**Town of Paradise**

**Council Agenda Summary** **Agenda Item: 6(b)**

**Date: November 10, 2020**

| | |
|---|---|
| **ORIGINATED BY:** | Katie Simmons, Disaster Recovery Director |
| **REVIEWED BY:** | Kevin Phillips, Town Manager |
| **SUBJECT:** | Early Warning System Design & Scoping Plan |
| **LONG TERM RECOVERY PLAN:** | Yes, Tier 1, Emergency Notification System |

**COUNCIL ACTION REQUESTED:**

1. Consider accepting the Design & Scoping Plan for the Early Warning System prepared by Genasys, Inc.
2. Consider authorizing Town staff to move ahead with a grant application seeking funding for construction and implementation, likely from the next round of Hazard Mitigation Funds. (ROLL CALL VOTE)

**Background**:

After the Camp Fire in November of 2018, the Town and community embarked upon a recovery planning process, funded in part by the Butte Strong Fund, that resulted in the Long-Term Community Recovery Plan (LTRP). A tier 1 priority within the Town-led projects in the LTRP is an Emergency Notification System, identified as critical to fire safety, physical resilience and recovery. The project asks for a multi-layered/redundant Emergency Notification System that could include the implementation of a mass notification system (siren).

The mass notification system project, henceforth referred to as an Early Warning System, was submitted by the Town to Hazard Mitigation for design and scoping. The Federal Emergency Management Agency (FEMA) approved and issued Hazard Mitigation Grant Program (HMGP) funds for the Town of Paradise, HMGP #4407-175-046R, Early Warning System – Advance Assistance.

Genasys, Inc., was contracted by the Town of Paradise to develop the Design & Scoping Plan for the Early Warning System. The Plan has been completed in advance of the December 7, 2020, deadline in anticipation of the next round of Hazard Mitigation grant funds.

**Analysis**:

Genasys and the Town of Paradise collaborated regarding hazardous risk and mitigation information. Some systems are in place, but additional tools such as outdoor siren/speakers will enhance a multi-channel dissemination approach to early warning.

The community survey disseminated as a key component of the project had an impressive response rate of more than 45%, much higher than the average expected rate of 5% - 30%.

Residents provided important feedback on how they want to receive emergency alerts using a combination of outdoor siren/speaker with messages followed by SMS alerts. The residents also expressed urgency in implementing an early warning system. In addition to the survey, Genasys reviewed FEMA documents and guidelines, and researched cities that have recently installed an early warning system for comparison.

The conclusion from all four points recommend an early warning system with multiple notification channels, including IPAWS/WEA, AM Radio, SMS, social media and outdoor siren/speakers capable of broadcasting audible alert tones and clear voice messages. The system should also be compatible with the county. If an IPAWS alert is activated in the Town of Paradise, a multi-layered platform will receive the notification and activate all channels listed above. If Genasys activates IPAWS, Butte County through Everbridge or another entity would receive the message and activate its systems accordingly

Due to the frequency of PSPS events and other power outages common in emergencies, the siren/speaker system must be redundant and not dependent on existing power or communications infrastructure. The system must have battery backup, AC, solar power, user friendly cloud-based software, and a reliable connection that is not reliant on local power or cell towers.

All installed poles should be constructed of Corten steel or similar and capable of local activation. The software must be capable of activating all speakers, a group of speakers, or individual speakers, to broadcast multiple tones and messages/instructions.

It will be evaluated if the system will be tested at full volume monthly. The system will also have a silent test feature. The system should provide an attention seeking tone followed by a message pre-recorded/live broadcast. In addition, the tests and training should be part a regular exercise program in order to maintain system staff proficiency and system expertise in event of an actual event.

Per the study, 21 siren/speaker installation locations would provide early warning for the town. The estimated installation cost of the system is in the $2.4 million - $2.9 million range. These estimates were based on actual implementations of similar systems in California.

The locations identified are in large part properties owned by the Town of Paradise or other public agencies such as Paradise Unified School District, Paradise Irrigation District, Feather River Hospital, and Paradise Recreation & Parks District. Tower locations were chosen for reasons of affordability and audibility throughout town. To date, some public agencies have offered conceptual support of the project and locations. Finalizing the siren locations and formalizing agreements with any public agencies whose properties are selected for construction will occur during the next phase of the project.

**Financial Impact:**

No financial impact at this time.

Genasys™

# TOWN OF PARADISE

Advanced Planning for Early Warning


## Genasys Inc.

## Final Report

**OCTOBER 22, 2020**

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# 1.0 Executive Summary

Paradise, CA – The Town of Paradise contracted Genasys Inc to assist in the initial planning and development of an Advanced Early Warning System supported by the Federal Emergency Management Agency (FEMA) in partnership with the California Office of Emergency Management Services.

Genasys would like to thank the Town and everyone that contributed to this document. Genasys was impressed with the resiliency of the community and the overwhelming support. Paradise is truly a special place.

The Town of Paradise identified this project as a Tier 1 priority in the Long-Term Community Recovery plan developed after the Camp Fire. The study addressed four main points: 1) research regarding the Town of Paradise and their needs; 2) a survey issued by the Town of Paradise to the residents regarding an Early Warning System; 3) research on the evolution of technologies and what is available today including FEMA reference documentation; and, 4) similar projects that have been implemented in the past few years.

During this period, Genasys and the Town of Paradise collaborated regarding hazardous risk and mitigation information. Some systems are in place, but additional tools such as outdoor siren/speakers will enhance a multi-channel dissemination approach to early warning.

The survey had an impressive response rate of more than 45%, much higher than the average expected rate of 5% - 30%. Residents provided important feedback on how they want to receive emergency alerts using a combination of outdoor siren/speaker with messages followed by SMS alerts. The residents also expressed urgency in implementing an early warning system. In addition to the survey, Genasys reviewed FEMA documents and guidelines, and researched cities that have recently installed an early warning system for comparison.

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# 2.0 Overview

## 2.1 Overview

Genasys conducted research regarding the Town of Paradise, including geographic, hazards and risk assessments, and trends and technology advancements. With input from Genasys, the Town of Paradise proactively designed a questionnaire requesting input from residents regarding early alert and warning systems, and where they currently receive emergency information.

## 2.2 Kick-off Meeting

The September 25, 2020 "Kick-off meeting" included introductions, work scope confirmation and project expectations and timelines. An in-person meeting was scheduled to review site locations, review existing technology and introduce new technology.

## 2.3 Site Visit

The October 8, 2020 site visit was conducted to verify potential locations. Some locations had to be changed due to potential future improvements, access/availability to power and property, and acoustic coverage. The meeting also addressed questions and concerns regarding redundancy and reliability

## 2.3 Report

The report includes elements from the meetings, site visits and research. The report includes the historical evolution of Advanced Early Warning technology and documentation supporting proposed enhancements. FEMA guidelines are also included, although there are gaps and inconsistencies due to the rapid pace of technology advances. The success of this project is due to the Town of Paradise's collaboration, response, commitment and dedication. Thank you.

# 3.0 Hazard and Risk Assessment

The study and assessment of hazards, risks and vulnerabilities (HRVA) of the Town of Paradise is intended to fulfill two key objectives in planning and designing the outdoor Early Warning System. First, the HRVA will map the town's residential areas to determine siren area coverage. Second, the town's hazards, risks and vulnerabilities will be assessed in order to implement an Early Warning System that takes these factors into account to ensure continuous operation.

The state-of-the-art outdoor system will be designed and built to provide early warning alerts that cover the Town of Paradise. The Early Warning System will provide redundancy if other communication channels are disabled due to power outages, cell tower disruptions or lost TV/Radio service. Climate information and HRVA for the Town of Paradise taken from official reports and findings are outlined below.

**Town of Paradise: Review of Hazard, Risk, Vulnerability and Environment**

**Town of Paradise**

Incorporated in 1979, the Town of Paradise is nestled in the foothills of Northern California's Sierra Nevada Mountains and sits astride a ridge top with elevations ranging from 1,200 to 2,400 feet above sea level. The Town encompasses 18.6 square miles area. Prior to incorporation, the Town was a County mountain community with older construction of light commercial and industrial and a predominant residential character.


**Figure 1 – Town of Paradise - Aerial View**

Most of dwelling units in the Town are single-family units. Multi-family units, at densities ranging from 8 to 12 units per acre, are found primarily in central Paradise, near commercial areas and along major arterial streets. The town contains relatively little industrial development. Agricultural uses, including vineyards, orchards, and grazing land, are located primarily in the southern third of the town.

**Population**

The population of Paradise, California has declined more than 90 percent since the 2018 Camp Fire that destroyed nearly every building in town. The 2010 census recorded 26,800 residents in the Town of Paradise. The California Department of Finance estimated the January 1, 2019 population for the Town of Paradise was 4,590.

The town's population is beginning to increase with more people rebuilding homes and businesses. As the town continues to recover from the impacts of the devastating Camp Fire, the town's demographics are expected to change from pre-fire Paradise.

## Critical Services / Key facilities

Critical facilities include all public and private facilities that a community considers essential for the delivery of vital services and for the protection of the community.

These services usually include emergency response facilities (fire stations, police stations, rescue squads, and emergency operation centers [EOCs]), custodial facilities (jails and other detention centers, long-term care facilities, hospitals, and other health care facilities), schools, emergency shelters, utilities (water supply, wastewater treatment facilities, and power), communications facilities, and any other assets determined by the community to be of critical importance for the protection, health and safety of the population.

**Table 1 – Town of Paradise - Critical facilities** (Source: 2013 Butte County Mitigation Plan)

| CATEGORY | FACILITY | COUNT |
|---|---|---|
| Population facilities at Risk | Adult Day Care | 2 |
| | Adult Residential | 16 |
| | Day Care Center | 7 |
| | Family Day Care Home | 26 |
| | Foster Family Agency | 1 |
| | Foster Family Agency Sub | 1 |
| | Group Home | 4 |
| | Infant Center | 1 |
| | Residential Care / Elder | 9 |
| | School | 8 |
| | School-Age Day Care | 3 |
| | Transitional Housing | 1 |
| Esssential Service Facilities | Bridge | 26 |
| | Fire Station | 4 |
| | Hospital | 1 |
| | Law Enforcement | 1 |
| | Air Port | 1 |
| | Irrigation water district water filteration plant | 1 |
| Hazardous Materials Facilities | CUPA (Certified Unified Program Agency ) | 98 |

*Source: Butte county Local Hazard Mitigation Plan Update May 2013*

The adverse effects of damaged critical facilities can extend far beyond direct physical damage. Disruption of health care, fire, and police services can impair search and rescue, emergency medical care, and even access to damaged areas. Table 1 lists the number and nature of critical facilities in the Town of Paradise as identified and incorporated in the Butte County Hazard Mitigation Plan (2013).

