> For agencies that don't have the resources or know-how to manufacture devices, partnerships with other agencies and academic institutions are a smart way to quickly deploy IoT with minimal investment.

Understanding the potential of the internet is crucial to realize its importance during a disaster and how it can assist emergency management. Unfortunately, IoT requires adequate telecommunications infrastructure and bandwidth to operate, In many disaster cases, like the 2017 wildfires, disasters originate in rural areas where telecommunications infrastructure is lacking the most, creating barriers for emergency management from operating most efficiently using modern practices and technologies.

2017 October Wildfire Internet Outage Overview

In the Telecommunications Outage Survey, a question asked about the status of the respondent's internet service *at their residence* during the wildfires. According to Figure 17, 98% of the NBNCBC respondents[42] have internet at home; and, out of the 98% of residents who have internet, 3% of the respondents couldn't report on their service status because their home burned down; and, an additional 17% of the respondents didn't know if they lost internet service due to power outages or other reasons. Factoring out those respondents, 78% of the respondents knew the status of their internet service at their residence during the wildfires. Further, out of the 2,585 respondents (78%) who reported on impacts (if any) to their normal internet service, 68.5%

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[40] http://www.isaca.org/Groups/Professional-English/cybersecurity/GroupDocuments/IoT%20in%20the%20Public%20Sector.pdf
[41] https://www.isaca.org/pages/default.aspx
[42] See the zip code spreadsheet for a complete listing of individual zip codes for each county with all data for cellular service losses in Appendix B.

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reported they lost some to all service and 31.5% reported their cell phone worked as normal at their residence during the wildfires.

Did you lose your Internet service at your residence?	Responses	
I don't have Internet at my home	2%	66
No -my Internet worked as normal	25%	813
Yes - my house burned down	3%	85
Yes - I lost all Internet service and my house did not burn down	47%	1559
Yes - I lost some service (Internet was slowed down)	6%	213
I don't know because my power was out	11%	361
I don't know	6%	204
	Answered	3301

Figure 17: (Source: Firestorm Mendocino-Napa-Sonoma Telecommunication Outage Survey Issued by North Bay North Coast Broadband Consortium)

Of those residents who lost internet service, 41% drove to another location (neighbors, local wifi hotspot, evacuation center, and library) to connect to the Internet. 18% were able to use their cell phone as a hotspot, and 22% were not able to connect even though they wanted to.

Internet outages affected (22) internet provider services over the 3-county region; however, not all (22) providers are available within each County. The graph below identifies providers in the 3-county region and the overall impact the wildfires had on the providers' service. Due to the high number of providers, not all of the providers are illustrated in the graphs; although, the complete set of data including all providers' information is attached in Appendix G for reference. The providers listed below experienced the largest impact for the 3-county region.
As shown in the graph below,

- 73.2% of Comcast internet subscribers reported a loss of their services, while 26.8% said their services performed as normal.
- 69.1% of AT&T internet subscribers reported a loss of their services, while 30.9% said their services performed as normal.

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- 46.2% of Pacific Internet subscribers reported a loss of their services, while 53.8% said their services performed as normal.
- 85.1% of Pacific Internet subscribers reported a loss of their services, while 14.9% said their services performed as normal.
- 67.2% of Century Link internet subscribers reported a loss of their services, while 32.8% said their services performed as normal.
- 37.5% of Sonic.net internet subscribers reported a loss of their services, while 62.5% said their services performed as normal.
- 100% of WillitsOnline internet subscribers reported a loss of their services.
- 26.3% of satellite internet subscribers reported a loss of their services (Hughes, Exede), while 73.7% said their services performed as normal.
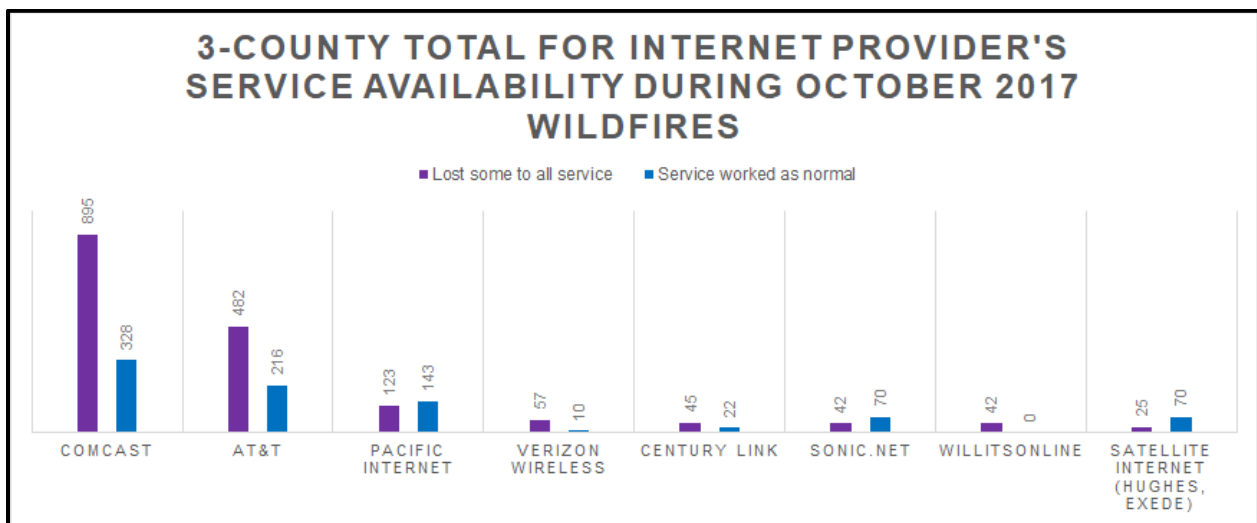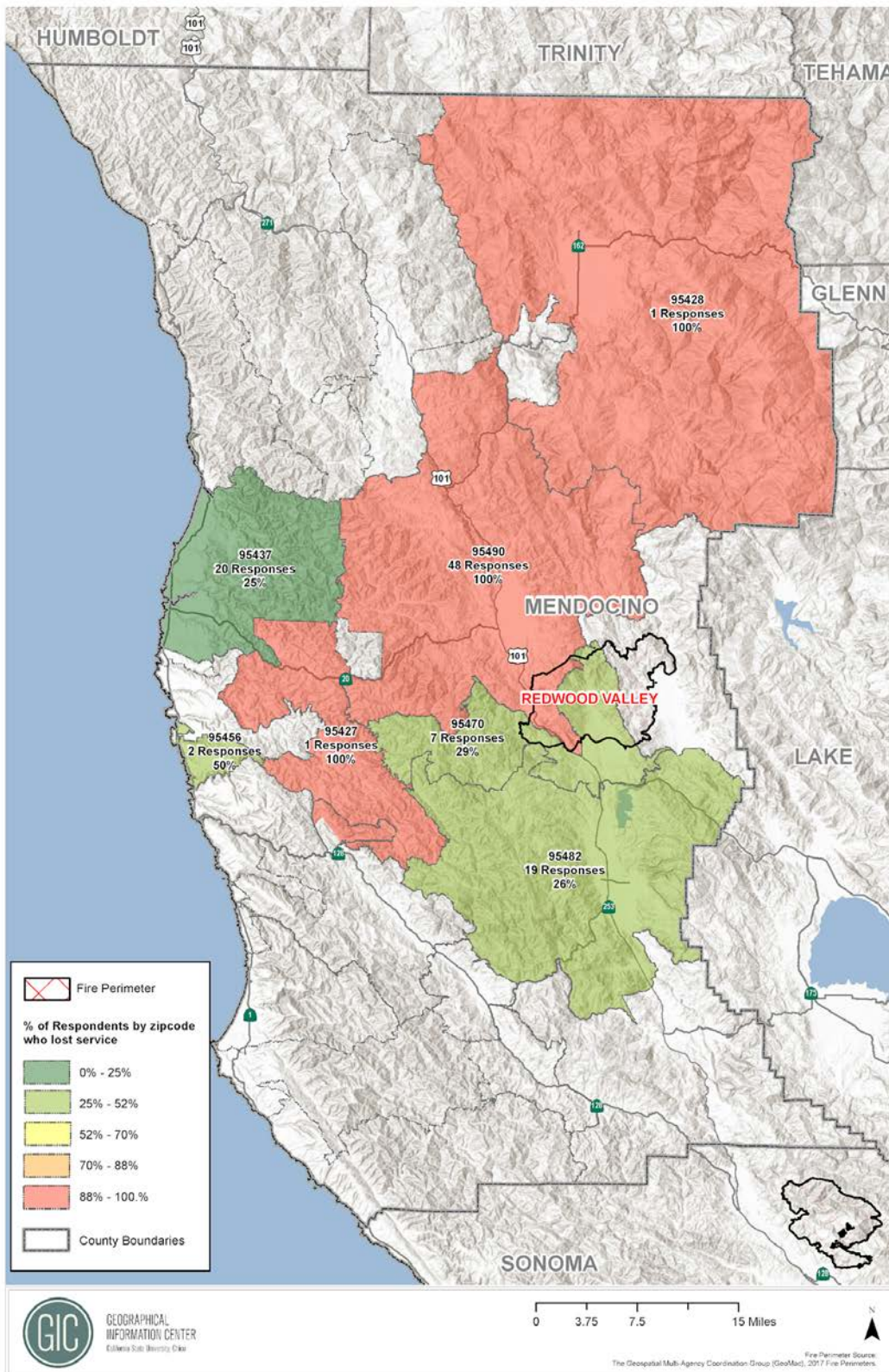

Figure 18: (Source: Firestorm Mendocino-Napa-Sonoma Telecommunication Outage Survey Issued by North Bay North Coast Broadband Consortium)

