



STAFF REPORT

Report To: Board of Supervisors **Meeting Date:** December 5, 2019

Staff Contact: Darren Schulz, Public Works Director

Agenda Title: For Discussion Only: Presentation and discussion regarding the 2019 Public Safety Radio System Plan (Darren Schulz, dschulz@carson.org)

Staff Summary: The Public Works Department has completed the 2019 Public Safety Radio System Plan. The Plan contains the information previously presented to the Board of Supervisors, details the limitations of the existing radio communications capability, and outlines the actions necessary to mitigate the identified deficiencies and increase the reliability, capability, and effectiveness of the City's Public Safety Radio System to support first responders and protect life and property.

Agenda Action: Other / Presentation **Time Requested:** 15 minutes

Proposed Motion

N/A

Board's Strategic Goal

Safety

Previous Action

None

Background/Issues & Analysis

The Carson City Radio System supports critical voice communications to the Carson City, including the business functions of the Sheriff's Office, Fire Department, Public Works Department, Alternative Sentencing, Juvenile Services, Health and Human Services, and Parks and Recreation. The radio system also supports interoperable communications with regional partners and mutual aid cooperators.

The City's existing radio system is a conventional repeated VHF system. The radio system has been maintained in its current state with minimal upgrade activity since the early 2000s. Large parts of the system are comprised of obsolete and/or end-of-life equipment. Carson City has identified a need for improvements and modernization of the system in addition to an increased level of service and capability from the system. This Plan lays out the actions identified to directly address the limitations defined by the radio users group and deliver the capabilities deemed necessary to better support the needs of the public safety users who rely on it for both routine and mission-critical communications needs.

The City previously completed a needs assessment and user survey. A number of alternatives were considered to address the limitations and deficiencies identified during that process. Consideration was also given to improve system longevity, reliability, performance, and interoperability. Based on the information gathered, the City has identified various issues affecting the current system, which it intends to mitigate or eliminate, including the following:

- End-of-life equipment is utilized throughout the existing system for both infrastructure and end-user equipment. The end-of-life equipment should be removed from service to bring the system up to a supported state.
- A lack of channel capacity negatively impacts operations. Capacity is not sufficient to meet day-to-day call volume requirements and incident or event needs simultaneously. Capacity should be increased to support daily operations plus one event or incident simultaneously.
- Coverage is inconsistent across resources and sites. In-building coverage is a real concern and is lacking throughout the area. Simplex/TAC channels are used to overcome coverage problems but are not supervised or recorded by dispatch and are only suitable for close proximity radio-to-radio communications. Coverage should be improved to ensure consistent reliable supervised communications for all routinely utilized resources.
- Interoperability with State and Washoe County agencies is limited. Interoperability with those agencies needs to be improved without negatively affecting existing VHF interoperability with quad county agencies.
- Reliability needs to be enhanced through redundancy. Action is required to eliminate existing single points of failure.

The solutions proposed in the Plan directly address those limitations and deficiencies and meet the objectives identified by the radio user group.

Applicable Statute, Code, Policy, Rule or Regulation

N/A

Financial Information

Is there a fiscal impact? Yes

If yes, account name/number: See section 6 page 37 of supporting material for financial impact.

Is it currently budgeted? Yes

Explanation of Fiscal Impact: Detailed analysis of financial impact is included in the attached report, section 6 starting on page 37.

Alternatives

N/A

Attachments:

[Radio System Plan-pr.pdf](#)

[20191126 Carson City Radio System Plan-revx.pdf](#)

Board Action Taken:

Motion: _____	1) _____	Aye/Nay
	2) _____	_____

(Vote Recorded By)

Public Safety Radio System Plan 2019



A tall, lattice-structured metal communication tower stands on a hillside. The tower is covered in various antennas and equipment. In the background, a city with residential and commercial buildings is visible, along with a range of mountains, some of which are covered in snow under a clear blue sky.

Strategic Plan

- ▶ Capabilities and Limitations
- ▶ Needs Assessment
- ▶ Alternatives Evaluation
- ▶ Outlines a clear path for the City's Public Safety Communications Capability



