From: seleong@roadrunner.com
To: ClerkoftheBoard
Subject: Item # 76: Amendment to Thousand Oaks Area Plan Policy TO-22.3
Date: Sunday, September 24, 2023 3:28:55 PM
Attachments: Item_76_Amendment to Thousand Oaks Area Plan Policy TO_22-3.pdf

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Dear Sirs:

I respectfully submit the attached technical position paper in support of Item # 76: Amendment to Thousand Oaks Area Plan Policy TO-22.3 (scheduled for discussion at 4:00PM, 26SEPT2023).

I am available for questions or comments on this position paper.

Thank you very much.

Respectfully,

Steven E. Leong
Newbury Park
310-505-5678

Public Safety Communications – The Role of Antenna Elevation

(In Support of Item #76: Amendment to Thousand Oaks Area Plan Policy TO-22.3)

Steven E. Leong
Ventura County Sheriff – Office of Emergency Services – Auxiliary Communications Services;
Northrop Grumman Corporation – Aeronautics Systems Division – Staff Engineer, Systems Architect;
Institute of Electrical and Electronics Engineers - Senior Life Member;
American Radio Relay League, FCC Licensed General Class Radio Operator, Newbury Park, CA, U.S.A.

INTRODUCTION

As a 42-year resident of Ventura County, I have experienced the breadth of natural disasters that are part of our community. I have been a member of the local technical Law Enforcement/First Responder profession since 1993. As a 30-year Aerospace Engineer specializing in RF Communications and Radar, I have volunteered my time and expertise to support local public safety radio communications. Since the 1980's, I have built and maintained radio repeaters throughout the county in support of emergency communications.
The primary defining attribute for the performance of these repeater sites is elevation. Elevation defines the service area of the radio, or its ability to reach population areas in the county. To put it simply, the higher the radio (antenna), the greater service area is defined.

Specifically, performance of public safety (radio) communications systems:

- Depend on elevation for the greatest coverage area to affect the fidelity, effectivity, and communication capability (public safety/emergency) for the area of interest;
- Are limited geographically by available mountain peaks with established infrastructure (primary and backup power, and accessibility);
- Are subject to increased operational interference based upon greater "energy densities*" if required to be co-located with competing services with all installations being at lower elevations. (*If all existing services are required to "just move down the tower" at the same geographic location, increased RF energy densities would require each operator to install much more robust (costly) equipment in attempts to mitigate this energy, without guarantee of maintaining previous operational capability).

SCENARIO OF INTEREST

I cite for example, an existing 2-meter (144MHz) repeater located in Building B, Rasnow Peak, that has been in operation at this site for over 30 years. It has served the Conejo Valley and Ventura County as one of the primary wide-area coverage emergency communications repeaters and has been delineated in the County Emergency Operations Plan as backup to primary public safety (Law Enforcement, Fire and Public Health) communications. (Case: This repeater has been used for Health and Welfare status at County Emergency Operation Centers and hospitals during wildfires and other evacuation events). Its antenna has been mounted at the top of the adjacent 60-foot tower. In this configuration, the system has provided critical communications links throughout the county during our many emergencies, natural and man-made. Its ability to maintain reliable communications from hand-held and mobile radios in most areas of the county is based to a high

degree upon excellent antenna elevation. Lowering the antenna to an elevation of 40-feet would decrease areal coverage of this system by an estimated 30-40 percent. The population density within this area is significant and would be considered under-served in worst case configuration.

The operational vignette captured in Figure 1, Figure 2, and Figure 3 illustrate the difference in areal coverage of this one radio system comparing notional 100-foot, existing 60-foot and decreased 40-foot tower elevations. Green areas are considered "good" high quality communications areas, and Yellow areas are considered "marginal to poor" communication areas. It is clear that as antenna elevation decreases, communication coverage area decrease. To mitigate the emergency communications coverage risk to this marginalized population, antenna elevation must be maximized to the greatest extent possible.