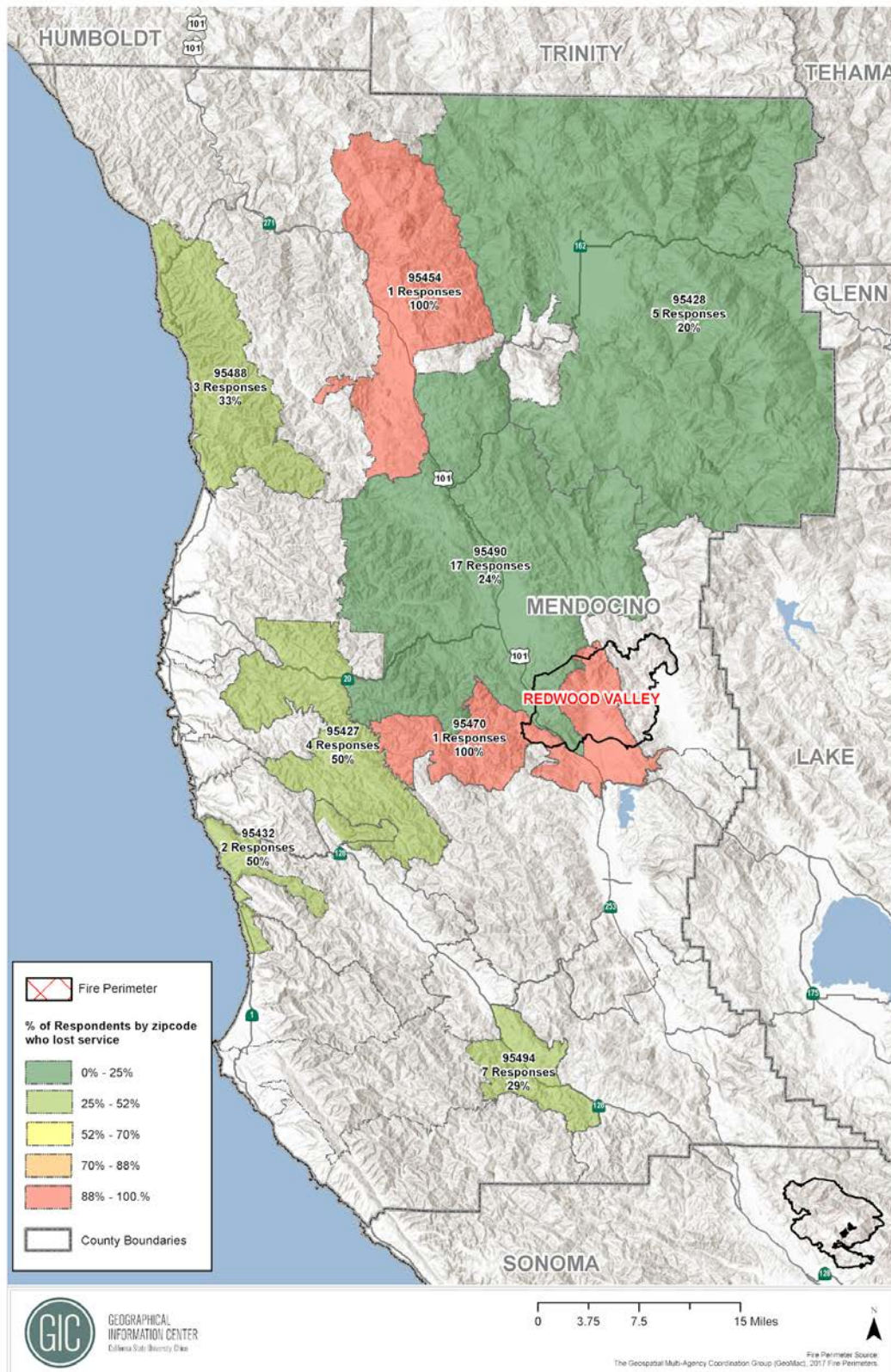# Geographic Extent of the Loss of Internet Services

In the 3-county region, 69% of respondents claimed to have lost some to all internet service; and more precisely, 54% of the respondents reporting losing some to all internet service in Mendocino, 73% in Napa, and 70% in Sonoma. This section of the report attempts to examine the extent and scope of the landline outage, and to determine how far outside the actual fire zones landline access and services were impacted. In the maps below, data show that the internet outages occurred regionally across 45/70 zip codes[43].

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[43] See the zip code spreadsheet for a complete listing of individual zip codes for each county with all data for landline service losses in Appendix B.

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MENDOCINO County - Comcast Internet Service Lost in 2017 Fires

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MENDOCINO County - Satellite Internet (Exede, Hughes) Service Lost in 2017 Fires

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MENDOCINO County - AT&T Internet Service Lost in 2017 Fires

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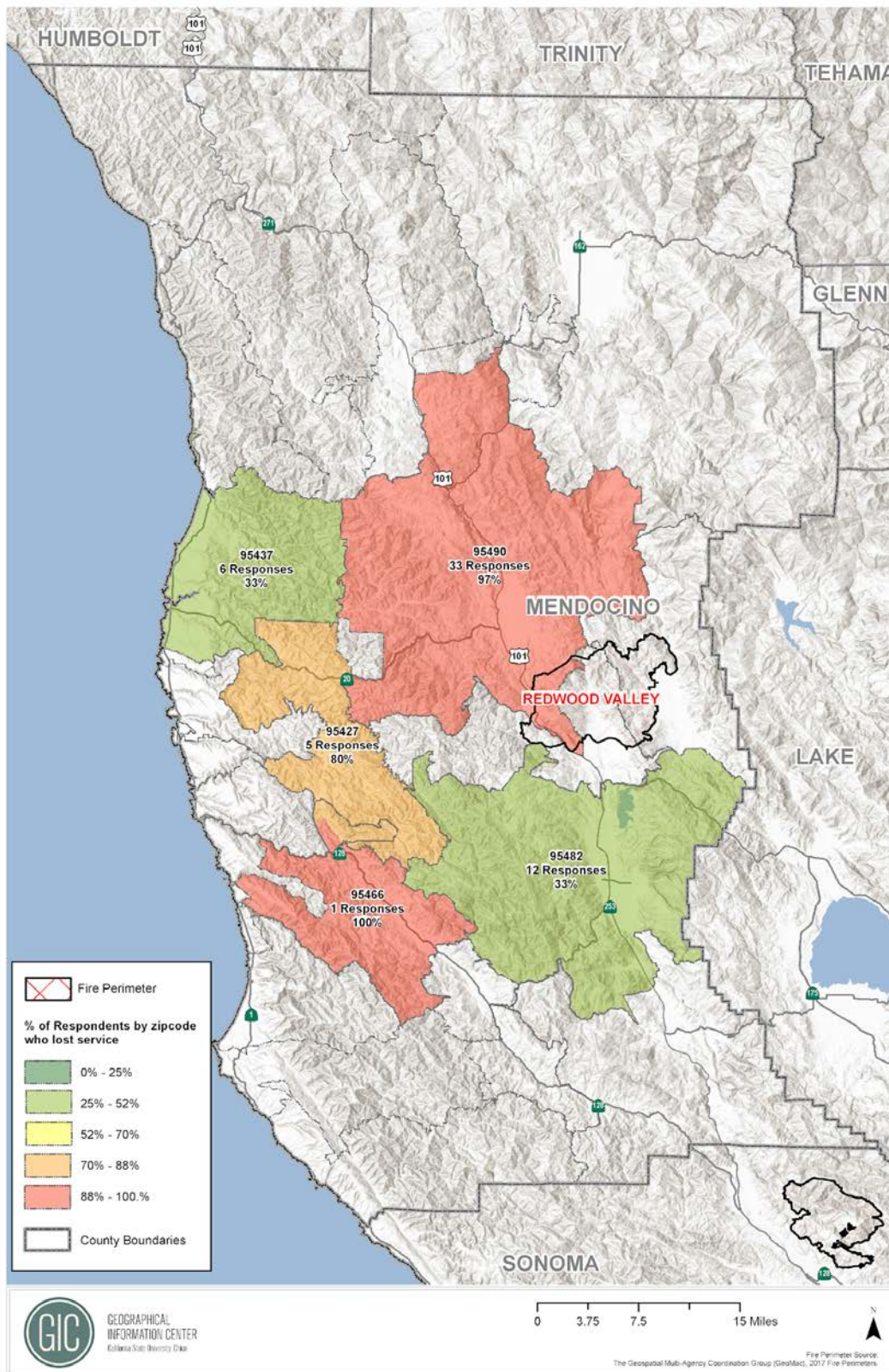
MENDOCINO County - WillitsOnline Internet Service Lost in 2017 Fires
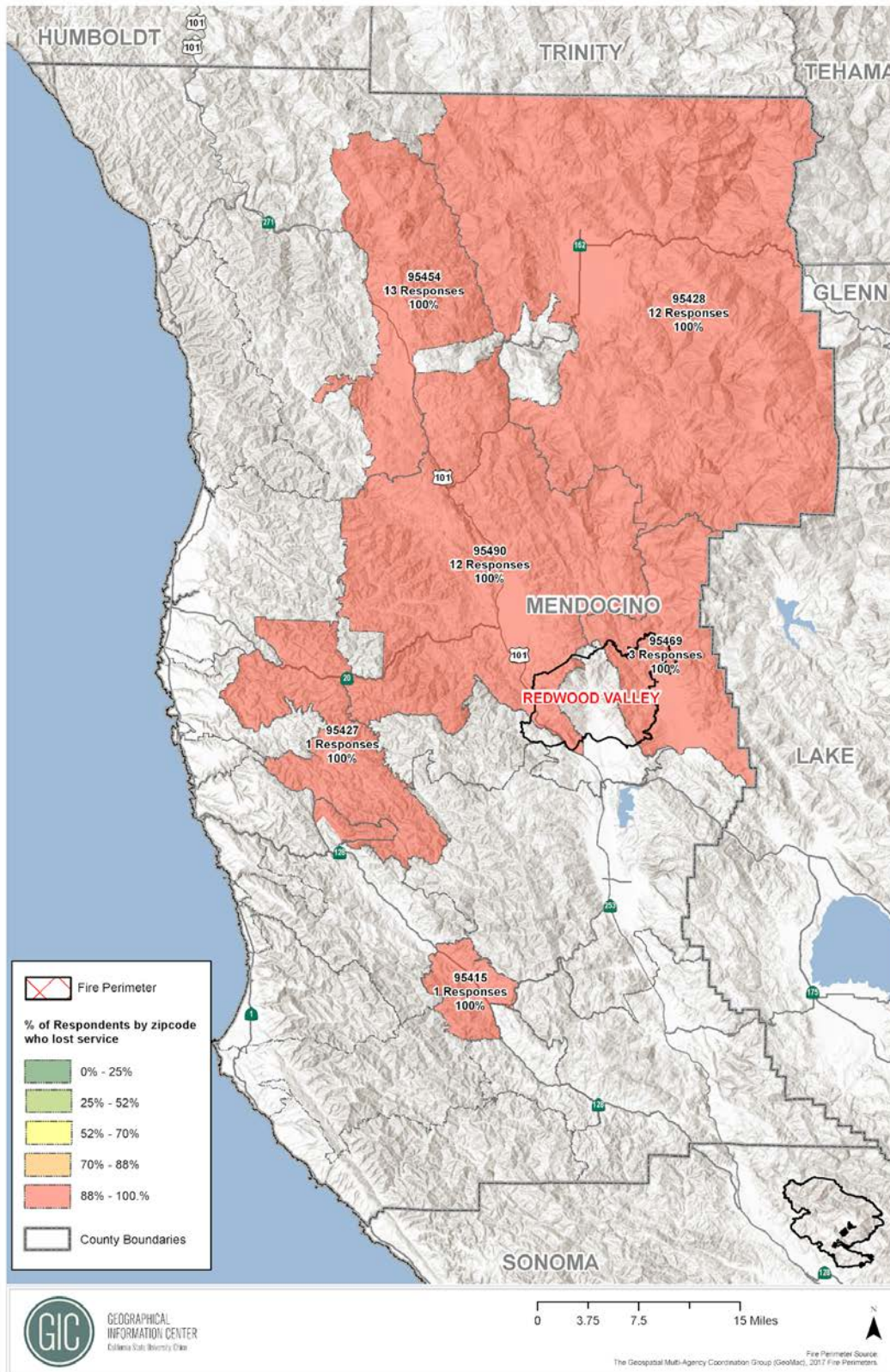
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NAPA County - Comcast Internet Service Lost in 2017 Fires