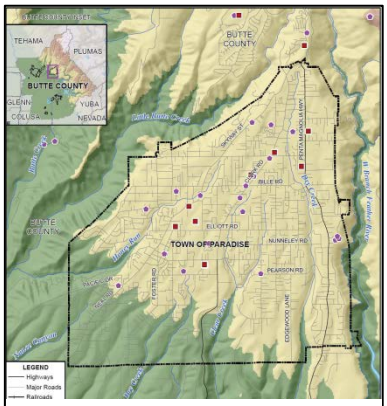



Figure 2 Town of Paradise Critical Facilities (2019)

Per the Local Hazard Mitigation Plan updated in 2019, critical Town of Paradise facilities are classified in three categories: (1) Essential Services Facilities (2) At-Risk Population Facilities (3) Hazardous Materials Facilities.

The locations of critical facilities in the Town of Paradise sourced from the Butte County GIS are shown in Figure 2. The thirty-three critical facilities listed in 2019 Local Hazard Mitigation Plan update are shown in Table 2 below. The critical facility inventory and associated maps include Essential Services and At-Risk Population.

Table 2 – Town of Paradise – Critical Facilities by Type (source: 2019 Butte Country Mitigation Plan Update)

| **Essential Service Facilities** | Number |
|---|---|
| Fire | 3 |
| Health Care | 15 |
| Law Enforcement | 1 |
| Public Assembly Point / Evacuation Center | 2 |
| **Total Essential Services Facilities** | 21 |
| | |
| **At-Risk Population Facilities** | |
| Schools | 12 |
| **Total Essential Services and At-Risk Population Facilities** | 33 |

## Climate, Geography and Topography

The Town of Paradise averages ~64" of rain and 2" of snow annually. In the summer months there is little, if any, measurable precipitation. Heavy rains and periodic snow, with accumulations above the 1,800 ft. level, occur often in winter months. Temperatures range from the mid 20's°F in winter to the low 100's°F in summer with light to gusty westerly winds. These drying winds, mixed with the density of dominant vegetation throughout the town, creates hazardous fuel conditions.

The Town of Paradise averages 250 sunny days per year. The average percentage of cloud coverage is subject to extreme seasonal variations.

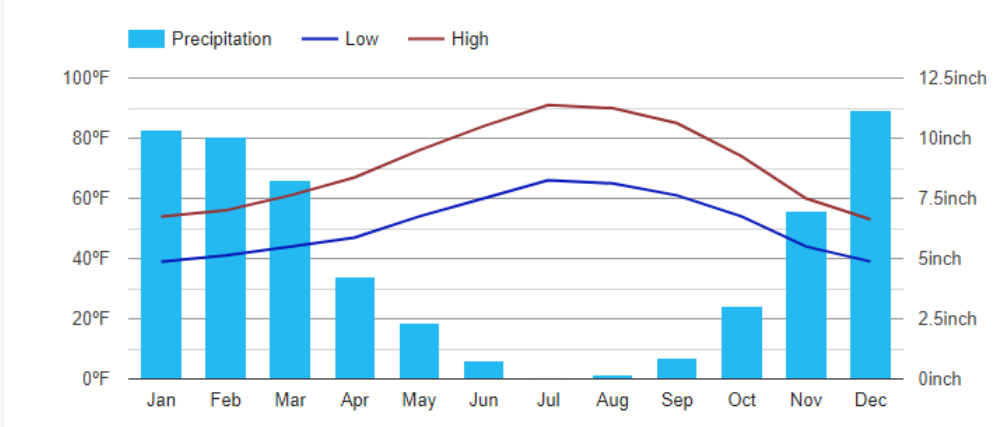



Table 3 – Town of Paradise Weather Data

The dense natural vegetative growth, both in the canyon areas and throughout the town, creates challenges in fighting and controlling the spread of wildfires. Pursuant to Government Code Section 51178.5 and 51179, which is based upon climatic, topographic, geologic and vegetative conditions, the Town of Paradise is in a very high fire hazard severity zone.

The topography of the town presents problems in delivering emergency services, including fire protection. Hilly terrain and narrow, winding roads with little circulation, limited escape routes, and limited town ingress and egress impedes rapid and orderly evacuations. The Town of Paradise also has many miles of public streets and private roads. Due to topography, many private roads are substandard in design and accessibility.

### Hazard Profile

Hazard, Vulnerability, Risk and environmental factors play a critical role in the overall process of planning, designing, implementing and operating an Early Warning System. The HVRA and environmental conditions will influence the site selections and technical specifications of the Early Warning System's components. Development of SOP (Standard operating procedure) for managing operations (including the development of alert messages) will be commensurate with the type of hazardous conditions and possible impacts. The hazard profile of the Town of Paradise remains nearly same between 2013 and 2019, with the exception of the “influence of climate change” included in the 2019 report. Risk from pandemics, which includes the COVID-19 global hazard, is a 2020 addendum to the report.

### Earthquake

A recent study of the seismicity of the Paradise area (Geomechanics, 1980) maps both the fault zones and the epicenters of earthquakes that have occurred near Paradise since 1934. There were fifty-four earthquakes ranging between magnitude 4.0 and 6.9 on the Richter scale between 1934 - 1980. Five earthquakes were magnitude 6.0 or greater. Two 5.7 magnitude earthquakes occurred near Paradise - the February 8, 1940 Ghost earthquake with an epicenter roughly twenty-five miles north-northeast of Paradise, and the August 1, 1975 Oroville earthquake with an epicenter approximately twenty-four miles southwest of Paradise on the Cleveland Hills Fault.

While the Town of Paradise is at risk for earthquakes, the town and surrounding area are relatively free from significant seismic and geologic hazards. There are no known or inferred active faults within the town. The only known active fault in Butte County is the Cleveland Hills fault, the site of the August 1975 Oroville earthquake. Due to the proximity of the City to the nearby Cleveland Hills Fault, the City can expect low to medium intensity shocks from time to time. The Town of Paradise is within the less hazardous earthquake Zone 3 category.

### Liquefaction

Liquefaction occurs when there is a sudden but temporary increase in fluid pressure between the soil grains and the weight of the overlying soil or structure is temporarily supported by water and not soil grains. The Paradise study area has been determined to have a low potential for liquefaction because of the area's  diverse particle soil size.

### Flooding

The Town of Paradise is located outside both the 1% and 0.2% annual flooding probability zone as defined by the Federal Emergency Management Agency (FEMA). Past flooding was mainly due to storm water that caused minimal property and structure damage. As there are no floodplains in Paradise, the town's vulnerability to flooding is low.

### Landslide, Mudslide and Debris Flow

Landslide potential is influenced by several factors, including geology, water influences and topography. According to the 1994 Town of Paradise General Plan, in Butte County, landslides frequently occur on **slopes greater than fifteen percent**, while slopes between five and fifteen percent exhibit very few landslides. Paradise and the surrounding study area are rated as having a low landslide potential. Detailed analysis of the complex interrelationships between the governing factors is needed to predict the stability of a specific area, and detailed on-site investigations are recommended to assess site-specific risks. Seismic shaking greatly increases landslide potential. Slope gradient and location will be taken into consideration for siren sites.

### Dam Inundation Hazards

There are twenty-four dams in Butte County under the jurisdiction of the California Division of Dam Safety.* The Paradise and Magalia Dams on Little Butte Creek are located above the Town of Paradise and are inspected annually. As there are no known geologic hazards in the vicinity of the dams, the town's dam inundation hazard is low.

### Volcanic

Mount Lassen, located approximately twenty-three miles north of Butte County, is considered one of the few active volcanoes in the continental United States. While geologic hazards exist in the Lassen Park area, the possibility of mudflows, flowing avalanches, or volcanic ash endangering Butte County is very remote, based upon historical and geological data.*

According to the Paradise Multi-hazard Disaster Plan, although most of the eruptions in the Mount Lassen area have been small, it is capable of larger eruptions similar to the one that occurred in 1915. Another eruption of unknown severity could occur within the next 100 years. The Town of Paradise may be within the range of ash flow or ash fall in the event of such an eruption.

### Severe Weather: Wind and Tornado

The Town of Paradise is subject to significant, non-tornadic (straight-line) winds. Winds often accompany heavy rain and storm events but can also occur frequently under high pressure conditions. Normally the wind in California blows from west to east – from the Pacific Ocean inland. But, particularly in the fall, hot northerly air from the Nevada deserts courses over the Sierra Nevada, rushing downslope over towns that include Paradise. According to the National Weather Service, Diablo winds occur below canyons in the East Bay hills (Diablo range) and in extreme cases can exceed 60 mph (97 km/h). These winds are warm and dry and can severely exacerbate brush or forest fires, especially under drought conditions. Analysis of Jarbo Gap USDA RAWS weather station shows sustained winds accelerated to 32 mph (with gusts to 52 mph), with peak winds at 4 AM the day the day the Camp Fire started. Historical town wind speeds and gusts will be taken into consideration in the design, specifications and installation of the Early Warning System.

### Severe Weather: Extreme Heat

Heat is a regional phenomenon that affects the Town of Paradise. The Town Planning Team notes that extreme heat events affecting Butte County also affect the town. Paradise experiences temperatures in excess of 100°F during the summer and fall months, and 100°-110°F in extreme situations. Extreme heat will be taken into consideration in the design, specifications and installation of the Early Warning System.

### Severe Weather: Freezing Conditions and Winter Storms

Per the Butte County Mitigation Plan 2019 update, freezing conditions and winter storms are regional issues that include the Town of Paradise. Temperature data from the Western Regional Climate Center (WRCC) indicates that there are ~22 days with temperatures below 32°F in eastern Butte County, and no days falling below 0°F. Freezing conditions and winter storms will be taken into consideration in the design, specifications and installation of the Early Warning System.

### Severe Weather: Heavy Rain and Storms (Hail, Lightning and Wind)

Storms in the Town of Paradise are generally characterized by heavy rain often accompanied by strong winds and sometimes lightning and hail. Most of the severe rains occur during the winter months. According to historical hazard data, severe weather is an annual occurrence in the Town of Paradise.

## Wildfires

Wildfires are the major hazard of the Town of Paradise. The fire season usually extends from early spring through late fall, although hotter, dryer conditions may lengthen the season. Wildfire risk increases when a combination of high temperatures and winds, low humidity and accumulated dry vegetation are present. CAL FIRE has estimated that wildfire risk varies throughout the Town and has created maps showing risk variance.