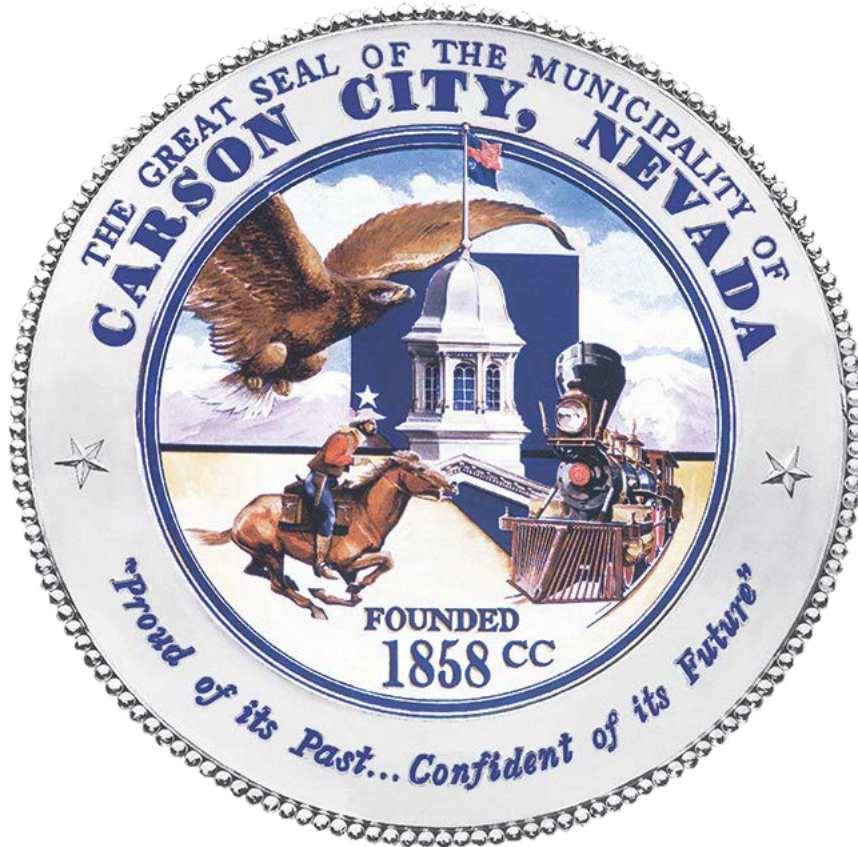
Contents

- ▶ Technical Baseline
- ▶ Operational Baseline
- ▶ Radio System Performance Findings
- ▶ System Alternative Evaluation
- ▶ Detailed Actions and Cost Estimate
- ▶ Financial Considerations

Action Items

- ▶ Interlocal Agreement – Statewide Radio System
- ▶ Radio Console Replacement
- ▶ Subscriber Replacement
- ▶ VHF Repeater Replacement
- ▶ Recording Logger Upgrade





CARSON CITY
PUBLIC SAFETY RADIO SYSTEM PLAN
2019

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EXECUTIVE SUMMARY

The Carson City Radio System supports critical voice communications to the consolidated municipality of Carson City, NV including the business functions of the Sheriff's Office, Fire Department, Public Works Department, Alternative Sentencing, Juvenile Services, Health and Human Services, and Parks and Recreation. The radio system also supports interoperable communications with regional partners and mutual aid cooperators.

The City's existing radio system is a conventional repeated VHF system. The radio system has been maintained in its current state with minimal upgrade activity since the early 2000's. Large parts of the system are comprised of obsolete and/or end-of-life equipment. Carson City has identified a need for improvements and modernization of the system in addition to an increased level of service and capability from the system. This report lays out the actions identified to directly address the limitations defined by the radio users group and deliver the capabilities deemed necessary to better support the needs of the public safety users who rely on it for both routine and mission-critical communications needs.

The City previously completed a needs assessment and user survey. A number of alternatives were considered to address the limitations and deficiencies identified during that process. Consideration was also given to improve system longevity, reliability, performance, and interoperability. Based on the information gathered, the City has identified various issues affecting the current system, which it intends to mitigate or eliminate, including the following:

- End-of-life equipment is utilized throughout the existing system for both infrastructure and end-user equipment. The end-of-life equipment should be removed from service to bring the system up to a supported state.
- A lack of channel capacity negatively impacts operations. Capacity is not sufficient to meet day-to-day call volume requirements and incident or event needs simultaneously. Capacity should be increased to support daily operations plus one event or incident simultaneously.
- Coverage is inconsistent across resources and sites. In-building coverage is a real concern and is lacking throughout the area. Simplex/TAC channels are used to overcome coverage problems but are not supervised or recorded by dispatch and are only suitable for close proximity radio-to-radio communications. Coverage should be improved to ensure consistent reliable supervised communications for all routinely utilized resources.

- Interoperability with State and Washoe County agencies is limited. Interoperability with those agencies needs to be improved without negatively affecting existing VHF interoperability with quad county agencies.
- Reliability needs to be enhanced through redundancy. Action is required to eliminate existing single points of failure.

The solutions proposed in this report directly address those limitations and deficiencies and meet the objectives identified by the radio user group.

BACKGROUND

Carson City, Nevada (City) has recognized that the existing public safety radio system is no longer meeting operational requirements. Three major reasons for seeking enhancements to the system are:

Improving System Coverage Characteristics—The current system has insufficient coverage, which results in significant areas of the City having less-than-adequate signal strength, and less-than-reliable radio system performance.

Capacity—Challenges faced by the City have grown faster than its communications capability. Existing communications resources are barely adequate to support normal daily operations let alone complex events like the Nevada day celebration or incidents such as spring flooding.

End-of-Life Service Limitations—Elements of the current system have reached end of life for guaranteed system support. Moving forward, support, maintenance, and repair of the current system will be on a best-effort basis rather than a service guaranteed by the manufacturer. This circumstance results in added risk of potential service interruptions when system problems occur.

1 TECHNICAL BASELINE

The following information summarizes the technical baseline for the current system to include recommendations for proposed enhancements.

1.1 CURRENT SYSTEM DESIGN

The existing radio system is a simple conventional repeated VHF system comprised of a primary repeater site that serves all daily operational needs. A second repeater site is installed on top of the Sierra range and provides supplemental coverage to the portion of Carson City that is west of the ridge. The third site is located at the corporate yard and is equipped with three backup channels and is intended to provide limited communications capability in the event of a primary site failure.