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NAPA County - AT&T Internet Service Lost in 2017 Fires

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SONOMA County - Comcast Internet Service Lost in 2017 Fires

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SONOMA County - AT&T Landline Service Lost in 2017 Fires

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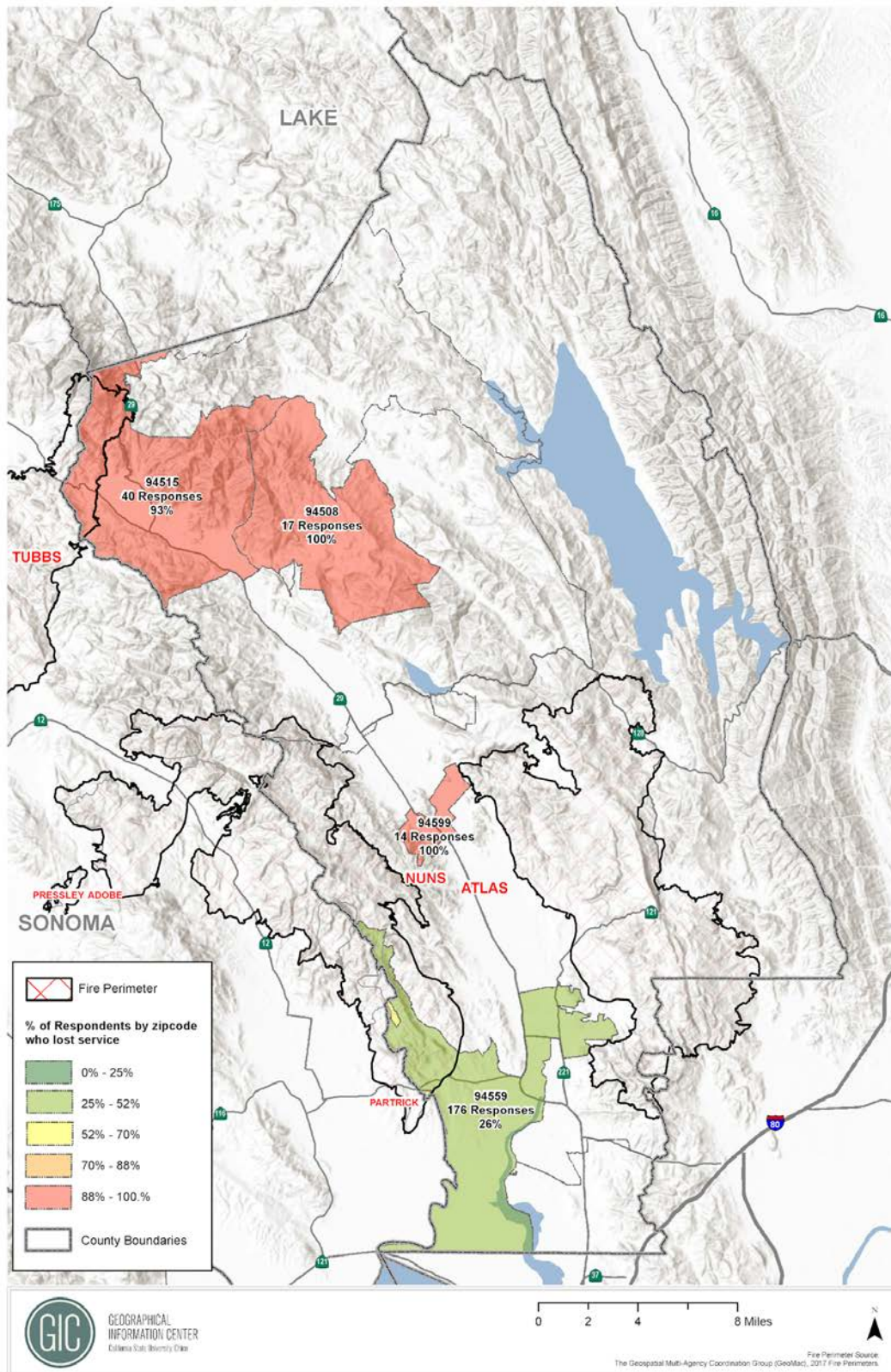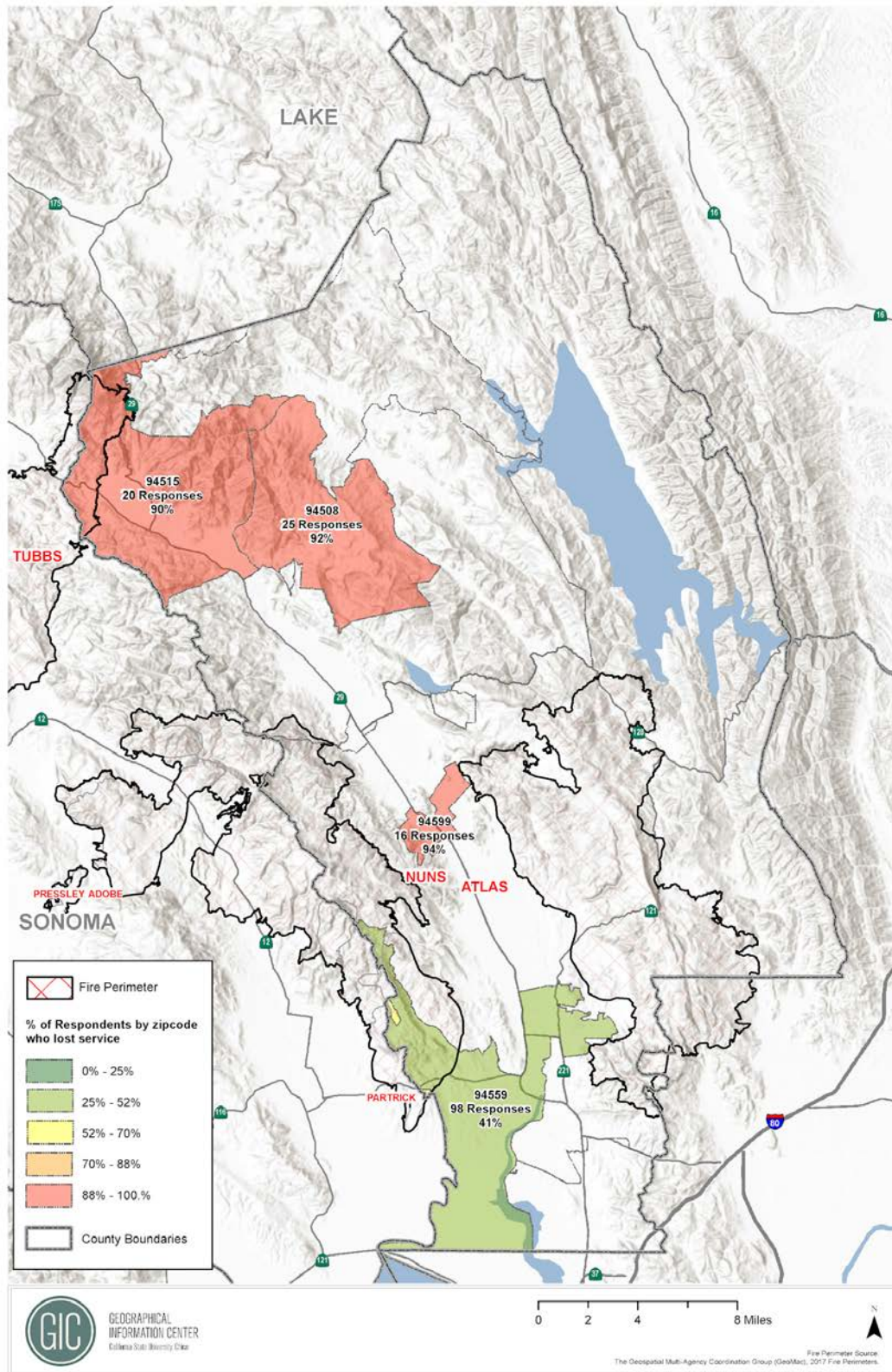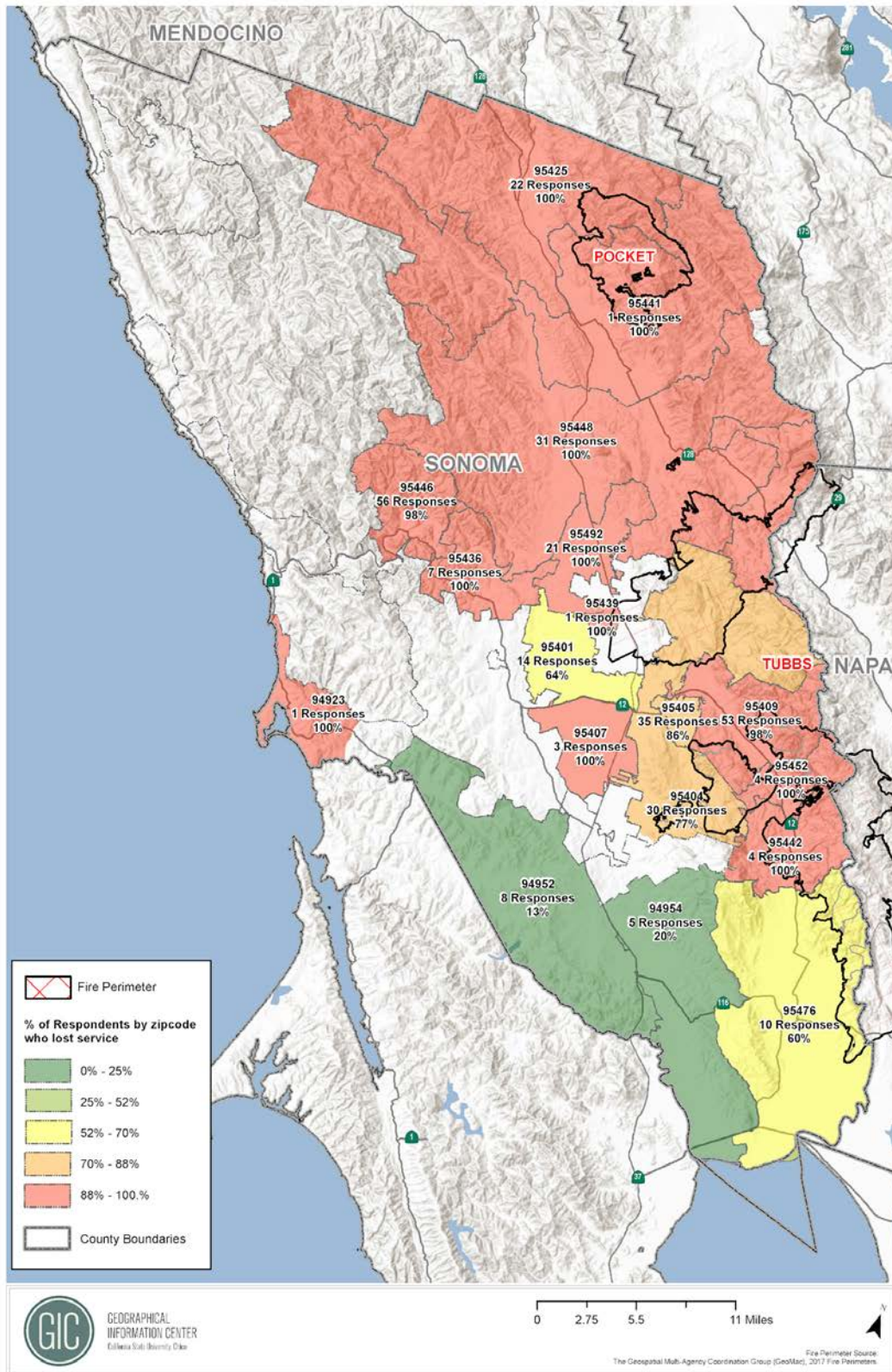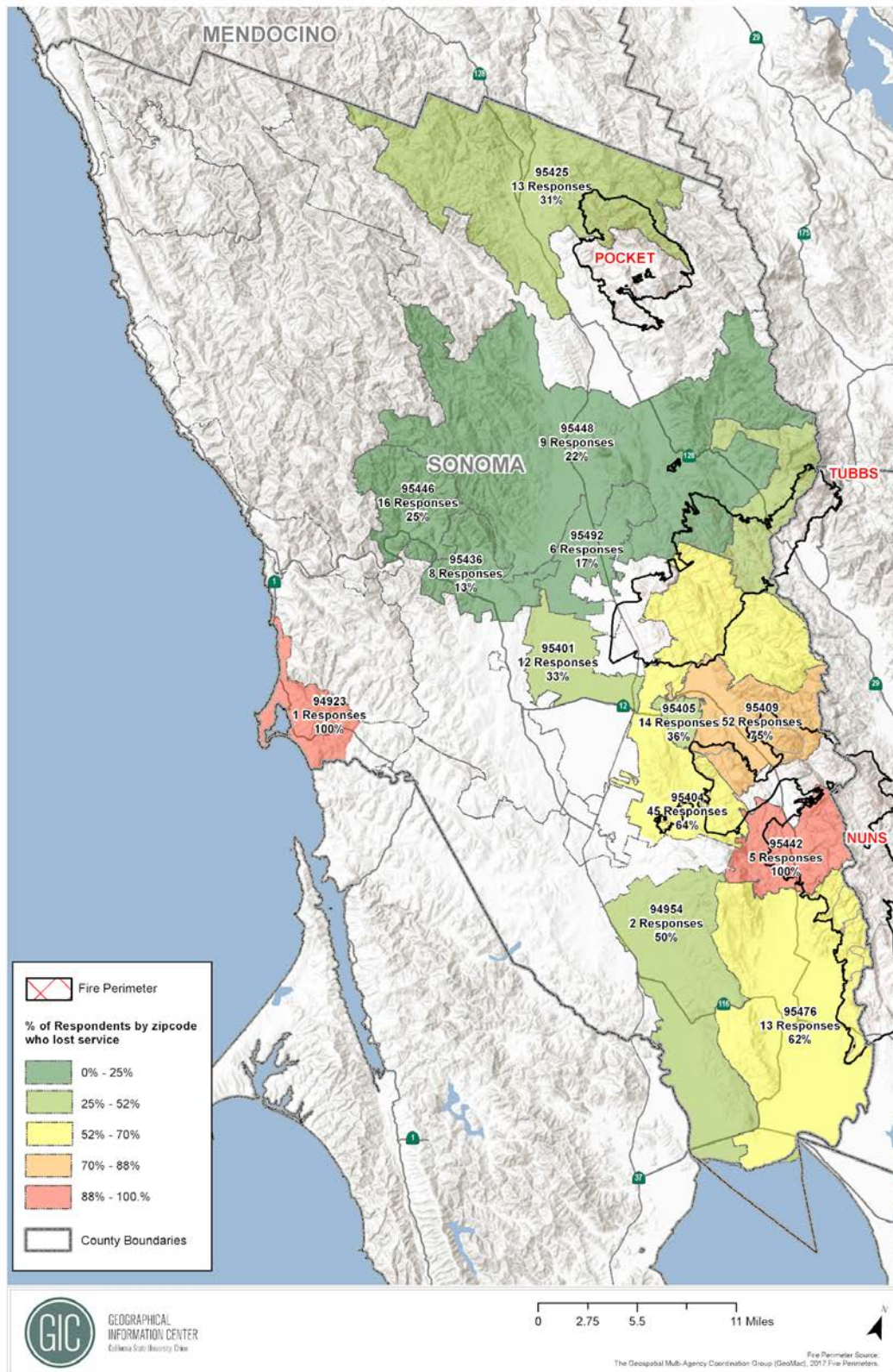
SONOMA County - Sonic.net Internet Service Lost in 2017 Fires