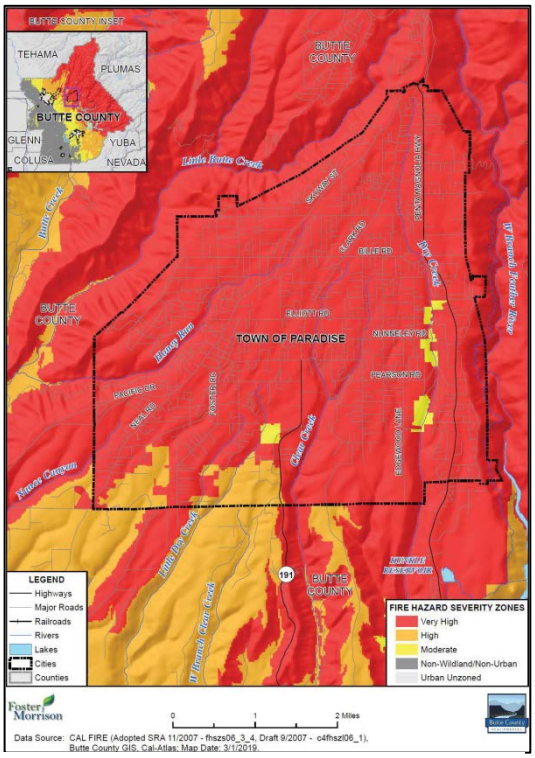



**Figure 3 – Town of Paradise - Fire Hazard Severity Zones (source: 2019 Butte Country Mitigation Plan Update)**

With the Town of Paradise located at the mouth of a major drainage, the Feather River Canyon, and between various intermediate drainages that also enhance wind speeds, it is extremely susceptible to rapidly moving wildfires. The town's proximity to substantial areas of wildland vegetation further exacerbates the town's wildfire risk.

Compounding the town's susceptibility to wildfire is the lack of egress and ingress routes. Several potential traffic flow problems exist. Blocked/restricted access and susceptibility to fire hazards will be taken into consideration in the design, specifications, materials and installation of the Early Warning System.

* Butte County Energy, Natural Resources, and Recreation Element (1989 draft)

**Table 4 – HRVA and Environmental Facts: Influence on Outdoor Siren System Design**

**(HRVA Data source: Butte County Local Hazard Mitigation Plan Update October 2019)**

| Hazard | Geographic extent | Probability of occurrence | Magnitude / Severity | Impact | Climate Change Influence | Early Warning System Installation Considerations |
|---|---|---|---|---|---|---|
| **Climate Change** | Extensive | Likely | Limited | Low | - | - |
| **Dam Failure** | Significant | Unlikely | Critical | Medium | Medium | Away from flood zone / low lying area |
| **Drought & Water Shortage** | Extensive | Likely | Limited | High | High | - |
| **Earthquakes** | Extensive | Likely | Critical | Medium | Low | Build using earthquake resistant structure |

| | | | | | | |
|---|---|---|---|---|---|---|
| **Landslide, Mudslide and Debris Flow** | Significant | Likely | Critical | Medium | Low | Siren sites to be examined w.r.t. landslide, mudslide |
| **Earth Movements: Erosion** | Limited | Likely | Significant | Medium | | Siren sites to be examined w.r.t. land movements |
| **Floods: 100/200/500 year** | Limited | Occasional/ Unlikely | Negligible | Low | Medium | Siren sites to be examined w.r.t. elevation and inundation |
| **Floods: Localized Storm water** | Extensive | Likely | Limited | Medium | Medium | Away from low lying, flood prone area |
| **Invasive Species:** Aquatic | Limited | Unlikely | Limited | Low | Medium | - |
| **Invasive Species: Pests/Plants** | Limited | Unlikely | Negligible | High | Low | - |
| **Levee Failure** | Limited | Likely | Limited | Low | Medium | - |
| **Severe Weather: Extreme Heat** | Significant | Likely | Critical | Medium | High | Max. ambient temperature to be considered for Outdoor installation speciation |
| **Severe Weather & Storms: Heavy Rain, Hailstorms, Lightning** | Significant | Likely | Critical | Medium | Medium | Stringent NEMA ratings for enclosures / Lightning protection |
| **Severe Weather: Wind and Tornado** | Extensive | Likely | Critical | High | Low | Outdoor structure to withstand Max. wind speed + margin |
| **Severe Weather: Freeze and Winter Storm** | Significant | Likely | Critical | Medium | Medium | Outdoor units to withstand +/- 20 % of average max / min temperature |
| **Stream Bank Erosion** | Limited | Occasional | Negligible | Low | Low | Siren sites should be away from stream bank |
| **Volcano** | Significant | Unlikely | Critical | Low | Low | - |
| **Wildfires** | Extensive | Likely | Critical | High | High | Keep site away from bushes/ trees; Plan moat around siren location |

## Cascade Effects of Severe Incident / Disaster

### Power Outages

Outdoor warning sirens with solar power and battery backup will continue to operate during a power outage. Solar power and battery backup capabilities will be designed commensurate with the average hours of daily sunshine and siren/speaker power consumption.

### Blocked Access

Fire, flooding, damaged roads/bridges and incident debris may limit access to the Emergency Operations Center (EOC) or siren locations. Remote siren operation and control via satellite or wireless connectivity must be an Early Warning System mandatory requirement.

### Communication Outages

Operating communication channels among multiple agencies, jurisdictions and communities is fundamental to alerting communities of danger and rapidly mobilizing the appropriate response resources. Without communications, the capacity to mobilize coordinated inter-organizational, inter-jurisdictional response operations decreases significantly.

The loss of cell towers during the Camp Fire sharply reduced communications when town residents urgently needed evacuation information. While the planned rollover of 911 dispatch calls from Paradise to Chico to Butte County facilitated the region-wide communications process, residents reliant on cellphones for information lost critical communications access at the time they needed it most. Call volume also escalated, congesting the remaining cell towers and causing many urgent calls to be dropped.

During the Camp Fire, public agencies used any and all modes of communication to alert residents, including radio, cell phones, the Internet, and social media platforms Facebook and Twitter. The Town issued CodeRed messages to registered residents in the central and eastern evacuation zones. National emergency alert systems Wireless Emergency Alerts (WEA) and Integrated Public Alert and Warning System (IPAWS) were not used.

# 4.0 Needs Assessment

### Town of Paradise Disaster Risk Management System

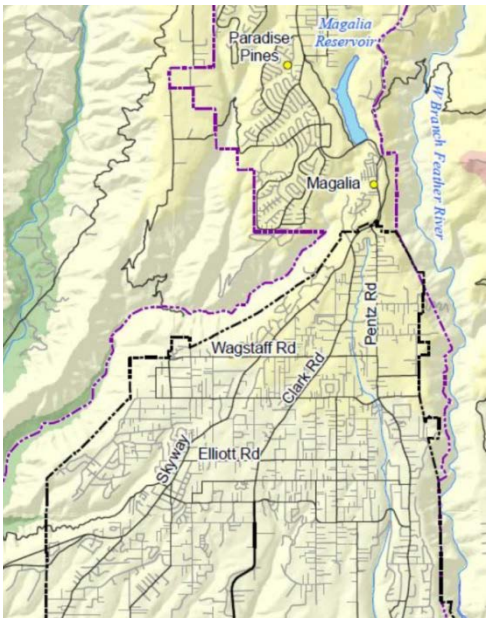



Figure 4 Town of Paradise Base map (source Hazard Mitigation Plan)

Butte County has a detailed Local Hazard Mitigation Plan (May 2013) which includes the Town of Paradise. The Town of Paradise has an established Emergency Operations Plan (EOP) that was prepared, tested and reviewed per State of California and FEMA guidelines. The town has an established emergency management organization, and an alert, warning and communications system. As outlined in the Town of Paradise Municipal Code, Paradise has identified the response capabilities and resources (equipment, personnel, etc.) to provide emergency situation responses. In addition to town employees, in the event of an emergency, Paradise has a dedicated group of trained volunteers that support the town in keeping residents safe. When an EOC is activated in response to an emergency, volunteers assist and support Town staff in administrative, planning and field tasks, and may act as liaisons to other agencies.

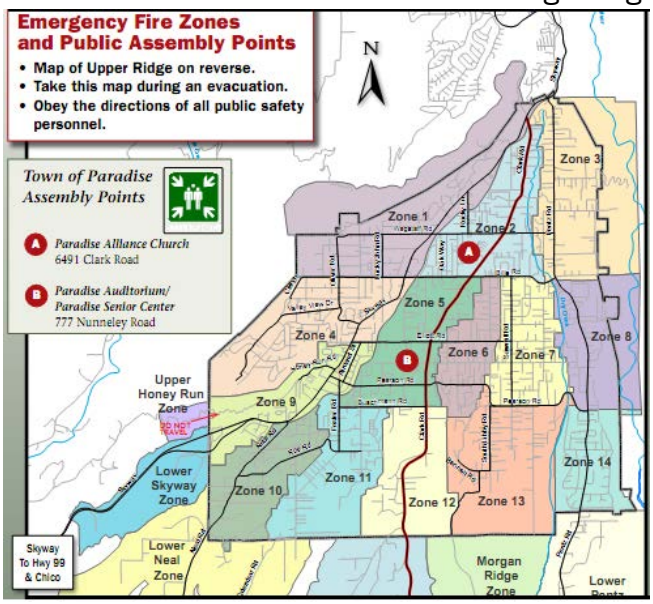



Figure 5 Fire Emergency Evacuation Plan (source Town of Paradise Website)

Beginning in 1998, Paradise Fire Chief Jim Broshears worked with area first responders from the Paradise FD (before it was Cal-Fire), Paradise PD, Paradise Public Works, CHP, Cal-Fire, the Red Cross and Butte County to formulate the Paradise and Upper Ridge Evacuations Plans.

The November 2018 Camp Fire was one of most devastating and deadly wildfire disasters in U.S. history. Shortly after the fire erupted, residents in the eastern quarter of Paradise were ordered to evacuate. The remaining residents were ordered to evacuate one hour later. Evacuation was constrained by road limitations, minimal time for residents to leave safely, and the number of people and vehicles that could move through the available routes.

## EMERGENCY OPERATION PLAN – Emergency Preparedness Plan

As a preparedness measure, the Town of Paradise has developed and implemented a fire emergency evacuation plan. The town is divided into zones for ease of monitoring and to manage life safety during fire emergencies. The Emergency Preparedness Plan is part of the the town's EOP, which addresses the town's planned response to extraordinary emergency situations associated with natural disasters, technological incidents, and national security emergencies in or affecting Paradise. Per the hazard profile published in the EOP, vulnerability to fire hazard is the town's major concern followed by severe weather, flood and drought. Susceptibility to pandemics, transportation accidents and resource depletion are also town vulnerabilities.

As part of the EOP, the Manager's Office has the capabilities to perform the necessary emergency response duties outlined. As outlined in the Paradise Municipal Code for Emergency Organization, Paradise has identified the capabilities and resources (equipment, personnel, etc.) needed when responding to an emergency situation.

The Town of Paradise has not established an outdoor siren-based alert and warning system or implemented an Emergency Alert System Plan as prescribed by State of California guidelines. The planning and design of a state-of-the-art Early Warning System for Town of Paradise is considered under the scope of this project.

## Early Warning System: Coverage and Resilience Consideration

The first step in designing an early warning system is to identify if and where there is a need for one. Genasys reviewed the Town of Paradise's HRVA reports to acquire an understanding of the multi-hazard risks to which the town is exposed. The study and review of the town's geophysical and exposure data available from various sources, was supplemented with the survey conducted during the field visit.