(Intentional blank space here to keep all plots on next page for comparison)

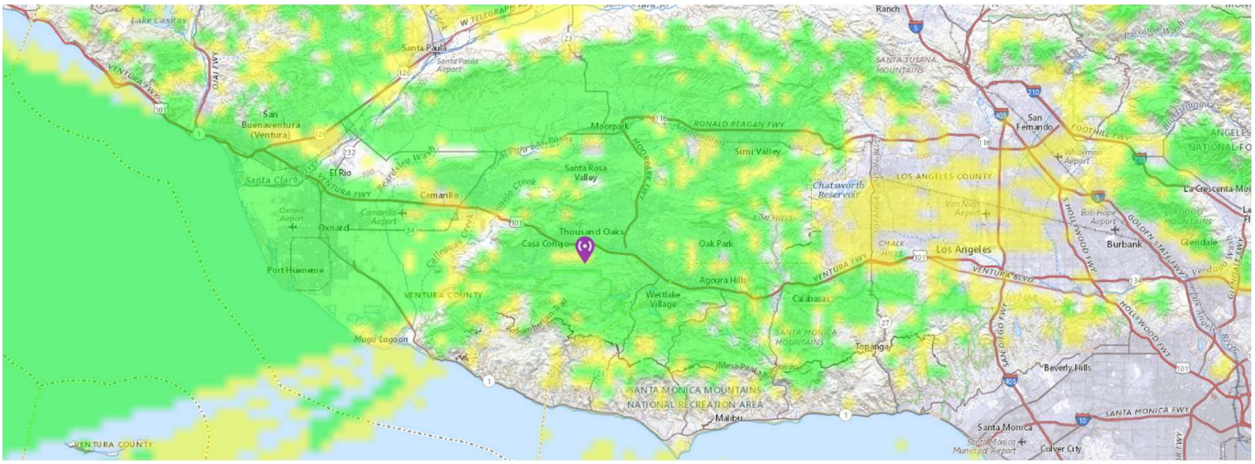

Figure 1. Scenario Considered – Notional 100-foot Antenna Elevation

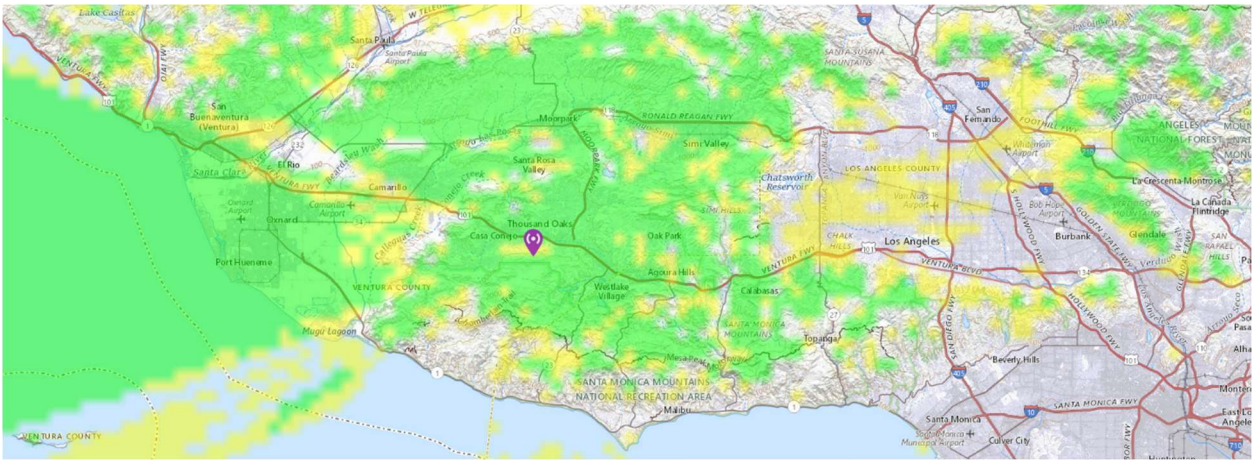

Figure 2. Scenario Considered – Existing 60-foot Antenna Elevation

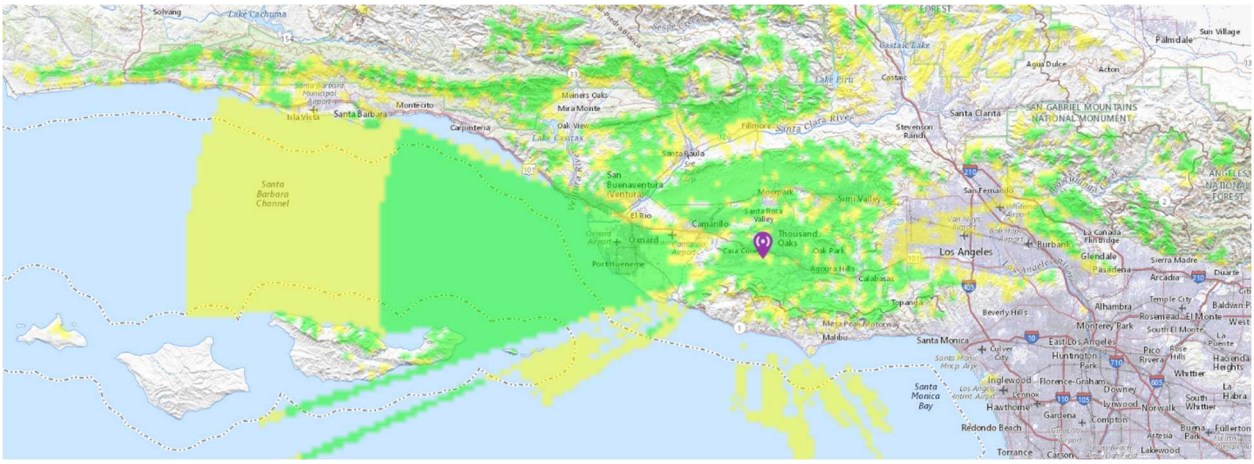

Figure 3. Scenario Considered – Decreased 40-foot Antenna Elevation

MODELING, SIMULATION, AND TEST ENVIRONMENTS

Through modeling and simulation analysis, a design of experiments was conducted to determine the effects of antenna height, output power and geographical location on the expected operation of repeaters. Existing repeater parameters (antenna height and output power) were used as control or expected operation of the system. Variables were composed of several elements:

- Antenna Height (Elevation): The intent was to determine if lower antenna height (elevation) could produce similar (acceptable) repeater operation. Changes in elevation varied from 10 feet to 40 feet below existing height.
- Repeater Output Power: The repeater output power was increased as the antenna elevation was decreased in efforts to compensate for the lowered elevation.
- Receiver Geographic Location: Receivers (hand-held and mobile radios), were used to compare operational capability both inside and outside of buildings as the antenna height was adjusted and repeater power was increased. Reception capability was compared to the original repeater site configuration (60-foot antenna elevation and 30W output power).

RESULTS

The results of these experiments show that with existing repeaters (both VHF and UHF frequencies), using varying (lower) antenna heights in conjunction with increased output power variations, that decreased antenna height cannot be overcome by increases in power output. The effects of terrain and other physical factors degrade the operational capability of the repeater when compared to the original site configuration (60-foot antenna elevation and 30W output power). The results of the experiments did not include radio repeater input modifications to mitigate the degradation due to RF energy density at lower antenna elevations.

CONCLUSION

The cited repeater is but one of dozens in the county serving emergency communication needs. Through analysis and demonstration, it has been determined that antenna elevation below 60-feet will seriously degrade the performance (capability) of radio repeaters. Effects of decreased antenna elevation are exacerbated as frequencies increase. Note that the FCC requirement to move all municipal public safety communications to the 700/800MHz band will suffer greatly if lower antenna heights are mandated. To support mission requirements (provision of high-grade emergency communications), it is imperative to maintain the greatest antenna elevation possible (60-feet+ AGL). Degradation of radio repeater capabilities are directly proportional to decreases in antenna elevation.

Decreasing allowable antenna elevations will negatively affect multiple agencies and providers of emergency communications capabilities throughout the county through cost impacts and quality/capability and should be seriously considered in the decision-making process.