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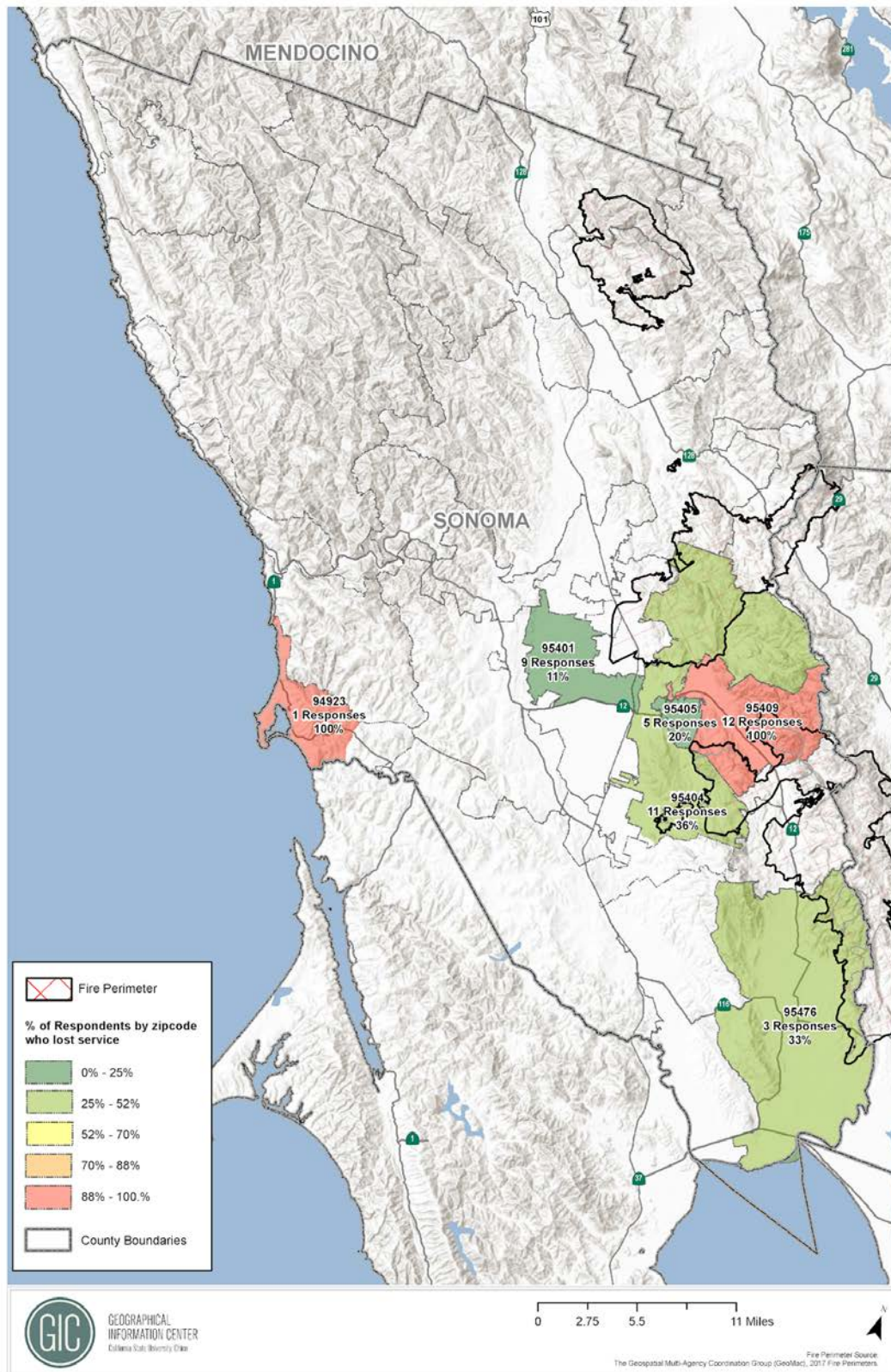
Internet Data Complications