The decibel levels produced by the various sirens at each listener site are estimated based on meteorological and terrain conditions. Vertical temperature gradient, and wind direction and vertical gradient, influence sound propagation conditions and accordingly should be factored into the Early Warning System design.

The Early Warning System design will consider current building and construction criteria relevant to foundation, and the installation of siren pole(s) and mast(s). Per recent Town of Paradise guidelines - Wind Speed of 85 mph (3-second gust) is to be considered for structure design. For safer installation, side mast / foundation and pole structure installation should consider wind speed of 100 mph (3-second gust).

The siren sites will also be reviewed using the following criteria: low lying /flood prone area, unstable area prone to land erosion, seismicity, proximity to critical infrastructure, roads / bridges access, surrounding noise environment, vegetation, high-rise, safety, and the required authorization for the use of each site.

**Early Warning System: Operation and Control**

In the California State Guidelines on Alert and Warning Systems, local entities, as defined in the local area alert and warning plan(s), are responsible for:

- Enactment of ordinances and/or policies identifying local roles and responsibilities to enable the issuance and coordinated dissemination of alerts and warnings to the public by responsible officials within their jurisdictions regarding imminent threats to human life and health and extraordinary threats to property
- Installation, maintenance, user training and exercise/testing of local public alert and warning capabilities within their jurisdiction;
- Understanding the access and functional needs-related considerations associated with public alert and warning systems and messaging;
- Obtaining authority and tools for accessing federal warning systems as a Collaborative Operating Group (COG) via the FEMA Integrated Public Alert and Warning System (IPAWS);
- Participate in revisions of mandated Federal Communications Commission (FCC) local EAS plans, including approval of authorized event codes;
- Development of procedures for proper chain of command for initiating, cancelling, and revoking accidental alerts, and for rapidly correcting and updating alert details as additional information becomes available;
- Coordination with adjoining jurisdictions, Operational Areas, the State, and the NWS regarding origination of alerts and warnings over NWS Weather Radio related to hazards that have effects across jurisdictional boundaries; and
- Developing, maintaining, and submitting to the State EAS Committee a Local Emergency Alert System Plan (Local EAS Plan).

Because of the Camp Fire and the high likelihood that Butte County will continue to experience increasing wildfire risks, the county updated the hazard mitigation plan in 2019 with short and long-term multi-hazard risk mitigation objectives.

A detailed Local Emergency Alert and Warning system plan (EAS Plan) for the Town of Paradise is to be prepared as a part of this project with standard operating procedures per state guidelines and regulatory provisions. Due to the current constraints of the town's resource capabilities, maintenance of the Early Warning System should be outsourced initially.

An Operation and Management (O&M) plan of the town's Early Warning System would be included in the scope of system procurement, installation and commissioning.

# 5.0 Alert and Warning: Current Technology Trend and Options

## 5.1 Siren Evolution and Trends

During an in-person meeting, Genasys provided information on the evolution of early warning system technology.

In the 1930s, the Civil Defense was set up and became the prevalent warning system during World War II. The triangle in the logo represented the 3-step philosophy of Mitigation, Prevention and Response. The Air Raid Sirens installed throughout the country were electro–mechanical, built using a stator and rotor to chop air creating a frequency tone between 400Hz -1000Hz. This design created the "air raid" tone still known today but the design limited a variety of tones due to chopping air at different speeds, the notification was based on two types of siren tones, constant tone and hi/low tone (created by turning the motor on/off). The sirens were painted yellow for easy visibility. The main risk was to alert the public from an enemy (nuclear) attack or other potential disaster.

In 1951, Conelrad (**CON**trol of **EL**ectromagnetic **RAD**iation) was implemented to provide citizens national emergency information via AM radio stations with frequencies of 640 kHz or 1240 kHz. The limitations of this design were radio access and tuning into specific AM radio frequencies.

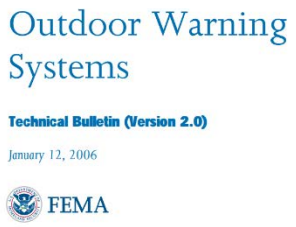
Technology advanced and the CONELRAD was replaced by the Emergency Broadcast Station (EBS) in 1963. This system created unsolicited notification designed to address the nation through audible alerts. Since the EBS could not target specific areas of the nation, its main purpose was to provide the President of the United States a way to communicate directly with the American public during a national emergency.

The Federal Emergency Management Agency (FEMA) is an agency of the United States Department of Homeland Security, initially created under President Jimmy Carter by Presidential Reorganization Plan No. 3 of 1978 and implemented by two Executive Orders on April 1, 1979.

In 1980,FEMA published an Outdoor Warning System Guide (CPG-1-17). The guide addressed principles of sound, outdoor warning systems and devices, propagation and detection of sound outdoors, avoiding hazardous noise exposures, and warning system planning, testing and use with technology that had emerged through 1980. Advancements in technology included different types of sirens, some of which rotated or had two choppers and rotors to produce a two-tone system. Electronic sirens capable of generating several audible tones were becoming available. Some of these electronic speakers could generate voice messages, however no measurement for vocal intelligibility existed. The guide also addressed rural and urban siren coverage ranges.

The Emergency Alert System (EAS) replaced the EBS in 1997. It was jointly coordinated by the Federal Communications Commission (FCC), FEMA and the National Oceanic and Atmospheric Administration (NOAA). The message consisted of a digital encoded header, attention signal, audio announcement and digital encoded end-of-message marker.

In 2006, FEMA's IPAWS modernized the EAS system by integrating public alert and warning systems with other leading technologies. IPAWS delivers a broader range of emergency messages through multiple channels. The system is designed to handle all hazards and can warn individual communities of emergencies impacting public safety.




FEMA provided an update to its 1980 guidelines in 2006. As electronic sirens and voice messaging had improved in 26 years, the update included a method for measuring warning system voice intelligibility using the Speech Transmission Index (STI) or Common intelligibility Scale (CIS).

| Intelligibility Rating | Speech Transmission Index (STI) | Common Intelligibility Scale (CIS) Equivalent | Speech Intelligibility Index (SII) | Intelligibility Scale (CIS) Equivalent |
|---|---|---|---|---|
| Excellent | > 0.75 | >0.87 | | |
| Good | 0.60 – 0.75 | 0.78 – 0.87 | > 0.75 | >0.82 |
| Fair | 0.45 – 0.60 | 0.65 – 0.78 | | |
| Poor | 0.30 – 0.45 | 0.48 – 0.65 | < 0.45 | <0.65 |
| Bad | < 0.30 | <0.48 | | |

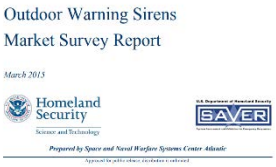
ANSI S3.5 provides two benchmarks for SII: good > 0.75, poor < 0.45.
STI in accordance with IEC 60268-16 or ISO 9921
CIS determined by use of Figure IV-1, OSHA Occupational Noise Limits, above.

Table 5 – Relationship of Objective Intelligibility Ratings

In 2010, two documents were updated to require outdoor notification use voice message Sirens/Speakers. The National Fire Protection Agency and United Facilities Code addressed Mass Notification and the requirement for intelligible voice speakers.

NFPA 72, 2010 Edition, Chapter 24: Mass Notification. Voice and tone speakers are required for indoor and outdoor use. Mass notification systems integrated with fire alarm systems must have 1-hour continuous activation and standby battery backup of 72 hours.

UFC 4-021-01 Design And O&M: Mass Notification Systems
Requires outdoor mass notification systems have battery backup, remote activation and monitoring, and a STI of 0.7.




A market survey report issued by the Department of Homeland Security addressed the need for reliable connectivity, solar power to charge batteries, and cloud-based activation systems. This document also addressed IPAWS and Common Alert Protocol (CAP) integration.

## 5.2 Limitations of Sirens and Speakers

Sirens and Speakers can be icons or symbols to the community regarding safety. There are also some limitations to an outdoor warning system.

Early Warning Systems are not designed to wake everyone up at night, especially people sleeping in newer, more energy-efficient and better-insulated homes. Air Conditioners, appliances and electronic equipment create noisier indoor environments. Outdoor noise may impact the effectiveness of Early Warning Systems.

Outdoor environmental factors including wind direction and speed, relative humidity, air stability and vegetation density can affect siren volume and where they are heard.

**Traditional Tone only Sirens**
A tone only siren requires a two-step process. Attract attention then tune into a different channel for further information. In addition, the tone only siren is limited to mainly two tones, constant and a high low. This technology hasn't changed from Air Raid siren days. The sirens do have battery backup vs an AC only version.

**Electronic Tone and Voice Sirens**
Voice capable speaker arrays broadcast alert siren tones and voice messages containing emergency information. Not all voice speaker arrays are the same. Loudness, intelligibility, area coverage, connectivity, activation, control and power options, battery backup capabilities, ease of use and other factors vary greatly.

**Activation and Connectivity**
Remote Activation software technology has moved to cloud-based solutions. Cloud-based software provides system access anytime, anywhere and includes service agreements that

keep the software updated. All software activation software is not the same and may lack compatibility with other emergency notification channels.

## 5.3 FEMA Recommendations

Based on the documents issued by competent agencies in the past 40 years an outdoor early warning system must have

### Voice/Siren

- AC and DC Battery backup system
- An effective average range of 2,000 - 3,000 feet or 600 meters to 1.1 KM.
- Speakers capable of providing different tones, voice messages and live Public Address
- Minimum STI 0.7
- AC and Solar Charging system with enough power to activate for 1 continuous hour of operation on battery

### Activation Software

- Reliable connectivity (satellite) or redundant connectivity
- IP/Cloud based remote monitoring and activation
- IPAWS compatible
- CAP compatible for 3rd party integration
- Multiple channel activation capability
- Remote Activation
- Remote monitoring and message delivery proof

## 5.4 Early Warning System Trends

Genasys researched cities implementing Early Warning systems. In the past few years, the trend in California is to purchase outdoor siren/speakers with voice messaging. These systems are independent of existing infrastructure with battery backup. The usefulness of the voice messages can provide information and instructions. For example, wildfire warning, tsunami, flood, or any other type of disaster may require different instructions such as shelter in place vs evacuate. Satellite connectivity has become a reliable solution and independent from cell towers and power grids. The latest implementations of Early Warning systems installed in chronology.

2020

- Newport Beach – Replaced Siren with Voice/Tone
  https://www.latimes.com/socal/daily-pilot/news/story/2019-08-20/newport-beach-to-replace-rusty-tsunami-warning-sirens
  The new sirens are manufactured by LRAD Corp. and have no moving parts. They also are equipped with a public address system, enabling public safety departments to dispatch information directly. Nearby Laguna Beach already

uses sirens manufactured by LRAD (Genasys), making joint activation possible, according to the police staff report.