Three primary public safety channels are equipped with remote receiver (voter) solutions that are installed at locations distributed throughout the City. A temporary fix was implemented in 2018 to restore the stability of the remote receiver system by moving from telephone lines to wireless radios. This system is comprised of a mix of equipment and is not configured per the manufacturer's suggestions. The remote receiver systems are beyond the end of their manufacturer guaranteed support window; thus, future maintenance and repair efforts will be on a best-effort basis resulting in an increased risk of potential outages and operational disruptions that may take longer to remedy.

The primary repeater site (Sugarloaf) is located north of Carson City and provides good coverage of the developed valley of Carson City. The repeater location was established as early as 1982 through a lease with BLM. A new tower and building was constructed in 2014, and the repeater equipment was relocated and commissioned in early 2015. Three low power, reduced coverage repeaters were added in 2019 as an interim solution for capacity requirements. Seven repeaters are installed at the site as shown in Table 1. Three of the repeaters are new and have an anticipated service life of 15 years. Four of the repeaters are at end of life and replacement is recommended.

TABLE 1 SUGARLOAF

Channel	Repeater Mode of Operation	Function	Note
FD Main	Analog Conventional Voted	Primary Channel for Fire Department Dispatching	Equipped with remote receiver network
SO Main	Analog Conventional Voted	Primary Channel for Sheriff's Office Dispatching	Equipped with remote receiver network
LG Main	P25 Conventional Standalone	Primary Channel for Local Government	
SO Secondary	P25 Conventional Encrypted Standalone	Secondary Channel for Sheriff's Office Dispatch - Sensitive Information	
FD 2 North	P25 Conventional Standalone	Secondary channel for Fire Department	Added 2019 – Low power, reduced coverage
Event 1 North	P25 Conventional Standalone	Event Channel- Priority of use	Added 2019 – Low power, reduced coverage
Event 2 North	P25 Conventional Standalone	Event Channel- Priority of use	Added 2019 – Low power, reduced coverage

The second repeater site (Snow Valley) is located west of Carson City on Snow Valley Peak. The site provides supplemental coverage to the west slope of the Sierra range and Lake Tahoe. The site does not provide acceptable coverage to the east slope of the Sierra range or the south-west developed valley portion of Carson City. The site shares frequencies with three of the Sugarloaf repeaters preventing the independent operation of either set of resources. The repeaters at Snow Valley have irregular and limited use due to the interference with the primary channels and poor operational coverage. Repeaters installed at the site are shown in Table 2. The repeater equipment suffered a direct lightning strike in early 2019, and although repairs have been made the longevity of the equipment is unknown. The buildings at the site are in fair condition, but the tower structure is in need of replacement.

TABLE 2 SNOW VALLEY

Channel	Repeater Mode of Operation	Function	Note
FD Snow	Analog Conventional Standalone	Mountain Channel for Fire Department	Interferes with FD Main, low power, limited coverage
SO Snow	Analog Conventional Standalone	Mountain Channel for Sheriff's Office	Interferes with SO Main, low power, limited coverage
LG Snow	P25 Conventional Standalone	Mountain Channel for Local Government	Interferes with LG Main, low power, limited coverage

The third repeater site (Corporate Yard) is located at the City corporate yard. The site provides backup communications capability for the developed valley portion of Carson City in the event of a failure with the primary site. Due to location, the south-east portion of the valley has poor coverage from this site. Three low power, reduced coverage repeaters were added in 2019 as an interim solution to meet redundancy/reliability requirements and meet Public Safety requirements. Repeaters installed at the site are shown in Table 3. The repeaters are new and have an anticipated service life of 15 years.

TABLE 3 CORPORATE YARD

Channel	Repeater Mode of Operation	Function	Note
FD 2 Valley	P25 Conventional Standalone	Redundant Secondary channel for Fire Department	Added 2019 – Low power, reduced coverage, uses the same frequency as FD2 North
Event 1 Valley	P25 Conventional Standalone	Redundant Event Channel-Priority of use	Added 2019 – Low power, reduced coverage, uses the same frequency as Event 1 North
Event 3 Valley	P25 Conventional Standalone	Additional Event Channel-Priority of use	Added 2019 – Low power, reduced coverage, independent from primary site

The City utilizes a number of simplex channels to meet operational requirements. Simplex channels are low power radio-to-radio channels that provide short-range communications without the need for any