In addition to the data complications mentioned in the introduction of this report that apply to all three services, data complications pertaining only to internet services are listed in this section. The data provide challenges to conclude the complete geographic extent of the loss of internet services due to multiple factors, including:

1.) **Leasing of other providers assets**
It is common for many smaller sized[44] ISPs to lease backhaul services from lager sized ISPs. If a larger ISPs network is disrupted somehow, the result affects anything attached to their network, including the services of other providers. Therefore, the internet outages experienced by smaller ISPs during the wildfires could be because another providers assets were damaged or destroyed by the wildfires.

2.) **Difference in internet transmission, services, and speeds**
There are various technologies used to transmit internet services which directly affect the capacity and bandwidth capability the service products can provide. The difference in technologies causes further discrepancies in the data. For example, fiber optics services generally provide **much** faster internet speeds than satellite internet services do, and disruptions in gigabit service are not always equivalent to disruptions in megabit service. Therefore, service disruptions in different service technologies are more effectively analyzed independently; however, when analyzing the overall impact and geographic extent of the internet outages in this report, all internet technologies are included in the analysis.

Restoration of Internet Service

The Telecommunications Outage Survey asked a question about the duration of time before residents' internet services were restored. Excluding the responses from those who replied "Not Applicable" and "I don't know", the remaining 1,846 respondents who experienced a cellular outage reported the duration of time before their cellular service was restored. From the data, 4.23% of the respondents reported having service restoration within 12 hours,
5.69% within 24 hours, 24.27% within 2 days, 23.62% within 3 days, 16.36% within 4 days, 21.94% longer than 4 days, and 2% were still waiting for their service to be restored at the time they took the survey. These results are similar to that seen for landline and cellular service restoration.

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[44] Smaller sized ISPs refer to providers who do not have as large of a footprint in a region's market as much as other larger ISPs do.

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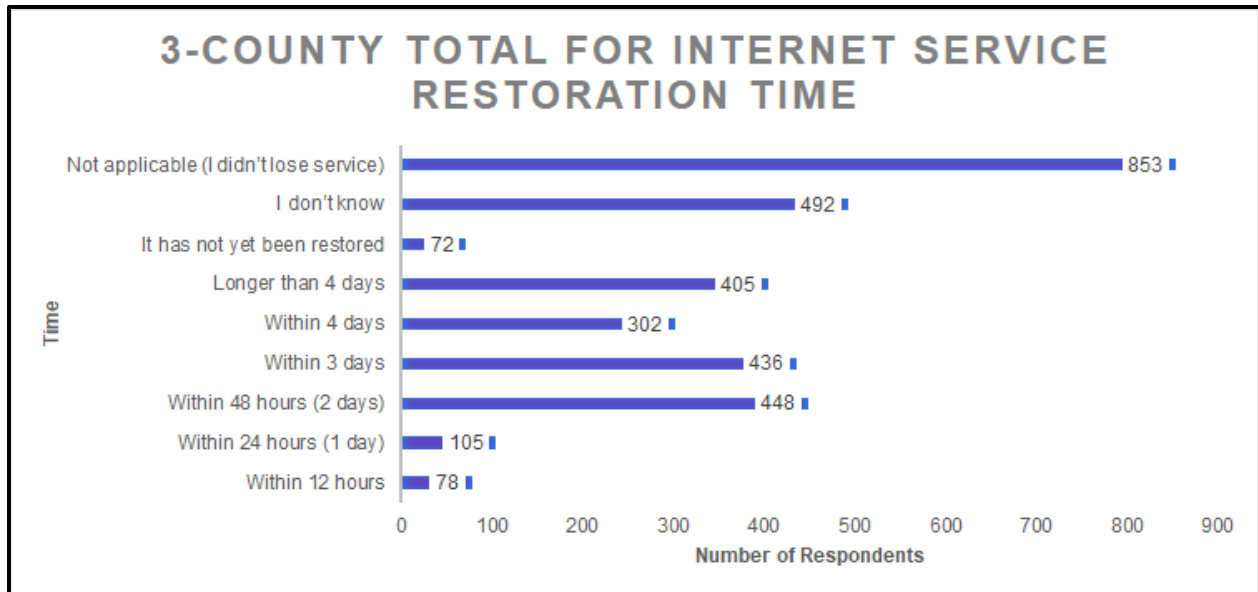## 3-COUNTY TOTAL FOR INTERNET SERVICE RESTORATION TIME

Figure 19: (Source: Firestorm Mendocino-Napa-Sonoma Telecommunication Outage Survey Issued by North Bay North Coast Broadband Consortium)

SUMMARY OF ALL OUTAGES

This survey found that the three telecommunications services this report focused (landline, cellular, and Internet) were impacted in geographic areas far from the actual burn areas in all three counties. All outages incurred their own issues, impacting residents' ability to communicate during the emergency. Summaries of all outage impacts are separately summarized below for each county in the 3-county region.

Napa County: Napa County received a 1.43% survey response rate in the 3-county region (of its estimated 140,973 population (Census Bureau 2017)). Napa County seemed to also have the most severe telecommunications impacts of the 3-county area; every zip code in Napa reported an impact from either landline, cellular, and/or internet outages. Overall in Napa County, 67% of respondents reported experiencing a landline outage, 87% of respondents reported cellular outages, and 73% of respondents reported experiencing an internet outage.

Mendocino County: Mendocino County received a 0.67% survey response rate from its estimated 88,018 population (Census Bureau 2017). Only three zip codes did not report any impacts from landline, cellular, and/or internet outages. The zip codes that *didn't* report any outage impacts include:

- 95481 - Talmage
- 95585 - Leggett
- 95587 - Piercy

Overall in Mendocino County, 66% of respondents reported experiencing landline outages, 75% of respondents reported cellular outages, and 54% of respondents reported experiencing internet outages.

Sonoma County: Sonoma County received a 0.2% survey response rate from its estimated 504,217 population (Census Bureau 2017). Many zip codes did not report any impacts from landline, cellular, and/or internet outages. The zip codes that didn't report any outage impacts include:

- 94922 - Winery
- 94951 - Penngrove
- 94953 - Petaluma
- 94955 - Petaluma
- 94972 - Valley Ford
- 94975 - Petaluma
- 95999 - Petaluma
- 95402 - Santa Rosa
- 95406 - Santa Rosa
- 95408 - Santa Rosa
- 95419 - Camp Meeker
- 95430 - Duncans Mills
- 95433 - Eldridge
- 95444 - Graton
- 95450 - Jenner

Overall in Sonoma County, 64% of respondents reported experiencing landline outages, 59% of respondents reported cellular outages, and 70% of respondents reported experiencing internet outages.

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SUMMARY OF OTHER IMPACTS

Concurrent Power Outage

This disaster not only saw devastating fires and widespread telecommunications outages, but also concurrent power outages. When a telecommunications outage occurs in conjunction with a real disaster such as a wild fire and a concurrent power outage, the negative impacts on residents increase in magnitude. 58.17% of 3,287 respondents reported experiencing a power outage at their residence, while 41.83% did not. Understanding the impact power outages had on telecommunications networks during the wildfires is important to identify any gaps or major issues involved in the interconnected relationship of power and telecommunications networks.

A multiple-choice question in the survey asked respondents to describe all power-outage related effects that applied to them; and out of the 2,105 responses, the majority (76.96%) of the respondents reported a loss of communications affecting them during the fire (including evacuation). In addition to the multiple choices respondents could select from, a free response option was included to answer the question, accumulating 380 "Other" responses[45].

How did the power outage affect you during the fire (including evacuation)?	Responses	
The power outage negatively affected my ability to evacuate	14.63%	308
I lost communications because of the power outage (TV, Wi-fi, or phone)	76.96%	1620
I lost ability to re-charge my devices	63.47%	1336
My medical devices would not work (CPAP, etc)	9.55%	201
My garage door opener would not work	43.23%	910
My outside electric security gate would not function	4.89%	103
My electric car could not charge	2.85%	60
I had no water because my well pump/pressure system was down	15.87%	334
My yard sprinkler system was down	23.90%	503
My home electronic lock system failed	2.14%	45

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[45] The 380 "Other" responses for how the power outage affected residents can be found in Appendix H.