- Laguna Beach – Additional Voice/Tone Systems
  https://www.globenewswire.com/news-release/2019/11/05/1940941/0/en/Genasys-Awarded-1-4-Million-in-New-Public-Safety-Mass-Notification-Orders-from-Laguna-Beach-and-Newport-Beach-CA.html
  "The successful installation and utilization of the initial Genasys LRAD systems installed in Laguna Beach in 2018 led to this award of a city-wide outdoor warning network," said Richard S. Danforth, Chief Executive Officer of Genasys. "In addition to the initial systems in the downtown retail district and two popular beach areas, several more networked Genasys installations will be located throughout Laguna Beach."

  "We're in a city that has a lot of hazards," commented Jordan Villwock, Laguna Beach Emergency Operations Coordinator. "We need to be prepared to alert and warn our residents appropriately, effectively and efficiently."

- Malibu Feasibility Study
  https://www.malibucity.org/1023/Siren-Feasibility-Study
  A feasibility study was conducted in 2020 to evaluate implementing an outdoor warning system. The recommendation was to install 20 - 33 sirens at an estimated cost of $1.2 - $1.9 million.

- Dana Point
  https://www.danapoint.org/department/general-services/public-safety/community-alert-siren-system

  Dana Point is keeping seven of the eight poles installed by SCE and is actively looking for a new system that will provide the city with additional siren capabilities and enable clear verbal messaging. The system would be used to disseminate information regarding disasters, hazards or public announcements, as well as providing system-wide and individual siren control for disbursement of information to specific areas of the city.

2019

- Mill Valley – Replaced Siren with Voice/Tone
  https://www.cityofmillvalley.org/fire/emergency/warnings.htm
  "In 2019, the City of Mill Valley installed new and more powerful emergency sirens to replace our aging system. These sirens are known as "LRADs" – Long Range Acoustic Devices - and they project both siren and voice recordings to alert and inform community members during a large-scale disaster. These new sirens will be the first LRAD (Genasys) systems in Marin County."

2018

- Menlo Park Sound off – Siren vs Voice/Tone
  https://www.menlopark.org/DocumentCenter/View/20784/D2---Community-notification-system "We've been looking at ways to upgrade and improve our existing system for several years now. We started looking at the LRAD platforms and the enhanced versatility of fixed and mobile 360 degree systems that they provide which allow either pre-scripted, multi-language, voice emergency messaging or instant real time messaging and information to occur after an attention tone" said Ryan Zollicoffer, Menlo Park Fire District Emergency Manager.

- San Jose – Portable Voice/Tone
  https://www.ktvu.com/news/new-lrad-emergency-alert-system-tested-in-san-jose-8-months-after-coyote-creek-floods

  He says the city just received several Long Range Acoustic Devices, at a cost ranging from $10,000 to $122,000. Known as LRADs, this one can broadcast warning messages up to one mile away, using an Omni-directional speaker atop a 30-foot mast. A smaller, uni-directional speaker can be mounted on a vehicle, and driven around a neighborhood, announcing evacuation orders up to 500-feet in distance.

  "Automatic loud announcement that we can make at any time of day, or night, so that the public can actually hear the announcement at the same time as sending out the message over the other devices. So, it's one of many tools we have to notify the public," said Riordan.

2017

- Shelter Cove – Voice/Siren
  https://americansecuritytoday.com/asc-install-tsunami-warning-sys-shelter-cove-ca-learn-video/
  American Signal Corporation (ASC), a competitor in the 2017 'ASTORS' Homeland Security Awards program, has been selected by Shelter Cove, CA to design and implement a Tsunami Warning System for the city.

- Laguna Beach – Voice/Tone

  http://www.lagunabeachcity.net/cityhall/police/emergprep/alert_and_warning_system.htm

  The City of Laguna Beach currently has installed three speakers/sirens within the downtown area. These speakers/sirens can be activated to provide emergency alerts and warnings to individuals within the alert areas and provide instructions to the community to take safety actions (i.e. shelter in place,

evacuation, etc.). The current locations of the speakers/sirens are: City Hall, White Lifeguard Tower, and the Gazebo.

Prior to 2016

- San Francisco – Voice/Tone
  https://sfdem.org/sirenshutdown
  The City and County of San Francisco is investing in upgrades to the aging Outdoor Public Warning System (OPWS). The siren system will be out of service during the two-year upgrade project. The upgrades include a new operating system, stronger encryption and hardware that will improve the reliability and security of the siren system.
- Shutdown Date: Wednesday, December 11, 2019
  Project Timeline: Estimated up to two (2) years
  Estimated Budget: $2,000,000 to $2,500,000
- San Luis Obispo (Diablo Canyon Nuclear) tone only for 10 mile EPZ (Emergency Planning Zone)
  https://www.prepareslo.org/en/early-warning-system-sirens.aspx

# 6.0 Town of Paradise Alert and Warning Lessons Learned

## 6.1 Camp Fire Alert and Warning Lessons Learned

The Town of Paradise had a well-practiced evacuation plan that included 14 zones and specified the order in which residents would evacuate through four designated evacuation routes. Paradise lies on a plateau surrounded by deep canyons that limit on egress routes.

Emergency services personnel conducted simulated evacuation exercises using a contraflow strategy so residents could practice driving out of town on all lanes. But the early morning ignition and rapid progression of the Camp Fire quickly overwhelmed the plans and protocols put in place to protect Paradise and its residents.

As the fire rapidly advanced, the planned rollover of 911 dispatch calls from Paradise to Chico to Butte County facilitated the region-wide communications process. However, emergency communications failed within a few hours as 17 cell towers were burned or became inoperable.

Two CodeRED messages were sent by the Paradise Police Department to all residents that had registered for the app. WEA and IPAWS were not used.

Communication is fundamentally a sociotechnical process that enables us to engage in informed, coordinated actions. In a catastrophic event such as the Camp Fire, the limitations of the technical infrastructure that enables us to exchange information over distance in a timely manner becomes readily apparent under the stress of the actual event.

The functionality of communication systems is dependent on multiple points of interaction — hardware to software, software to system operator, system operator to software or hardware, software or hardware message delivery to receivers. Each of these points comes under stress in an extreme event, and the capacity of communication systems to maintain interdependent functions depends on workable connections among all points. If one point fails, most communication systems go down.

## 6.2 Community Early Warning Survey

When implementing an Early Warning System that aims to reach everyone in the whole community, it's important to identify the wide diversity of needs and preferences residents have in receiving emergency alerts and notifications. It is essential that residents have a voice in planning, designing and implementing the Early Warning System. The Town of Paradise conducted a community survey to assess early warning needs. A questionnaire was prepared and circulated with an excellent response rate having 46% of the residents responded. A summary of resident responses follows:

1. The survey results conclude that an emergency alert and warning system should notify of an imminent emergency, provide specific information to help protect the community and provide updates throughout an emergency.

2. The survey results concluded a tone alert with a voice message specifying the type of disaster and the actions that should be taken is a priority.
3. TOP's community relies on multi channels to receive their information. The most popular channels include Text Messaging, Phone and Social media with the least being print, TV, radio, websites/email and word of mouth.
4. More than 92% of the respondents are concerned regarding power outages during an emergency.
5. The majority of the respondents would prefer both an outdoor early warning system with a tone followed by a message and in tandem receive a text message to a mobile device.
6. 82% of the respondents said they would support an outdoor early warning system near their home.

Other notable comments from the survey include:

- The Alert and warning system should issue alert and actionable warning message
- Alert and warning should reach to community even if there is (a) No Power, (b) No cellular service, (c) No Radio / TV service, and (d) No internet service in the area
- Monthly testing is acceptable by the community

Translating the insights gained during Camp Fire and hazardous incidents that will likely occur in subsequent years, increases the capacity of community organizations to act in coordinated efforts to reduce shared risk.

Research on past incidents and responses, the valuable input and experience of Paradise officials, and the results of the community survey provides important insights in emergency planning for a Building-Back-Better (BBB) Early Warning System.

Based on the information outlined in this section, the following broad system requirements and objectives for the Paradise Early Warning System are summarized below.

1. Early detection of a hazardous event and assessment / analysis of associated risks and vulnerabilities is crucial. Emergency Alert and warning system design should ensure robust information exchange with Cal Fire and Cal EMA who play a key role in the early detection, analysis and forecast of hazardous events. Reliable, robust and simple protocols are necessary for regional communication and interagency communication.
2. Local authorities are responsible for issuing emergency alerts and notifications when a hazardous event is detected. The town's emergency alert plan should guide dissemination and management of public alert and warnings.

3. The Early Warning System should support siren tones and voice messages.
4. Failure of communication and power infrastructure commonly occurs during severe incidents. Failures may last for a few hours to several days. Early Warning System infrastructure should integrate multiple redundancies to provide failsafe operation.
5. The Early Warning System should enable local authorities to alert and warn at-risk residents and visitors when TV, radio, cellular, landline and internet service are out.
6. No resident or visitor registration should be required to receive alerts and notifications from the town's Early Warning System.
7. IPAWS, EAS, Mobile Messaging Systems and other emergency alerts should interface with the Early Warning System.
8. Remote activation and operation of the Early Warning System should require user authentication. A contingency plan to override the authentication requirement during extreme circumstances should be considered.
9. The Early Warning System should support the integration of IoT devices (remote fire, wind, flood and other sensors)

## 6.3 Existing Alert and Warning System with TOP

The Town of Paradise can currently issue warnings and information through multiple channels. The current systems include notification and information dissemination through an AM radio station, social media, website, the county mobile messaging system, IPAWS and WEA. The ToP mobile messaging system has the ability to provide SMS/Voice Calls and communication via a mobile app.

The (WEA) Wireless Emergency Alerts is part of (IPAWS) Integrated Public Alert and Warning System. IPAWS uses FIPS (**Federal Information Processing Standard** a five-digit code uniquely identified counties and county equivalents in the United States) or geocodes and Butte County currently holds the permission. The Town may use polygons within WEAs to constrain distribution of the WEA reach, there is a potential for overlap outside the polygon area even though the FCC implemented a requirement that cell carriers alert 100% of cell phones within a polygon with no more than 0.10 overshoot, the technology of handsets and software is being developed. The recommendation for a WEA activation is to include in a WEA message (90 -360 characters).

| | |
|---|---|
| i) | what is going on |
| ii) | where |
| iii) | action to take place |

- AM Radio
- Mobile Messaging System
- County IPAWS/WEA
- Website
- Social Media
- Route alerting

Consolidating the activation and operation of multiple channels is possible with today's advanced software technology. Indoor notification, including NOAA radio or connectivity to smart home devices may enhance the dissemination of emergency alerts. Portable hailing devices provide clear emergency messaging that penetrates vehicles and buildings.