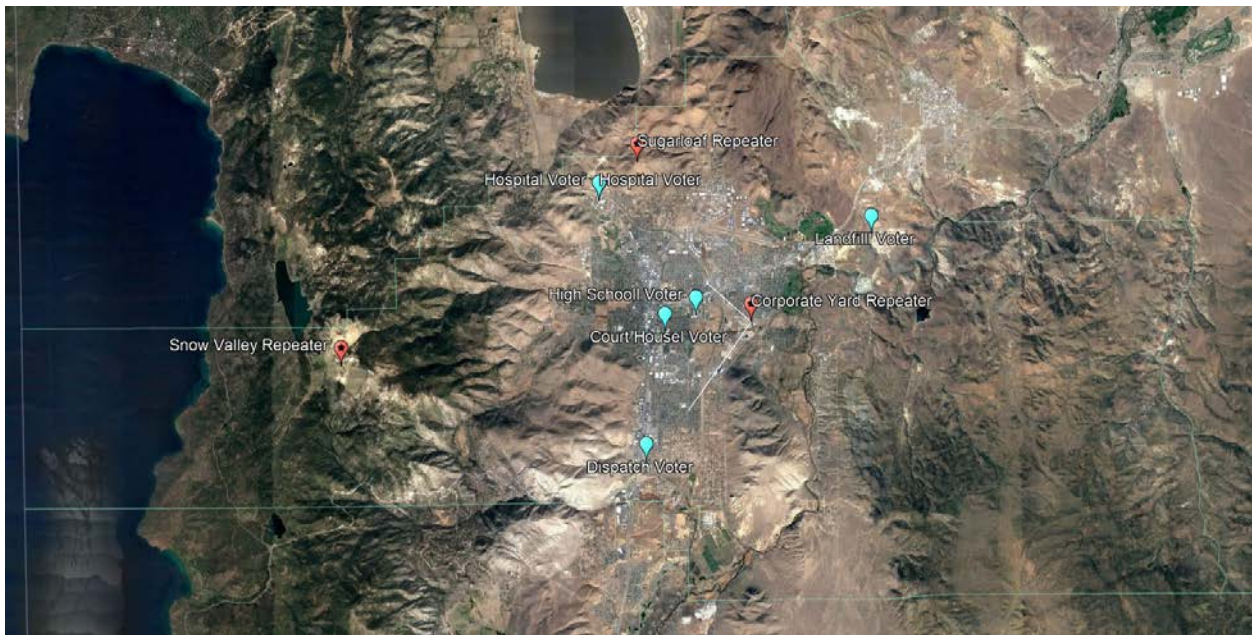
additional infrastructure. The City’s over-dependence on simplex channels is due to a lack of repeated channels and quality system capacity. Simplex channels used are shown in Table 4.

TABLE 4 SIMPLEX CHANNELS

Channel	Mode of Operation	Function	Note
SO Tac 1	P25 Encrypted	Law Enforcement Operations	
SO Tac 2	Analog Conventional	Law Enforcement Operations	
FD Tac 1	Analog Conventional – Enhanced with remote receivers (voted)	Primary operational channel for urban Fire/EMS indoor/structure	
FD Tac 2	Analog Conventional	Primary operational channel for urban outdoor on-scene	
LG Tac 1	P25 Conventional	Local Government tactical on-scene	
LG Tac 2	P25 Conventional	Local Government tactical on-scene	
Jail	Analog Conventional indoor repeater	Internal Jail Operations	Repeater installed specifically for coverage within the facility
SO SAR	Analog Conventional	Search and Rescue	
Juvenile	Analog Conventional	Juvenile Parole and Probation	

1.2 COVERAGE

System coverage is driven by the number, location, and configuration of transmit-and-receive sites. The current system design uses three repeater sites and five remote receiver sites distributed around the City. The existing configuration is the result of years of operational refinement rather than a comprehensive performance based design.



The existing system coverage does not adequately cover the entire City, and coverage does not extend much farther than the county lines. Coverage differs significantly from one channel to another and commonly leads to confusion and inefficiencies in response activities.

Modern public safety radio system coverage designs generally will provide a higher level of coverage/signal strength compared with the current system. Radio system user feedback indicates that the current level of coverage is insufficient and often unreliable in many areas of the City.

The City should increase coverage for all public safety channels to deliver coverage/signal strength to ensure that a portable radio with 20 decibels (dB) of building loss would work reliably. Doing so would significantly improve coverage and signal strength across the City, resulting in more reliable system performance for public safety users.

1.3 CAPACITY

The City operates a conventional radio system. Conventional radio systems do not utilize the spectrum efficiently. They require two frequencies to be assigned and dedicated in order to deliver a single functional channel. Acquiring additional frequencies to add the capacity required by the City is extremely difficult due to the lack of available spectrum in the VHF band. In 2018 the City successfully acquired and licensed six additional frequencies to provide three functional channels. Due to co-channel interference and band congestion, the City was only able to license the channels with a fraction of the output power and coverage that it has with legacy channels. The new channels, now operational, do not offer adequate building penetration to meet primary public safety operational requirements.

The City does not currently have enough capacity to support daily operations and one additional incident or event at the same time. The City has been reliant upon outside support to facilitate a minimum level of acceptable communication capability during planned events. Use of outside resources including state cross-band repeaters, radios borrowed from Washoe County, DEM, and NDOT, and resource support from the military via the 92nd Civil Support Team have been critical to the success in recent years. The availability of these resources to the City is contingent upon no greater need by the owning agencies. In the event of a regional event/incident it is highly unlikely that they will be available.

It is essential that the City take action to ensure that it has the capacity required to meet operational requirements to include day-to-day business needs and during events, incidents, and emergencies.

1.4 SUBSCRIBER RADIOS

Subscriber units (mobile, portable, and control stations) are primarily single band VHF radios that are not compatible with regional partners operating on the 800MHz statewide system. The approximate number of radios currently in use on the system includes 543 portables and 369 mobiles. Of these, 151 are new multi-band fully compliant radios representing approximately 17% of the total inventory.

In order to allow for interoperability with regional partners, all subscriber radios should be fully compatible with P25 Phase 2 and operate on both the VHF and 800MHz bands. The City has started to deploy multi-band fully compliant radios. Currently, 151 of the radios are multi-band and fully compatible with regional partners representing approximately 17% of the total inventory.

Approximately 761 subscriber units in the City need to be replaced. Subscriber radio replacement has been funded and managed by Public Works since 2018.