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My home security system failed	11.50%	242
My home air filtration system failed (HVAC)	22.61%	476
It did not affect me	8.08%	170
Other (please specify)	18.05%	380
	Answered	2105

Figure 20: (Source: Firestorm Mendocino-Napa-Sonoma Telecommunication Outage Survey Issued by North Bay North Coast Broadband Consortium)

Power Restoration

The majority of respondents (23%) reported their power being restored within two days, while 22% reported their power being restored longer than 4 days after their power initially failed.
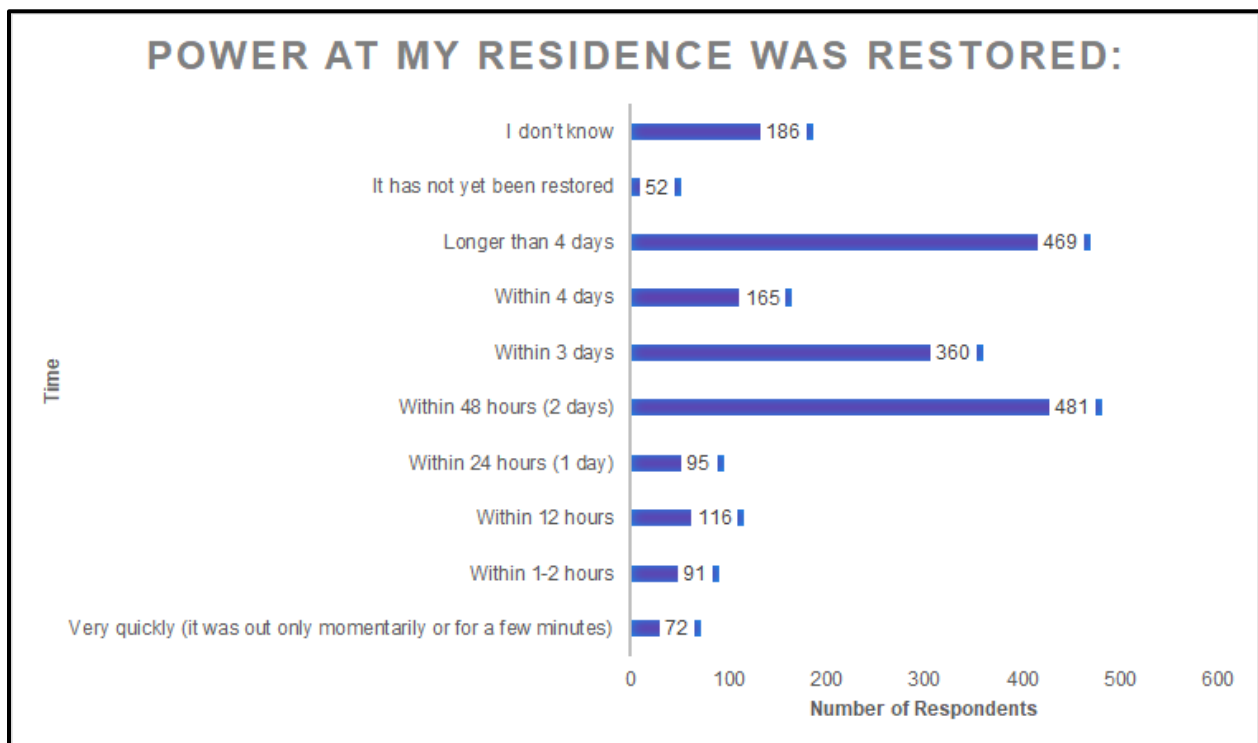
Figure 21: (Source: Firestorm Mendocino-Napa-Sonoma Telecommunication Outage Survey Issued by North Bay North Coast Broadband Consortium)

Evacuation

Understanding the overall scope of evacuation during the wildfires can help to identify gaps and major issues in telecommunications networks and notification systems by providing perspective on what residents actually experienced during their evacuations. According to Figure 22, a majority (29.72) of 3,614 respondents' residences were near an evacuation zone, while 22.61% were in a mandatory evacuation zone.

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| Residential Evacuation	Responses	
My residence was burned by the fire	2.99%	108
My residence was in a mandatory evacuation zone	22.61%	817
My residence was in a voluntary evacuation zone	12.98%	469
My residence was near an evacuation zone (within 5 linear miles)	29.72%	1074
My residence was not in an evacuation zone	31.71%	1146
	Answered	3614

Figure 22: (Source: Firestorm Mendocino-Napa-Sonoma Telecommunication Outage Survey Issued by North Bay North Coast Broadband Consortium)

As a result of the various telecommunications outages; and the impact the power outages had on communications during the emergency, evacuation became very difficult for residents since many failed to have a reliable source of notification to evacuate. A multiple-choice question in the survey asked how the respondents were notified to evacuate, where a majority (22%) of 1,627 respondents reported they "did not receive any warning from anyone outside their own home." In addition to the multiple choices respondents could select from, a free response option was included to answer the question, accumulating 279 "Other" responses[46]. The complete list of responses is shown below in Figure 23.

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[46] The 279 "other" responses for how residents were warned to evacuate can be found in Appendix I.

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When you evacuated your residence, how did you receive warning/notice to evacuate?	Responses	
I did not receive any warning from anyone outside my own home	23.48%	382
I received a reverse 9-1-1 call	3.50%	57
I received a phone alert of some kind (text alert, amber alert, etc)	15.67%	255
I heard a power outage alarm at my home	1.23%	20
I received warning from a neighbor physically at my door	12.05%	196
I received a phone call from a neighbor, family or friend	13.52%	220
I received warning from a public safety official physically at my door	6.88%	112
I heard sirens/bullhorns/public safety officials outside my home	3.44%	56
I received notice on the radio	2.03%	33
I received notice from a press event	0.86%	14
I received notice from a ham radio operator	0.18%	3
Other (please specify)	17.15%	279
	Answered	1627

Figure 23: (Source: Firestorm Mendocino-Napa-Sonoma Telecommunication Outage Survey Issued by North Bay North Coast Broadband Consortium)

Evacuation Time

A question in the survey asked evacuees how much time they had before leaving their residence, and a majority (22.22%) of the 1,616 respondents reported having 1-5 hours to evacuate their homes. The time residents had to evacuate their homes ranged from "literally seconds" to "more than four days", forcing some to escape their homes with nothing due to the lack of time, while other residents had sufficient time to collect some belongings. The impact of telecommunications and power outages on communications systems correlates to the amount of time residents have to evacuate their homes.

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In Figure 24, a complete list of results are shown. This data highlight the importance of access availability to a reliable communications system that is resilient and can effectively notify residents of an emergency, giving them a better chance to prepare for evacuation.

When you evacuated your residence, how much time did you have before leaving?	Responses	
Literally seconds	1.11%	18
Less than one minute	0.56%	9
One to two minutes	1.42%	23
2 to 5 minutes	3.16%	51
5-10 minutes	6.93%	112
10-20 minutes	8.66%	140
20-60 minutes	14.05%	227
1 hour - 5 hours	22.22%	359
5-10 hours	5.88%	95
10-24 hours	7.12%	115
1-2 days	13.06%	211
2-4 days	8.91%	144
More than 4 days	6.93%	112
	Answered	1616

Figure 24: (Source: Firestorm Mendocino-Napa-Sonoma Telecommunication Outage Survey Issued by North Bay North Coast Broadband Consortium)

The amount of time to prepare for evacuation is not only crucial for residents, but also for the thousands of animals impacted as well. Within the NBNCBC region, agriculture is a major industry, and farmers or ranchers who had to evacuate were required to account for any animals living on the farm or ranch. Furthermore, evacuating with pets/livestock required their owners would have to find a place that would accept them: In a free response detailing a respondent's personal experience, they said, "My family evacuated with 4 dogs, horse, 4 chickens, and 6 cats. Friends had evacuated to our house with their horse, goats, chickens, dogs, cats and kittens. All together there were about 30 animals and 5 humans."

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Even more distressing was leaving pets, horses and livestock behind to a terrifying fate; an untold number of animals were injured and died in the fires or their aftermath: "Due to the fact we had no prior warning we were forced to leave our horses behind to fend for themselves. What a horrible thing for them to go through. They were all injured, frightened and one has since died of a heart attack."

There are many other scenarios where notification timing is crucial, correlating directly to the need for a resilient and redundant telecommunications network and/or communications system.

Availability of Information

In addition to having adequate time to evacuate, access to *accurate* information is pivotal for emergency evacuation planning. Lack of access can lead to inefficient planning, potentially resulting in the worst-case scenarios. When a resident has access to multiple forms of communication (e.g. internet, cellular, landline, radio, TV, in person, sirens, etc.) the information provided by each service collectively increases the overall accuracy of guidance; correspondingly, when a service fails to function, such as a major telecommunications outage, the accuracy, as well as scope, of information decreases.

When asked how informed respondents felt during first 48 hours of the fires (Monday 10/9 and Tuesday 10/10), the majority (30.43%) of 3,010 respondents felt "minimally informed about what was happening". Figure 25, shows the complete list of responses.

For the first 48 hours of the fire (Monday, Tuesday), overall I felt:	Responses	
Very informed about what was happening	9.80%	295
Informed about what was happening	17.24%	519
Somewhat informed about what was happening	26.41%	795
Minimally informed about what was happening	30.43%	916
Not informed about what was happening	0.00%	0
Completely in the dark about what was happening	16.11%	485
	Answered	3010

Figure 25: (Source: Firestorm Mendocino-Napa-Sonoma Telecommunication Outage Survey Issued by North Bay North Coast Broadband Consortium)

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Life-Safety Risk

A question in the survey asked the respondents if they felt the lack of telecommunications services at any point endangered their life or that of their family, and a majority (27.32%) of 2,767 respondents claimed "no"; meanwhile, the remaining 72.68% of respondents claimed to feel "minimally" to "very much" endangered by the lack of telecommunications services during the fire. Figure 26 shows a complete list of responses.

Did you feel like the lack of telecommunications services at any point in the fire endangered your life or that of your family?	Responses	
Yes very much so	15.54%	430
Yes	16.99%	470
Somewhat	21.86%	605
Minimally	18.29%	506
No	27.32%	756
	Answered	2767

Figure 26: (Source: Firestorm Mendocino-Napa-Sonoma Telecommunication Outage Survey Issued by North Bay North Coast Broadband Consortium)

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IN THEIR OWN WORDS

After the wildfires occurred, public meetings were, and still are, being held to find solutions to all the major issues associated with the wildfires. At public meetings, public participants are provided the opportunity to speak and express their opinion to the other attendees. While these meetings are productive in identifying issues and solutions, not all public participants are given the opportunity to speak due to time restraints, inability to attend, etc., possibly causing many issues and/or solutions to be overlooked or unaddressed. If the Telecommunications Outage Survey is recognized similarly to a public meeting, held to identify major issues and solutions relating to telecommunications outages, then all 3,705 survey respondents were given the chance and time to speak and express their comments on the matter.