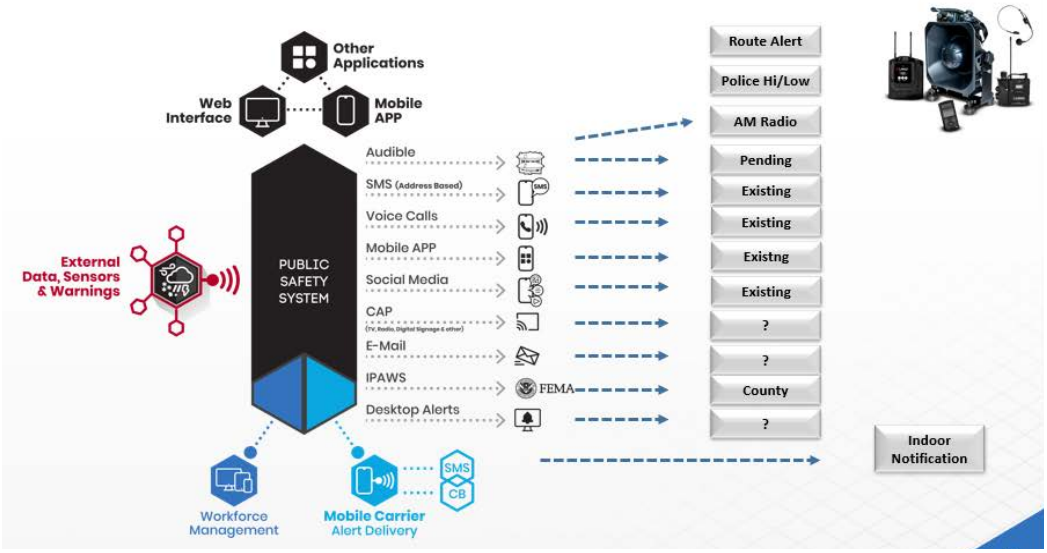



**Figure 6 – Single Source Activation**

## 6.4 Broad Level Technology Recommendation

Electronic sirens with clear voice capabilities provide the most system functionality and versatility. Accordingly, it is recommended to install an electronic siren-based Early Warning System for the Town of Paradise. This recommendation forms the basis for reviewing technology options. Four California projects designed using similar technologies are listed below.

## 6.5 Similar Projects

| Name of Project | Relative Design | Value |
|---|---|---|
| City of Laguna Beach | Laguna Beach is a coastal city with many hazard and topographical challenges. The city's Early Warning System is connected via satellite to the Laguna Beach Police Department. 22 voice/siren arrays of various size and coverage areas are currently installed with solar power and battery backup. The remote activation and operation software is cloud-based, mobile app activation and is IPAWS and WEA compatible. | Est $1.-1.5M |
| City of Mill Valley | Mill Valley replaced its five aging sirens with an electronic voice/siren array system. The cloud-based software enables Marin County or Mill Valley authorities to remotely activate each or all arrays via satellite from mobile devices. At 4.8 square miles, Mill Valley is approximately 75% smaller than Paradise. Mill Valley recommends other cities to install solar panels due to high potential of power outages. | Est $400-500K |
| City of Newport Beach | Newport Beach replaced its three mechanical tsunami sirens with electronic voice/siren arrays that are activated by satellite using cloud-based software. The cloud-based software uses one source to activate IPAWS, WEA and the speaker arrays. A service program is in place for both software and preventative maintenance roughly 7-10% of the cost of the equipment. | Est $200 -300K |
| City of Malibu | A feasibility study was released and reviewed by the Genasys team. At 19 square miles, Malibu is similar to the Town of Paradise in area size and topographical challenges. A July 2020 Early Warning System siren feasibility study recommended 20 - 33 steel pole installation locations. | Est $1.5 – 2.3M |

# 7.0 System Recommendations & Design

The Genasys team has designed many systems around the world and follow the common fundamentals regarding sound propagation and attenuation and the potential impact of outdoor and indoor coverage.

## 7.1 Attenuation

The principles of sound and its movement through the atmosphere are fundamental to understanding the way in which audible warning systems work at the device and system levels. Sound is a form of mechanical energy that moves from a source (e.g., a voice, a musical instrument, or an emergency siren) through the air as tiny oscillations above and below the surrounding air pressure. When people hear sounds, they can distinguish: 1) loudness (volume); 2) frequency (pitch); and, 3) modulations (variations) in loudness and frequency over time (i.e., the changes in sound that allow us to discern and interpret speech or a specific musical passage.)

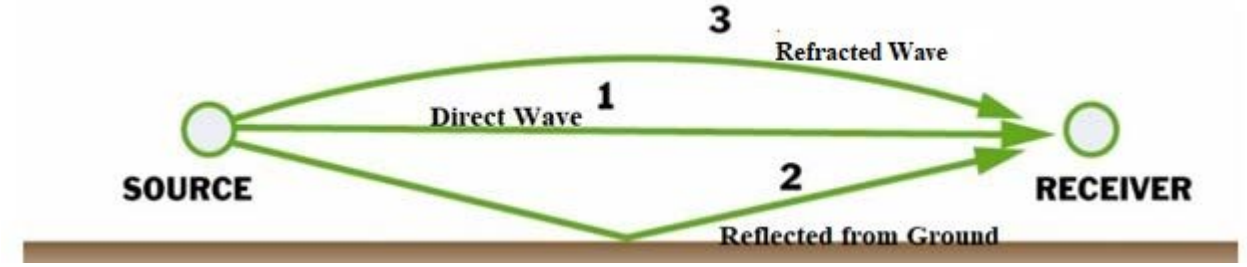



Figure 7 – Outdoor Sound Propagation near Ground (Source: FEMA guidelines)

It is well known that sound decreases in loudness at greater distances from its source. This is called “attenuation with respect to distance.” An audible warning system’s effective range is the distance at which the sound is predicted to attenuate to a predetermined value, typically 70 dB. Factors that affect range of siren for a specific frequency, include:

- Ambient noise in the environment
- Ambient temperature
- Ambient humidity
- Wind speed
- Wind direction
- Pole / Building height
- Terrain
- Trees and Vegetation

## 7.2 Outdoor vs Indoor Coverage

An outdoor Early Warning System can reasonably be expected to alert some people inside buildings depending on the distance from the nearest audible device, outdoor conditions, building construction, indoor sound levels (e.g. stereo system or appliances), whether people

| Building or Construction Type | Sound Loss (dB) | |
|---|---|---|
| | Open Windows | Closed Windows |
| Residences – light frame, single-pane windows | 12 | 20 |
| Residences – light frame, dual-pane or storm windows | 12 | 25 |
| Schools | 12 | 25 |
| Churches | 20 | 30 |
| Hospitals/Convalescent Homes | 17 | 25 |
| Offices | 20 | 30 |
| Theaters | 17 | 25 |
| Hotels/Motels | 17 | 25 |
| Masonry wall construction – single pane windows | 12 | 25 |
| Masonry wall construction – dual pane windows | 12 | 35 |
| Sealed glass wall –1/4-inch glass thickness more than 50 percent of exterior wall area | - | 28 |
| 20 lb/ft² solid wall – no windows, no cracks, no openings | - | 30 |
| 50 lb/ft² solid wall – no windows, no cracks, no openings | - | 38 |

**Table 6 – Typical Outside to Inside Sound Losses for Various Types of Building Construction (Source: FEMA Guidelines)**

are awake or sleeping, and whether or not windows are open. Typical outside to inside sound losses for various buildings or construction types are shown in Table above. (The dB values in the table need to be added to the indoor decibel level required for arousal in order to determine the required outdoor decibel level.)

Using collected data, Genasys can produce sound propagation maps using planning software to determine the levels of coverage achieved from the proposed sites. The coverage models take into consideration varying geographical topology and environmental factors such as foliage and building density. Although this is not a perfect prediction model, it does try to account for various environmental conditions. Meteorological data used for sound modeling includes average temperature, humidity, pressure, and pole height. The average environmental noise level in Town of Paradise is approximately 65 dB (source Town of Paradise Planning document 1994)

## 7.3 Detail Design

Genasys along with the Town of Paradise reviewed potential locations for preliminary sites. The conclusion requires (21) twenty-one locations. The review included factors for optimal acoustic coverage, accessibility, approval and power availability. The system is based on voice intelligibility of 0.7 STI with speaker distances ranging 2600 to 3,200ft (800 to 1km).

## Table 7 – Site locations

| Site | | Description | Lat | Long |
|---|---|---|---|---|
| 1 | A | Police Dept | 39°45'15.26"N | 121°37'27.73"W |
| 2 | B | Paradise Elementary School | 39°45'4.89"N | 121°36'34.81"W |
| 3 | C | Paradise High School | 39°45'40.89"N | 121°36'45.70"W |
| 4 | D | Sawmill & Nunnely | 39°45'20.90"N | 121°35'20.14"W |
| 5 | E | Paradise Middle School | 39°46'15.93"N | 121°35'53.73"W |
| 6 | F | Town Hall | 39°44'55.21"N | 121°38'3.65"W |
| 7 | G | Skyway Crossroad | 39°44'28.73"N | 121°39'17.90"W |
| 8 | H | Neal & Roe | 39°44'12.57"N | 121°38'55.43"W |
| 9 | I | Foster & Applelane | 39°43'59.74"N | 121°38'10.23"W |
| 10 | J | American Way | 121°38'10.23"W | 121°36'36.83"W |
| 11 | K | Bennett & S. Libby | 39°44'15.46"N | 121°35'37.56"W |
| 12 | L | Pentz & Water Tower | 39°44'2.76"N | 121°34'25.08"W |
| 13 | M | Ponderosa Elementary | 39°46'34.61"N | 121°34'47.46"W |
| 14 | N | Redbud Dr & Rose Ln | 39°45'33.83"N | 121°38'27.37"W |
| 15 | O | Bille Park | 39°46'15.06"N | 121°37'56.05"W |
| 16 | P | Clark PMTrail | 39°47'46.28"N | 121°35'5.84"W |
| 17 | Q | Feather River Hospital | 39°45'30.78"N | 121°34'20.14"W |
| 18 | R | Pentz & Pearson | 39°44'52.07"N | 121°34'21.86"W |
| 19 | S | Trailway & Rocky Lane | 39°46'53.56"N | 121°35'53.74"W |
| 20 | T | Gregory Lane & Waggoner Rd | 39°46'43.88"N | 121°36'47.71"W |
| 21 | U | Roe Rd & Scottwood Rd | 39°44'27.71"N | 121°37'19.07"W |