1.5 CONSOLIDATED DISPATCH CENTER

The City has one public safety answering point (PSAP), which currently has six radio positions. The PSAP is responsible for dispatching all fire/rescue, law enforcement, and local government departments within the City. The dispatch center has the capability to communicate with other PSAPs, but generally does not have the ability to communicate via radio directly with most outside agencies.

The PSAP uses Motorola Gold Elite dispatch consoles. This console version has a significant amount of electronics located within the communications equipment room. The backroom infrastructure received an end-of-manufacturer-support notice in 2012 and has officially been without manufacturer support since December 2018. The City has been purchasing parts from online auction sites to maintain the system.

The dispatch center also has a standalone Zetron system, which supports resource based paging through the radio system from the Computer-Aided Dispatch (CAD) software. Most agencies have moved away from audible paging due to the delay it introduces in emergency response and the inability for it to support complex resource assignments. The City has embarked on a phased approach to move to CAD based resource paging and is in the beginning stages of identifying costs.

1.6 EQUIPMENT END-OF-LIFE

As stated earlier, the existing radio system is primarily comprised of equipment that is no longer supported by the manufacturer. Public Works has received funding to replace the most critical components of the system and ensure operational readiness for the first responders and community.

1.7 FREQUENCY CONSIDERATIONS

The VHF band currently used by the City suffers from a number of problems. Band congestion and lack of availability has led to disorganization. The few channels that the City has are not arranged in a way that allows the City to provide reliable in building coverage even when solutions such as building distributed antenna systems are utilized. The restrictions on the band no longer allow the power output needed to penetrate structures, and the interference causes sub-optimal performance.

The 700/800 megahertz (MHz) band utilized on the statewide radio system is an advantageous band for semi-urban areas like Carson City. The 700/800 MHz spectrum offers a good balance of signal penetration and coverage. The band is organized and reliable in-building coverage is possible and much more economical than VHF solutions.

1.8 SYSTEM RESILIENCY AND SINGLE POINTS OF FAILURE

- Several single points of failure and system resilience concerns have been identified in the current system.
- Dispatch console hardware is obsolete and operating on Windows XP
- Primary public safety channels and remote receiver system all depend on a single communication site (Sugarloaf)
- The backup radio sites do not have indoor or outdoor coverage to fully support daily public safety operations
- Radio network has no redundancy

1.9 CONNECTIVITY/BACKHAUL

The PSAP and radio sites are interconnected by microwave Ethernet radios. The radio networking equipment is on an isolated network. The operation of the primary public safety channels and the remote receive sites is dependent upon network connectivity. No redundancy is provided for the microwave links. The routing/switching equipment is end-of-life and without redundancy.

AT&T-leased telephone lines are the current method used for backhaul connectivity between the PSAP and the public safety complex and several other sites equipped with control stations. Leased circuits have proven unreliable, and the City has replaced most links with microwave connectivity.

The Nevada Quad County Interconnect (NQCI) is utilized to provide connectivity from the City PSAP to regional PSAPs and the Washoe County Regional Communications System. The system is currently utilized to provide dispatch console to dispatch console connectivity between the counties. The equipment comprising the NQCI is nearing the end of its useful life.

1.10 INTEROPERABILITY

Current radio interoperability with regional VHF based agencies is good. The similar use of VHF equipment allows native communication through a channel change. Interoperability with regional 800 MHz radio users is primarily accomplished by carrying two radios, one City and one loaner 800 MHz. Interoperability for planned events is highly reliant on patching VHF and 800 MHz channels together with portable interoperability gateways. Limited patching capability exists at the PSAP since the City radio console does not have the ability to communicate on 800 MHz. Several other solutions including PSAP to PSAP communication channels (Nevada Dispatch Interconnect Project) and state cross-band conventional repeaters are in place but are not favored due to training and performance implications.

1.11 MAINTENANCE

The City has historically been dependent upon a radio service provider for maintenance and repair of the radio system. Repair response by the provider has become a significant concern over that last several years. The broad service area, lack of technician resources, and large number of customers reliant upon the provider commonly result in a no-response or delayed response when the City calls for service. The City currently staffs a single communication technician position within the Public Works department. The technician is responsible for coordinating all radio system activities for all departments. The technician does not have the training necessary to maintain the existing system without support from the provider. The City relies upon the provider for after-hours response and support. The single City technician is not on standby and not required to respond after hours. Modern radio systems are technologically complicated and require specialized training for proper maintenance. The response and repair capability maintained by the City to support the radio system should be increased to ensure sustained operational readiness.

2 OPERATIONAL BASELINE

The following information summarizes the operational baseline for the current system.

2.1 SYSTEM USER OBSERVATIONS

The City contracted with Federal Engineering (FE) to develop a memorandum documenting the needs and requirements of their system users. In-person interviews were conducted to gather information from users about the operational and technical needs for radio system communications. Data gathered through the interviews helped to identify the ability of the current systems to meet users' needs, to identify any unmet needs, and to gather ideas for meeting those unmet needs. The interviews included a mix of public safety and public service disciplines, including a cross section of field users, technical staff, and interoperability partners. Participating agencies attended one or more group sessions:

- Session #1 Carson City Local Government User Focus Group.
- Session #2: Carson City Fire Department Focus Group
- Session #3 Regional Fire Department Partners with Carson City Fire Department
- Session #4: Regional Law Enforcement Partners with Carson City Sheriff's Office
- Session #5: Carson Law Enforcement Focus Group
- Session #6: Sheriff's Private Individual Interview
- Session #7: Fire Chief's Private Individual Interview

To gather additional feedback on system concerns and requirements, FE collaborated with the City to develop an assessment questionnaire. The questionnaire focused on system coverage, channel capacity, system reliability, radio and dispatch features, customer support, and regional interoperability.