Survey respondents were given the option to answer two separate free response questions:

1.) PERSONAL STORIES:
Optional - If you want, please share your story of your experience with this fire. Important: Your story may be made public but only anonymously (please keep personal details out). However, if you want to have your name associated with your story (which again, may be made public) you may do so by typing your name at the end of your story, and your name will not be removed/redacted.

2.) CPUC COMMENTS:
What would you like to tell the California Public Utilities Commissioners and your elected officials with regards to this fire and telecommunications? You can choose to put your name after your comment, but this may be made public. To keep your comment anonymous, don't include your name.

The 1st open-ended question received 746 written responses, a 30% responses rate of all residents. For those who shared, a complete collection of personal stories can be found in Appendix J. It is encouraged to read the accounts to better understand what residents faced during these fires. The stories offer a range of experiences, from the matter-of-fact and mundane, to vivid and emotional stories of evacuation with only seconds to spare. There are narratives of residents feeling isolated and cut off from the world, heroics and neighbors helping neighbors, residents who had no choice but to leave behind beloved animals to an unknown and terrifying fate, and unfortunately, many more tragic stories to read. These accounts should create inspiration to constantly improve public safety networks for the sake of all communities.

The 2nd open-ended question elicited 1,396 written responses, a 55% response rate of all survey respondents. Again, for those who shared, a complete list of comments to the CPUC can be found in Appendix K. The comments' intentions vary; but overall, they revolve around providing

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suggestions and potential solutions to major issues, along with praising and/or criticizing current systems of multiple agencies. Many comments express emotion and reflect personal experiences such as those found in the previous question; however, all information provided is useful to understand in detail the diverse impacts of the wildfires. These comments can be analyzed by the CPUC and/or public officials to understand the public's needs and incorporate their information into future decision-making that results in finding solutions to major wildfire related issues.

Data Analysis and Methodology

Collectively, both free response questions received 2,142 responses; and, many responses ranged from a few sentences to a few pages. It is important when analyzing qualitative data to find a methodology that omits as much bias as possible, especially for a large amount of responses as those received in the outage survey. The two free response questions were analyzed using the following methodology.

1.) Initially reading through 20-30 stories and comments from each question, commonly used key-words and phrases were identified.
2.) Using those key-words and phrases, relatable category topics were created.
3.) All 2,142 comments were filtered through using the identified key-words and phrases and any comments containing the key-words and phrases were categorized to their related category.
4.) Again, commonly used key-words and phrases were identified to capture remaining uncategorized comments to categorize in their relatable categories.

It should be noted that the above methodology is not perfect or free from bias; however, the methodology is uniform in analysis among all comments, creating consistency. In addition, the methodology requires less resources and time to analyze the data; and due to the urgency of time and the "norm" of annual wildfires, the methodology was considered most effective for analyzing the large amount of qualitative data.

Summary of Free Response Answers

PERSONAL STORIES

Ten (10) main categories were created using commonly used key-words and phrases from PERSONAL STORIES and are listed in the chart below, in order from those with the most responses to those with the least. Category descriptions and key-word/phrases associated with the categories are also included. Communication was a key issue that was mentioned by 76% of all responses. Over half of the stories (54%) also included some emotional response and about half (54%) included the theme of evacuation.

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1	Category: **COMMUNICATION.** <u>Response # in this category</u>: **567** of 746 (76%). <u>Explanation:</u> The respondent(s) discussed how they communicated with others during the wildfires. They may have discussed what technologies or services worked and/or what didn't work as effective means of communication. They may have also discussed how they stayed updated on wildfire related news. Key words/phrases: Communication, tv, t.v.,service, wifi,Wi-Fi, Verizon, Comcast, AT&T, ATT, Sonic, satellite, Sprint, landline, telephone, scanner, cell, cellular, ham radio, voip,VoIP, Internet, information, texts, facebookFacebook, news, radio, KLLK, KZYX, KVYN, KSRO, KOZT, KVON, maps, Spanish, other than english, translate.
2	Category: **EMOTIONAL RESPONSE.** <u>Response # in this category</u>: **405** of 746 (54%). <u>Explanation:</u> The respondent(s) expressed some form of emotional opinion or response regarding any subject, including the major categories. <u>Key Words/phrases</u>: vulnerable, terrifying, outraged, lucky, thank, thankful, confused, confusing, unnerving, scary, scarey,scary, sadness, freaked, grateful, l stress, frightened, frightening, stressful, worried, concerned, blessed, anxiety, hysteria, frustrating, ptsd, discouraging, fortunate, terrifying, terrified, fear, fearful, panicked, felt, forgotten, helpless , upset, afraid, hate, harrowing, tremble, pray, heartwarming
3	Category: **EVACUATION**. <u>Response # in this category</u>: **402** of 746 (54%). <u>Explanation:</u> The respondent(s) discussed the topic of evacuation, whether they had to evacuate or not. The response may have reflected a sequence of events that occurred in the evacuation process, including details of what, when, where, why, and who. <u>Key words/phrases:</u> evacuate, evacuation, displaced, leave now, got in the car, jumped in the car, told to leave, headed out, forced to leave, loading the car, relocated, grabbed, left everything, had to leave, get out, Left town, mandatory evacuation
4	Category: **POWER.** <u>Response # in this category</u>: **296** of 746 (40%). <u>Explanation:</u> The respondent(s) discussed the topic of power, including whether their power worked, or didn't work. They may have discussed how power affected their ability to communicate or not communicate, evacuate or not evacuate. <u>Key words/phrases:</u> power, grid, electricity, electric, underground, undergrounding, PG&E, PGE, Pacific Gas and Electric
5	Category: **WARNING/ALERT SYSTEM.** <u>Response # in this category</u>: **252** of 746 (34%). <u>Explanation:</u> The respondent(s) discussed the topic of warning and alert systems and how they were notified about the fire, or not notified about the fire. In this case, Warning/Alert System corresponds to any and all public safety services that communities rely on in times of emergencies. The discussion may have also related to criticisms or praises of all the various warning/alert systems for how people were warned or alerted. <u>Key words/phrases:</u> warning system, reverse 911, reverse 9-1-1, nixle, Sheriff, notified, COPE, alert system, amber alert, robo call, failed, police, notification, notify, notified, siren, CalFire, firefighters
6	Category: **NEIGHBORHOOD HELP.** <u>Response # in this category</u>: **187** of 746 (25%). <u>Explanation:</u> The respondent(s) discussed how they or others were helped by other community members, or how they or others helped other community members themselves. The help refers to how the community helped each other during the scope of the wildfires. The response may reflect help during: an initial warning/alert, evacuation, post evacuation,

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	temporary/permanent housing/shelter, food, supplies, supplies, etc. A specific timeframe for this category was not established. Key words: helped, helping, evacuees, saved me, neighbors, refugees, notified by neighbors, hosting, hosted, assist
7	Category: **PUBLIC SAFETY**. Response # in this category: **117** out of 746 (16%). Explanation: The respondent (s) discussed the topic of public safety officials. The response may reflect criticism or praise of public safety officials and their performance during the fires. The Fires. The response may reflect interactions the respondent(s) may have had with public safety officials during the fires and (or) evacuation. Key words/phrases: Firefighters, Firemen, Ambulance, scanner, maps (GIS from CalFire), Sheriff, Police, CalFire, Paramedic, Hospitals, first responders, emergency responders
8	Category: **CPUC RELEVANT DATA**. Response # in this category: **102** of 746 (14%). Explanation: The respondent(s) discussed topics that may be of importance to the CPUC. The discussion were determined as important if they contained key words that are commonly associated with PUC operations and administration. Key words/phrases: PUC, CPUC, Verizon, Frontier, telecommunications, utilities, telecoms, California Public Utilities Commission, Sprint, Infrastructure, there needs to be, Commissioners, Comcast, government, underground, AT&T, Sonic, ATT, investigation, please, examination
9	Category: **OTHER.** Response # in this category: **21** of 746 (3%). Explanation: The respondent(s) discussed various topics that were considered difficult to associate with the Major Categories. While the content of the comments are still recognized as useful information, there is not a significant amount of responses containing similar context to categorize these responses under a Major Category, besides "Other". Key words/phrases: (do we have any key words?)
10	Category: **NO PROBLEMS.** Response # in this category: **11** of 746 (1%). Explanation: The respondent(s) answer(s) did not reflect any significant impact relating to their wildfire experience. Key words/phrases: did not have any problems, no issues, no problems

CPUC COMMENTS

Eight (8) main categories were created using commonly used key-words and phrases from CPUC COMMENTS and are listed in the chart below, in order from those with the most responses to those with the least. Category descriptions and key words/phrases associated with the categories are also included. Again, communication was a key issue that was mentioned by 68% of all responses. Over half of the comments (53%) included mention of broadband, and slightly less than half (47%) included mention of the alert/warning system.