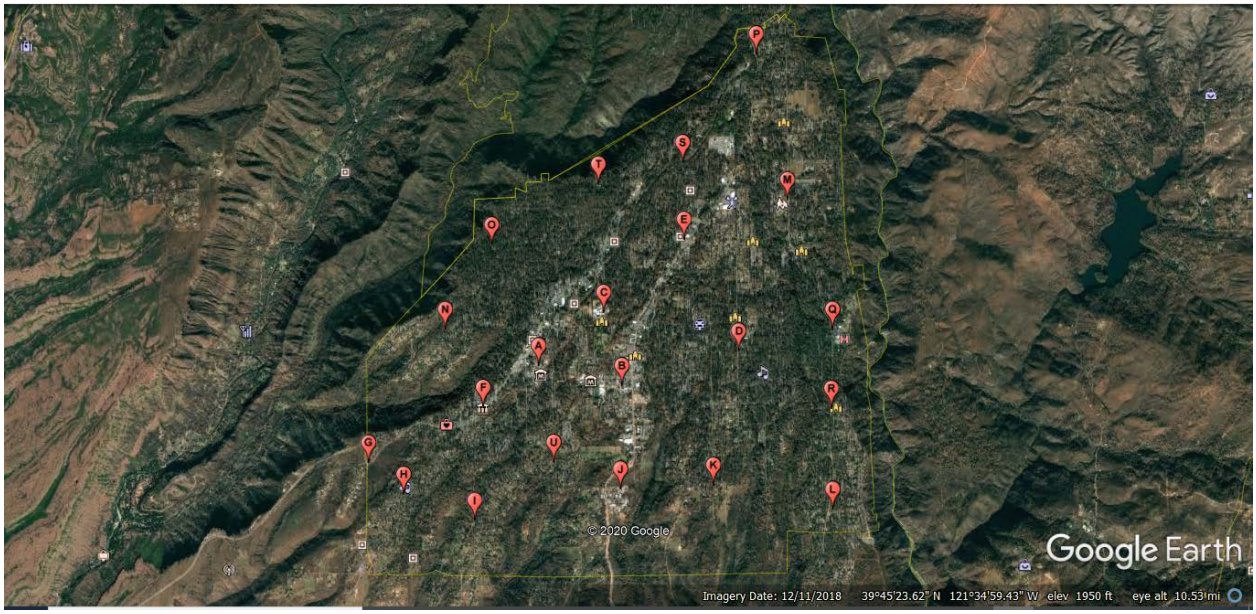



**Figure 8 – Site locations**

Twenty-one locations are identified alphanumerically

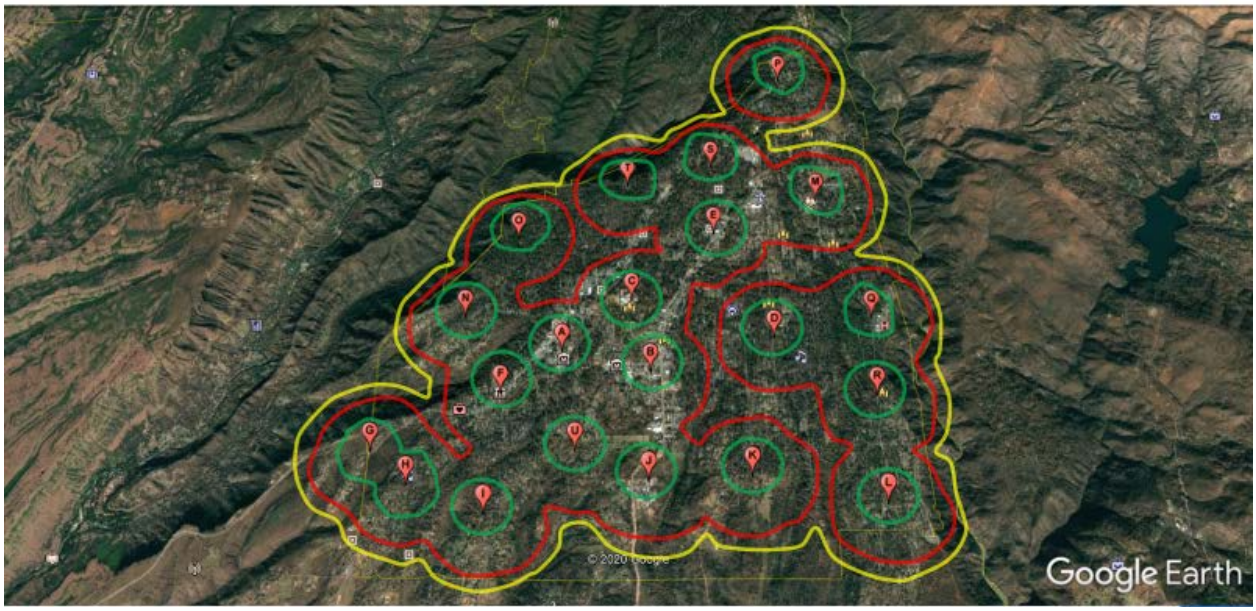



**Figure 9 – Coverage areas - Green 400M – Red 800M – Yellow 1Km**

Inside green areas - 90dB or louder (Likely to be heard indoors depending on the structure). Inside red areas - 80dB or louder. Inside yellow areas - 70dB or louder.

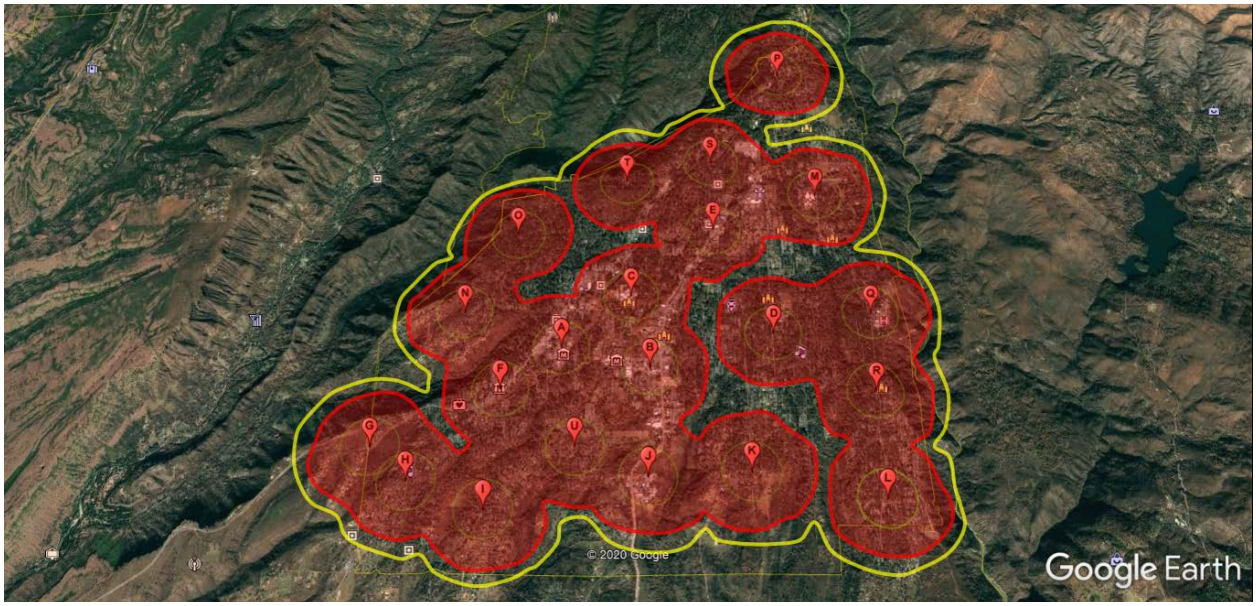



**Figure – 10 Coverage areas - Red 800M - Yellow 1Km**

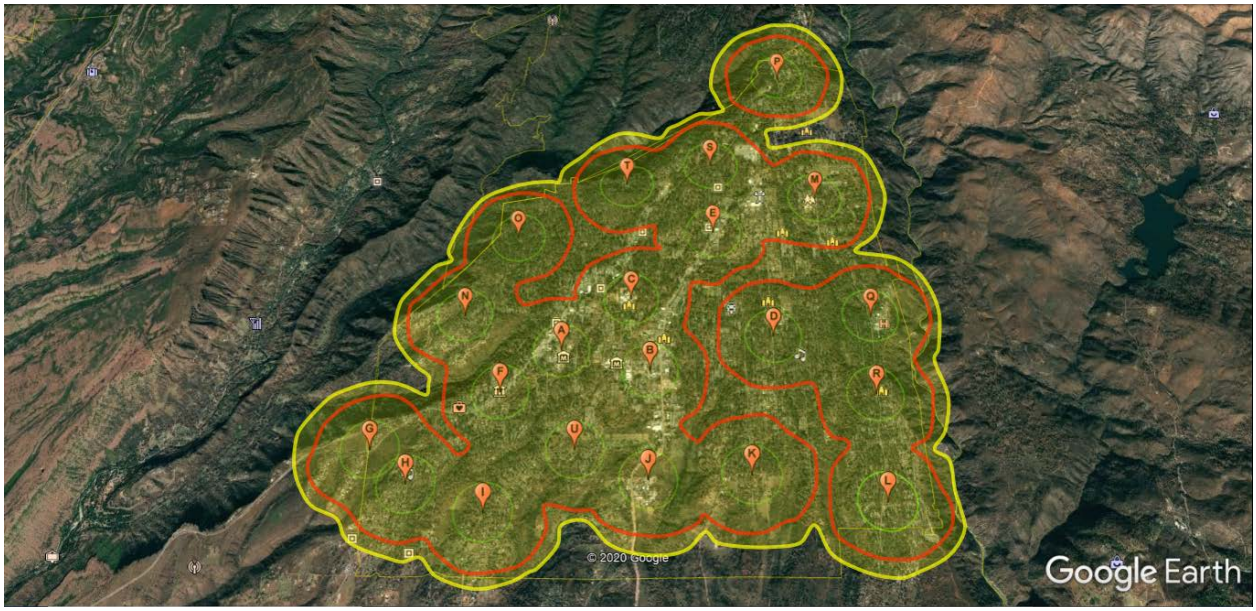



**Figure 11 - Coverage areas - Green 400M - Red 800M - Yellow 1Km**

Based on the research, each site location shall have a speaker mounted on a direct bury or pedestal steel or concrete pole with a minimum height of 42ft above grade. Poles should not be susceptible to fire. The pole shall have speakers mounted to adequately provide 1Km range in 360 degrees. Some locations may be directional horns such as Bille Park or Clark PM trail. The system shall be AC and Solar power charging with battery back up to power an activation for 1hour continuous activation.