To assess satisfaction with the current system performance and identify the future system requirements, FE completed a thorough analysis of in-person interviews web-based surveys. In addition to the cumulative data results from key stakeholders and users, the following assessment highlights any agency-specific comments or concerns.

2.1.1 COVERAGE

Users require radio system coverage within and outside the Carson City and County boundaries. While the majority of users operate within the City and County, there are departments that require radios to work in the Carson River Canyon, Reno, Sparks, Storey County, Lyon County, Douglas County, Washoe County, and at Lake Tahoe. Carson City's geographic area includes rural and mountainous areas, commercial and industrial buildings, hospitals, schools, and casinos/retail space.

Analysis of user interview and web survey results concludes that current system coverage is an area of concern for many of the system users. Half of the system users reported mobile coverage as adequate, and more than three-fourths of system users reported poor to adequate coverage for portable radios on street or in building.

The consensus is that there are many areas with no coverage with the current system, particularly in rural areas and in buildings. Unless facilities have bidirectional amplifier (BDA) systems installed, there are many coverage issues with different structure types, including multi-story buildings, jails, hospitals, casinos, campuses, etc.

System users expressed the need for improved mobile, portable on-street, and portable in- building coverage within the City and County boundaries. During the interviews, stakeholders re-iterated the importance of additional tower locations to address the numerous areas of inadequate coverage for public service and public safety users. All stakeholders agree that the new system shall provide at a minimum, the equivalent coverage that exists today, but also address the areas of inadequate coverage.

2.1.2 CHANNEL CAPACITY

Survey results show that the current system does not have sufficient channel capacity to support normal (busy hour) and heavy (emergency) voice traffic. On a day-to-day basis, system users experience occasional channel congestion on repeated channels, causing them to switch over to simplex tactical (TAC) channel(s). Dispatchers also report that they often have to wait for emergency or non-emergency calls to end before they get on the radio to transmit. When a Public Safety channel is being utilized for emergency traffic, the limited number of repeated channels causes problems for other operations taking place in the City.

Depending on the location and nature of the incident (flood, snow, etc.), as well as the number of agencies involved, system capacity is impacted by those high call volumes. In heavy loading conditions

such as large emergency or weather-related incidents, all four repeaters (SO Primary, FD Main, LG Main and SO Secondary) are used heavily causing other traffic to wait or use TAC channels. TAC channels do work well for some departments when used for Special Enforcement Team or Fire ground operations. However, use of TAC channels does have a negative impact on other department operations because they are not repeated, recorded or secure, and they become unusable when users exceed line-of-sight (LOS) distances. There are also reports of poor audio quality with TAC channels including difficulty hearing transmissions, delayed responses, and garbled sounds.

Users state that they do not have the operational ability to safely run a complex incident or simultaneous incidents due to the lack of repeated channels. Law Enforcement conveys that they do not have enough repeated and encrypted channels to support tactical/covert operations, public events, or records checks; along with day-to-day operations. Multiple agencies utilizing the same repeater during emergency operations results in wait times of 10- 40 seconds and up to several minutes, according to users.

System users have a requirement for additional LG, FD, and SO (repeated and TAC) channels to alleviate current channel congestion during normal and heavy loading conditions, and to support future capacity needs including City growth and events (planned or unplanned). NOTE: Since the assessment, four new low power channels have been activated and were used to support the 2019 Epic Rides event. Limited building penetration and reduced coverage has been observed with these channels limiting their usefulness compared to the primary channels.

There is interest from the City and users for a Project 25 (P25) Phase 2 system which would increase the number of talk paths per voice channel. Technical staff believes that personnel would use the system more if they had dedicated divisional talk groups versus one repeated channel they currently have. If the City were to implement that technology, the recommended capacity of the new system would be less than or equal to 1% Grade of Service (GoS), meaning less than one percent of all attempted calls (i.e., push-to-talks) will be either queued or blocked. This reflects a Public Safety grade of service.

2.1.3 SYSTEM RELIABILITY

While the system has performed well over the years, users report that it was occasionally down for failures several times in recent years. It is important to note that significant portions of the system are at or near end of life with limited or no support from the manufacturer over the next few years. Feedback from the users regarding system reliability indicates that technology obsolescence, parts availability, and the expiration of vendor support are areas of major concern.

Users state that the current system is outdated and unsafe. Deputies working patrol are consistently concerned with radio problems which directly affect safety and ability to coordinate during dangerous

operations and calls. Carson City relies heavily on mutual aid during critical incidents, however, the current interoperability system is unreliable or difficult to use.

Reliability issues arise from a number of reasons, including lack of redundancy (single-site systems), level of spares and parts availability, and previous phone line carriers. Spring floods have proven that single-site, systems with no redundancy are single points of failure. The current backhaul network does not have path redundancy or ring protection, thus resulting in other points of failure. Users also state that there are insufficient in-service spares to support day-to-day operations, a limited supply of accessories, and that they rely on depot support for more serious repairs.