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1	Category: **COMMUNICATION.** Response # in this category: **946** of 1396 (68%). Explanation: The respondent(s) discussed how they communicated with others during the wildfires. They may have discussed what technologies or services worked and/or what didn't work as effective means of communication. They may have also discussed how they stayed updated on wildfire related news. Key words/phrases: Communication, KSRO, tv, update, not knowing, radio, KZYX, KLLK, KVYN, KOZT, KVON, telephone, VoIP, information, texts, maps, Facebook, satellite, news, landline, scanner, ham radio, Internet
2	Category: **BROADBAND.** Response # in this category: **741** of 1396 (53%). Explanation: The respondent(s) discussed the topic of broadband related items. Broadband refers to telecommunications services and infrastructure. In response to the question prompt, the discussion may relate to criticisms/praises/suggestions/questions associated with telecommunications services and infrastructure that may be important to recognize for future decision-making for various, topics related to Broadband. Key words/phrases: fiber, internet, copper, wireless, cellular, infrastructure, cell towers, satellite, connectivity, Wi-Fi, antenna, cellphones cable, copper, service, broadband, coverage
3	Category: **WARNING/ALERT SYSTEM.** Response # in this category: **657** of 1396 (47%). Explanation: The respondent(s) discussed the topic of warning and alert systems and how they were notified about the fire, or not notified about the fire. In this case, Warning/Alert System corresponds to any and all public safety services that communities rely on in times of emergencies. The discussion may have also related to criticisms or praises of all the various warning/alert systems for how people were warned or alerted. Key words/phrases: warning system, warning, reverse 911, reverse 9-1-1, nixle, Sheriff, bullhorn, COPE, alert system, amber alert, robo call, emergency broadcast system, scanner, notification, notify, notified, notifying, siren, knock, door to door, emergency system, procedure, backup, emergency, emergencies, emergency response
4	Category: **GOVERNMENT.** Response # in this category: **572** of 1396 (41%). Explanation: The respondent(s) discussed forms of regulations relating to various topics. The response(s) may reflect suggestions for improving regulations that directly result in public safety. Key words/phrases: law, laws, rules, regulation, policies, public, CPUC, PUC, procedure, OES, public officials, Boards of Sups, BOS, Board of Supervisors, Supervisors, County, City, government
5	Category: **UTILITIES**. Response # in this category: **487** of 1396 (35%). Explanation: The respondent(s) discussed the topic of utilities services and/or infrastructure. Since PG&E is the electric and gas provider for the regions affected by the wildfires, the respondent(s) may have discussed their role during the fires and in post fire recovery. The response(s) may detail any utility infrastructure that was damaged by the fires or remained safe from fire damage. The response(s) may suggest public/private action to create more resilient utility infrastructure that can withstand future natural disasters. Key words/phrases: PGE, PG&E, PG & E, Utilities, power, water lines, gas, electric transmission, outage, power lines, telephone poles, damaged, phone lines, transformer, underground, bury, burying, wires, maintenance, infrastructure

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6	Category: **PUBLIC SAFETY**. Response # in this category: **459** of 1396 (33%). Explanation: The respondent (s) discussed the topic of public safety officials. The response may reflect criticism or praise of public safety officials and their performance during the fires. The response may reflect interactions the respondent(s) may have had with public safety officials during the fires and (or) evacuation. Key words/phrases: policemen, county enforcement, firefighters, firemen/fireman, ambulance, maps (GIS from CalFire), sheriff, police, CalFire, paramedic, hospitals, first responders, emergency responders
7	Category: **INTERNET SERVICE PROVIDERS.** Response # in this category: **203** of 1396 (15%). Explanation: The respondent(s) discussed the topic of Internet Service Providers/Local Exchange Carriers. The discussion may reflect criticism/praise/questions regarding the provider's service performance throughout the fires. The response may also reflect potential suggestions or requests for future action and decision-making. Key words/phrases: ATT, Verizon, Sprint, Comcast, Frontier, Sonic, T-Mobile, provider, ISP
8	Category: **OTHER.** Response # in this category: **62** of 1396 (4%). Explanation: The respondent(s) discussed various topics that were considered difficult to associate with the other major categories. While the content of the comments are still recognized as useful information, there is not a significant amount of responses containing similar context to categorize these responses under a Major Category, besides "Other". Key words/phrases: (do we have any key words?)

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CONCLUSIONS

Gordon Graham, a 33-year California Law Enforcement veteran and nationally recognized leader/speaker on Risk Management has a remarkably simple message that he teaches in his training to public safety officials:

"If it's predictable, it's preventable."

Were these outages predictable? If so, what can be learned from the data[47], detailing real experiences provided by the public, to prevent future telecommunications outages from repeating?

The history of telecommunication outages in the NBNCBC member county's regions has created awareness on network vulnerabilities, where infrastructure failed to be resilient, diverse or redundant enough to survive an outage. An example of this fact was documented in the 2014 Mendocino Outage report after a single point of failure was discovered on the main north-south fiber-optic cable serving the North Coast. The 2014 Mendocino outage report concluded with the warning, "This report documents the impacts such an event can have on a community, and should act as a warning for all – communities, local government, emergency services, and regulatory agencies whose function it is to oversee these networks. A loss of communications capabilities puts everyone's life at risk if they cannot place an emergency 9-1-1 call." Less than one year later in 2015, residents responded to yet *another* outage report[48] where 44% of respondents specifically requested for "redundancy" and the need for "back-up" systems to the telecommunications network in Mendocino. In 2015, concerns were expressed that if a concurrent disaster or emergency occurred in conjunction with the outage, like the outages that occurred during the wildfires, the community would have been in much dire trouble.

In a connected world, technology exists that can, and should, provide stellar broadband and telecommunications networks for everyone throughout the state - to urban and rural citizens alike. Well-designed networks have the ability to operate with redundancy and diversity in the background; and, when a network has a point of failure, the system automatically switches to the back-up routing with no glitch in connectivity. Typically, no one is even aware that an event has occurred except the engineers and technicians.

During the 2017 wildfires, it was learned that the NBNCBC region lacked a well-designed telecommunications network that was resilient enough to survive the wildfires. To create a well-

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[47] States, Counties, communities, and residents can learn from the data to address their own needs for safety purposes. The survey collected massive amounts of data that have been made publicly available upon request.

[48] You can see the 2015 outage report here: http://www.mendocinobroadband.org/wp-content/uploads/Outage-Report-as-approved-11216-by-BoS.pdf

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designed network, continued investment to attain effective solutions for resilient, reliable, redundant, and diverse telecommunications infrastructure is critical and should be prioritized by public entities for the public's safety.
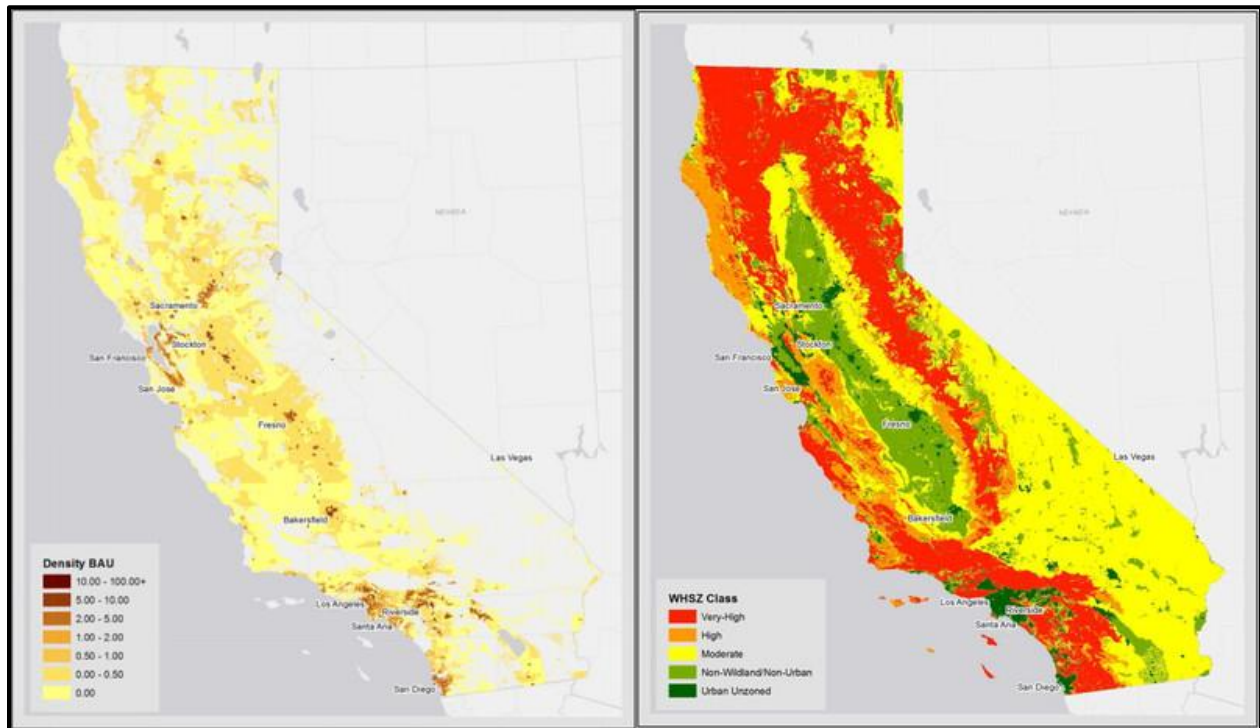

Figure 27: A map showing population density growth projections (left) and a map showing fire hazards (Source49: Mann et al. Land Use Policy 2014)

Even though increasing public safety should be a primary reason to prioritize investment, it isn't the only beneficial outcome of building a well-designed telecommunications network. Resilient and robust networks are also capable of providing the foundation for economic development that can help create a sustainable future for all residents, especially for those living in low density rural areas, where many in the NBNCBC region often struggle economically. Correspondingly, as shown in Figure 27, low density rural areas are also where most of California's high fire risk areas have been identified; and, in these areas are also where many telecommunications outages initially commence.

California has always experienced wildfires, and we can expect the same in the future. Fires bring into focus the importance of making investments, as in times of crisis, our communications networks are critical. As California enters a period of higher risk brought on by drought and climate change, it is pivotal for every community to prepare for future emergencies by prioritizing investment using available resources *now* to solve major telecommunications outage

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[49] https://nature.berkeley.edu/moritzlab/wp-content/uploads/2016/01/Mann_etal_LUP_2014.pdf

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issues in the future – What can we predict? And if we can predict, we have a responsibility to prevent. California must find a solution to the problem for the sake of its residents.

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APPENDIX

Due to volume and size constraints of the appendix, online access to the appendices can be found here: http://www.mendocinobroadband.org/data-and-reports/

Appendix A – 2017 Telecommunications Outage Survey Summary and Methodology

Appendix B – Individual Zip Code Outages

Appendix C – North Bay Fires 2017 Statistics

Appendix D – CPUC Report of Communication Carriers' Impact and Mitigations

Appendix E – AT&T North Coast Upgrades Press Release to BoS

Appendix F – ILEC Map

Appendix G – Provider Outage Data

Appendix H – "Other" Free Responses: Power Outage Effects on Residents

Appendix I – "Other" Free Responses: Residential Warning for Evacuation

Appendix J – "Other" Free Responses: Personal Stories

Appendix K - "Other" Free Responses: CPUC Comments

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