The minimum requirements are as follows (Sample Bid Specification 8.0):

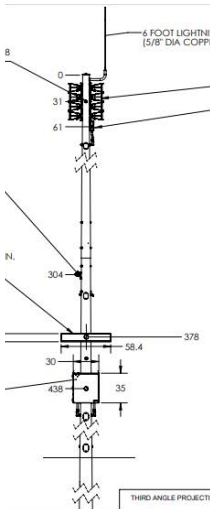
Voice/Siren Requirements:

- Coverage area
- Voice
- Tone
- Minimum STI 0.7
- Omnidirectional 360° coverage
- Selected sites may require directional coverage

Power Requirements:

- Alternating current AC 110V
- AC and 24V DC Operation
- Adequate backup power available for 1 hour of continuous alerting
- Backup power equipment should be recharged to 80% of the maximum rated capacity from the fully discharged state within 24 hours
- When used for backup power, batteries should be 3-year maintenance-free
- Connect and power to Communication device

## Installation Requirements:




- Pole shall be Corten steel or similar and require customer approval
- Pole shall be direct buried pole designed or pedestal mount
- Pole & equipment shall withstand 100 mph 3-second wind gust
- Steel pole height 42 ft. above grade (45-55ft total length)
- 120V 20-amp dedicated circuit
- Voice/siren array and connectivity shall not be covered by foliage or other obstructions
- Notification panel shall be accessible by ladder, but sufficiently out of reach to impede unauthorized tampering
- Solar panel shall be installed above the notification panel and positioned for optimal sunlight
- Satellite device shall be properly installed unobstructed line-of-sight
- Maintenance support availability

## Activation Software Functional Requirements:


- Coverage area
- Voice
- Tone
- Activation and operation using computer-based activation, control, monitoring and testing methods which include supervisory control and data acquisition (SCADA) systems.
- Remote mobile activation
- Polygon activation
- All Call/Group/Individual Activation
- Voice/Siren connectivity
- Cloud-based solution
- Service Level Agreement package
- Live Broadcast
- Play multiple recorded messages and agile to send SMS/Text messages
- Interconnectivity with other systems, including:
  - IPAWS
  - CodeRed or similar system
  - Social media
  - Electronic signage
  - Radio station
  - GIS mapping
  - IoT devices and sensors

## 7.3 Budgetary Costs

| Description | QTY | Equipment | Extended |
|---|---|---|---|
| Speaker Array | 21 | $ 28,000 | $ 588,000 |
| Notification Panel | 21 | $ 22,000 | $ 462,000 |
| Connectivity/Satellite | 21 | $ 5,000 | $ 105,000 |
| Battery System | 21 | $ 2,000 | $ 42,000 |
| Solar Panel | 21 | $ 3,500 | $ 73,500 |
| Remote Activation System | 21 | $ 20,000 | $ 420,000 |
| Corten Steel Pole | 21 | $ 15,000 | $ 315,000 |
| Installation | 21 | $ 30,000 | $ 630,000 |
| Optimization/Training | 21 | $ 2,000 | $ 42,000 |
| Service Agreement/Sat fee per year | 3 | $ 38,000 | $ 114,000 |
| Annual Maintenance | 1 | $ 30,000 | $ 30,000 |
| Freight | 1 | $ 65,000 | $ 65,000 |
| Permits | 21 | $ 200 | $ 4,200 |
| Total | | | $ 2,890,700 |

# 8.0 System Specification

Bid Specification

Advanced Warning System Statement of Work (SOW)

1. Introduction

    1.1 Project Description

2. Required Technical Qualifications

    2.1 The contractor shall demonstrate full knowledge and understanding of the specifications and requirements for the implementation of voice capable Early Warning system by submitting a detailed and comprehensive proposal outlining methodology, coverage area(s) and detailed product list to satisfy the SOW. The proposal must include the following

    2.2 Design

    - Executive Summary
    - Overview
    - California Implementation References (minimum of 3 within the last two years)
    - System Recommendations
    - Speaker locations
    - Implementation and integration plan
    - System testing and operations

    2.3 The contractor shall be able to prove previous experience and past performance with an IPAWS integrated system within cities in California.

    2.4 Contractor shall provide California based factory-trained personnel to perform system design, manufacturing, testing, and training through the receipt of system certification documentation.

3. Technical Services Required

    3.1 The contractor shall design, obtain and install a customized Voice speaker that provides tones and messages that shall meet all specific requirements listed in the SOW. The system must be planned out in detail to ensure that safe sound levels are not exceeded, and emergency warning coverage is adequate for the desired area. Acoustic map(s) shall be submitted as part of the initial contractor proposal, with final acoustic map(s) provided upon completion of the site survey.

4. Outdoor Speaker Activation Requirements

4.1 Contractor to provide a web-based activation software and shall include the following:
4.2 Software shall activate remotely with additional capability to activate via a mobile app
4.3 Software to be IP based with satellite activation
4.4 Software to provide multiple alerting platforms to be activated from one system including but not limited to:

- Acoustic Devices (Speakers)
- SMS
- Voice Call
- Mobile Application (push), geo-located communication
- Social Media: Facebook, Twitter, Whats App, YouTube
- Common Alerting Protocol (CAP) commonly used protocol to integrate other communications
- IPAWS (Wireless Emergency Alert – both posting and receiving codes)
- AM Radio

4.5 System to be capable of redundant paths of communication (i.e. LTE/GSM, Ethernet, 2-way Radio, Satellite)
4.6 Software shall have reporting capability
4.7 Software shall set audio levels from low to full volume

5. Outdoor Speaker Requirements

5.1 Individual speaker performance of at least 139 dBA SPL at 3 kHz with effective frequency response of 350Hz – 7.0KHz
5.2 Speaker to meet Speech Transmission Intelligibility (STI) greater than 0.93
5.3 Speaker must have capability for directionality and modular/stackable for increased performance
5.4 Speaker to have voice and tone capability

6. Notification Cabinet Requirements

6.1 Notification panel to include amplifier and electronics and shall be weather resistant with a NEMA 4X cabinet.
6.2 Notification panel to have the ability to operate on AC only. If AC power is present, notification panel should be able to playback audio at full volume for an unlimited amount of time
6.3 Notification panel to automatically transfer and operate on DC power if utility AC power is eliminated
6.4 Notification panel to consist of three 110 Ah AGM batteries to provide at least 1 hour of continuous activation after 72 hours of power loss
6.5 Notification panel to have a removable MP3 Player with 20 ft. cord for onsite activation
6.6. Notification panel to be equipped with a playback microphone with record-on-the-fly capability to reduce potential feedback and loop continuous activation.

6.7 Notification panel to have a smart charger with battery state of charge (SoC) and power source feedback
6.8 Notification panel to have solar and AC charging systems
6.9 Notification panel to store over 100 prerecorded messages and tones
6.10 Notification panel to be able to load new messages remotely or from a USB connection
6.11 Notification panel to be activated by Ethernet and/or satellite connection
6.12 Notification panel to have the ability to integrate with third party sensors (air quality, wind speed, temperature, fire, humidity and more) through USB and/or RS-232 serial interface
6.13 Notification panel to provide Power-over-Ethernet (PoE) required for satellite terminal

7.0 Solar Panel
7.1 Solar panel to be rated at 160W or higher

8.0 Satellite Device
8.1 Satellite device to be rated for the outdoor environment
8.2 Satellite device to be 99.8% reliable
8.3 Satellite device to have live voice bandwidth capability

9.0 Construction/Installation
9.1 Poles shall be corten steel or concrete/customer approval required
9.2 Speakers and cabinets shall be mounted securely to the pole
9.3 Poles shall be a direct bury or pedestal design
9.4 Poles shall be a minimum of 42 ft above grade
9.5 Poles to withstand 100 mph wind load

10.0 Testing
10.1 Describe the testing criteria of the system
10.2 System to have the following minimum capabilities:
10.3 Capable of initiating a silent test
10.4 Activation of an individual speaker, group via polygon, all Call speakers
10.5 Activation of the IPAWS/WEA system
10.6 Execute a campaign with from all platforms
10.7 Build a MACRO for quick activation
10.8 Successful activation from the Town's existing emergency notification system

11.0 Training
11.1 Provide a training plan
11.2 Provide a service and maintenance plan

12.0 Pricing

13.0 Evaluation Criteria

| Criteria | Weight |
|---|---|
| Experience in the Region | 15% |
| Equipment Quality | 20% |
| Personnel | 10% |
| Confidence to perform | 20% |
| Proposal Format (Completeness) | 10% |
| Understanding, Approach, and Scope | 20% |
| Cost | 5% |
| **Total** | **100%** |

# 9.0 Development Plan

Please find a sample development plan

**Phase 1 – Procurement**
**Phase 2 – Bid Evaluation and Award of Work**
**Phase 3 – Site Preparations**
**Phase 4 – Production, Supply and inspection**
**Phase 5 – Installation and Testing**

Hardware/speaker installation

- Installer will provide schedule of installation
- Ship equipment and install mounts/speakers and cabinets/satellite devices/solar panels

Software installation/tests

- Test Bed/ Preproduction
- Production environment

The Test Bed environment will be setup and used to do the migration process over existing data used in the current system. After this process, the production environment will be configured. Functionality, performance, high availability and load testing will be executed as described in next chapter, including alarms and monitoring integration with 24/7 support team.

**Phase 6 - Pre-Live Training and Validation Tests Period**
The software service will be available for training and validation purpose before the production rollout. We propose a period of 4 weeks.

After the speaker equipment is installed, it will be ready for low volume or individual testing based on governmental approval.

**Phase 7– Software Production rollout**
The migration process will be executed again to generate an updated version and then controlled production rollout process will be implemented.

**Phase 8 – Full Testing and support of system-wide test through web-based and mobile app, and system wide integration with the Town's existing emergency notification system.**

- Mass Notification
- Text
- IPAWS
- Tone/Speaker
- Satellite/IP

### Phase 9 – Final Acceptance Testing

As part of the acceptance process, all the functionality should be tested in test bed and production environments.

During the Kickoff meeting, a detailed test use cases document will be created and agreed upon. This use case will cover all functional, load, performance, high availability and alarming testing.

The software process will include:

- Access and authorization profiles
- Migration process
- Web Event manager
- Registration portal
- Mobile apps
- Mapping
- External integrations
- Output notifications channels
- High availability
- Other

Test to include real test cases in a controlled environment. New releases shall go through quality control process and then installed and tested in the Test bed environment before going to production.

### Project Progress Monitoring / Milestone Chart

# 10.0 System Testing and Operations

Testing a system is an important part of an outdoor warning system and education process. Providers of the system offer testing and operational documents relevant to system. Additional information may be found in FEMA CPG-1-17 and FEMA 2006 Technical Bulletin.

Test Frequency: Based on the survey results and other California communities, testing once a month is preferred. The test should be consistent and convenient, for example noon on the first Wednesday of every month.

Example Message: A seven second siren tone (may be different from the Alert tone) followed by a message example: “This is a test of the outdoor warning system. This is only a test”. Repeat.

Providers often have a library of messages or the capability to professionally record custom messages and tones. It is important to have the provider optimize the message to maximize message quality and performance.

Silent Test: Many systems can verify activation without voice or tone being emitted. Silent tests can be conducted weekly or daily to verify the system is in operation.

Cloud-based service. Some providers offer a service level agreement that includes 24/7 monitoring by technical experts. Customers are notified if the system is off-line and can quickly remedy the activation issue.

Cloud-based activation updates. Some providers will deliver software updates to enhance the user experience. Additional features may be included in the updates or built into the system.

Cloud-based Remote Test: Some providers have multiple activation methods. These methods include mobile activation, desktop activation or other protocols requested by the customer.

Preventative Maintenance: Many providers recommend regular physical site checks as part of preventative maintenance. A site check inspection procedure is often provided. The customer or authorized provider can provide this maintenance, which usually includes visual inspection, battery and electronic systems check and an onsite low volume test.