Given that the current system supports a number of user types, including public safety and public service, stakeholders require a new system that is fault tolerant with no single point of failure. A Public Safety grade availability of 99.999% would provide the City a maximum downtime of 5.26 minutes per year. Stakeholders express the need for a system with fault tolerant architecture, reliable backhaul connectivity, vendor onsite and remote support, software upgrade agreements, and an increased level of spares. Geographic redundancy provides continued operations from a secondary site in the event the primary site fails. A ring protected backhaul network provides alternate path(s) to sites in the event of a linkfailure.

A recommended 10% level of spares for a system of this size and scope would help to minimize the downtime of critical system components.

2.1.4 REGIONAL INTEROPERABILITY

Carson City recognizes that communications are critical in providing public safety. However, the current system does not allow for multiple agency communications during critical events. Survey results show that over three-fourths of system users rate the current interoperability as adequate or below. Carson City has a need to interoperate with a number of agencies, including local law enforcement, Fire/EMS, and public works agencies, as well as other county, state, federal and tribal agencies. The most widely used communications methods for interoperability consists of programmed channels (on same frequency band), console patches, phone (cellular or other), or carrying multiple radios (for different frequency bands).

User interviews confirmed that the need for overall improved interoperability capabilities in a future radio system is extremely important. The majority of system users and interoperability partners express the need for the following interoperability capabilities:

- Interoperability with local City and County agencies, including Fire, Local Government, and Sheriff's Office
- Interoperability with State agencies including:
 - Nevada Capitol Police and Legislative Police
 - Nevada Department of Transportation (NDOT)
 - Nevada Division of Emergency Management (Nevada National Guard)
 - Nevada Highway Patrol (NHP)
 - Nevada Public Health Preparedness (as part of the Division of Public and Behavioral Health)
 - Nevada State Parks
- Regional interoperability with Quad-County (Carson, Douglas, Lyon, Storey) law enforcement and fire agencies
- Interoperability with medical providers including Carson Tahoe Hospital, Carson Valley Medical Center, South Lyon Medical Center
- Interoperability with other surrounding agencies, including Reno PD, Sparks PD, Washoe County, Truckee Meadows
- Interoperability with Federal and tribal agencies, including Bureau of Land Management (BLM), United States Forest Service (USFS)

Technical staff advises that some of the above capabilities may exist, but users may not have adequate knowledge and/or training on how to access the other systems. Education (channel names) and training is needed for switching to other agency channels.

Users did express a concern regarding the potential for any one Quad-County agency moving to a different frequency band and technology. The three other counties would need to follow suit in order to maintain the current Quad-County regional interoperability. Some users briefly discussed the benefits of a regional-based, shared radio system.

The Nevada Shared Radio System (NSRS), including Nevada Department of Transportation (NDOT), NV Energy and the Washoe County Regional Communications System (WCRCS), is in the process of migrating to a 700/800 MHz P25 Phase 2 platform. From an interoperability standpoint, there are stakeholders that feel the best solution for Carson City is to join the NSRS 700/800 MHz P25 trunking system.

2.1.5 RADIO AND DISPATCH FEATURES

Field users expressed the need for new standards-based, P25 system that offers a number of standard features including group calls, emergency calls, and private calls. Users expressed an interest in the following optional features, prioritized from most important to least important:

1. Global Positioning System (GPS)

GPS or AVL (Automatic Vehicle Location) systems typically use the standardized GPS protocol within the P25 standard. In some cases, vendors have also created higher efficiency proprietary protocols to improve system operation. The hope is that these extensions will become standardized in the future.

2. Standards-based Voice Encryption

While many legacy radio systems have had encryption options, prior to P25 there was no standardized encryption system for Land Mobile Radio. P25 brings to the user a thorough set of encryption standards that go beyond the basis of the encryption protocol and include key distribution and keymanagement.

3. Over-the-air Programming (OTAP)

OTAP is proprietary to the specific subscriber user equipment being programmed. Additional infrastructure may be needed, depending on the vendor selected. However, by using the standardized underlying data services to transport the programming information, it is possible for maintenance personnel to install any vendor's subscriber programming equipment on their own or any other vendor's infrastructure.

4. User Authentication

User Authentication ensures that only properly authorized subscriber radios may communicate on the system. This prevents both the unauthorized use of radio resources as well as preventing unauthorized (and potentially disruptive or fraudulent) communications with workgroups.

5. Over-the-air Rekeying (OTAR)

OTAR facilitates key system/subscriber management without the need to touch each radio physically. The digital encryption standard uses the same Vocoder and modulation as P25 non-encrypted voice; therefore, the use of encryption does not reduce either range or voice clarity.

Technical staff also mention that future/desired LMR system features include GPS for unit tracking in CAD, OTAR for re-keying of crypto key, OTAP for remote program changes, and Remote Disable in case of a lost / stolen radio.

The City has a need to replace five end-of-life consoles on the dispatch floor and one in the training room. If call traffic (calls for service) were to increase significantly, additional console positions and dispatch operators may be required in the future. Dispatchers expressed the need for new mission-critical, IP-based dispatch consoles compatible with a standards-based P25 radio system. While there are many features that come standard with these consoles, dispatchers rated the following features as top ten (shown in alphabetical order):

1. Alert Tone(s) (one-time tone)
2. Call History
3. Call Playback (instant playback on dispatch console)
4. Dispatch Priority (interrupt a transmitting subscriber radio)
5. Display Loss of Network Connectivity
6. Emergency Alarm (Receipt, Ack, Clear)
7. Emergency Call (Receipt, Ack, Clear)
8. RF (Control-Station) Backup
9. Unit ID Display
10. Voice encryption

Almost half the system users also expressed an interest in using mission critical push to talk (MCPTT) over a Long Term Evolution (LTE) network for daily and/or emergency communications. The consensus is that this capability would most beneficial for Admin and Command Staff, not fire ground suppression forces or law enforcement officers on patrol.

2.1.6 CUSTOMER SUPPORT

Users were asked to rate their level of satisfaction with the customer/technical support that the City/radio shop currently provides. Although the ratings ranged from very dissatisfied to very satisfied, over half of the field users and dispatchers were satisfied to very satisfied.

Users also rated how responsive the City/radio shop is to their customer service needs. While the ratings ranged the full spectrum, more than half of the field users and dispatchers rated the City/radio shop as very to extremely responsive. The City did mention that their local radio shop, which is located in Reno, is fairly responsive except when they are responding to a higher priority. While no details were provided, there was some discussion regarding prior issues (turnover and return for work) with Sierra Electronics.

Other comments indicate that the City/radio shop is very supportive and does whatever it can in their power to fix issues. However, the shop is working feverishly on an outdated system, and with declining spares holding, are limited in how much longer they can support the system.

With regards to improvements, users have complained for years about the lack of connectivity with dispatch in certain areas, primarily while using portable radios. There still have been no improvements made in this area. Users felt that this is a dangerous and serious situation and are concerned about the safety of employees when they can't effectively communicate.

There were reports that the City is very limited with funding and staff, which results in requests usually taking several days to get equipment replaced such as microphones and antennas for vehicles. Because the City is understaffed with radio technicians, Fire performs much of the radio programming. The users and stakeholders conveyed that the City requires improved funding processes and staffing levels, allowing for improved inventory, proactive systems monitoring, maintenance, and engineering, which would help them to better meet the customer service needs of its system users.

Technical staff reports that their ability to monitor the performance (including outages) of City LMR and backhaul equipment, sites, and other items throughout the system is adequate at best. Technical staff states that the ability to monitor switches, repeaters and network gateways along with monitoring dispatch console status is necessary. A new network management system (NMS) would allow for quick and efficient diagnosis of system errors and malfunctions leading to a rapid recovery from system issues. The management functions would allow for the effective administration of the systems' security and functionality parameters from City specified locations. The NMS would have a license server for the management of software licenses across the network. The NMS would also have the capability to receive and analyze traps containing status/error data and the ability to archive system data and maintain an electronic history of alarm events.

3 RADIO SYSTEM PERFORMANCE FINDINGS

Through this fact-finding process and analysis of the information, the three key reasons for the City's decision to replace its current radio system have been validated and reinforced.

Improving System Coverage Characteristics—The current system has insufficient coverage, which results in significant areas of the City having less-than-adequate signal strength, and less-than-reliable radio system performance.

Capacity—Challenges faced by the City have grown faster than its communications capability. Existing communications resources are barely adequate to support normal daily operations let alone complex events like the Nevada day celebration or incidents such as spring flooding.

End-of-Life Service Limitations—Elements of the current system have reached end of life for guaranteed system support. Moving forward, support, maintenance and repair of the current system will be on a best-effort basis rather than a service guaranteed by the manufacturer. This circumstance results in added risk of potential service interruptions when system problems occur.

4 SYSTEM ALTERNATIVE EVALUATION

The City identified a number of system alternatives. The top three alternatives were evaluated against each other. The top factors considered during this evaluation included cost, performance, and sustainability.

4.1 ALTERNATIVES CONSIDERED

4.1.1 ALTERNATIVE 1 – REFRESH EXISTING ANALOG CONVENTIONAL SYSTEMS

- Refresh LG, FD, and SO systems with new analog conventional equipment
- Leverage existing sites to greatest extent possible; only adding new towers and shelters where needed
- Provide at a minimum, the equivalent system coverage that exists today, while improving mobile, portable on-street, and portable in-building coverage in areas where inadequate coverage exists
 - If applicable, new redundant simulcast control and voting equipment
- Leverage existing licensed frequencies, and adding additional channels as needed to alleviate current channel congestion during normal and heavy loading conditions
- New analog conventional repeaters (upgradeable to P25), with new antennas, transmission lines, combiners and multi-couplers
- If needed, new control station(s) and/or gateway(s) for interoperability with other regional and state systems
- New microwave backhaul, including loop protected rings and monitored hot standby spares (if applicable) and new antenna systems, DC power plants, and dehydrator systems
- New network management system and terminals
- Install new mission-critical, IP-based dispatch consoles compatible with a standards-based P25 radio system, each with a backup control station

- Upgrade and/or replace existing (end-of-life) subscriber equipment operation

4.1.2 ALTERNATIVE 2 – REPLACE EXISTING SYSTEMS WITH CITYWIDE P25 SYSTEM

- LG, FD, and SO systems replaced with a shared Citywide P25 system
 - New shared, redundant (geographically separated) system control:
 - New network management system and terminals
 - If applicable, new redundant simulcast control and voting equipment
 - New interoperability gateway(s) for connection to conventional systems
 - Optional ISSI connection(s) for interoperability with other P25 systems
- Leverage existing sites to greatest extent possible; only adding new towers and shelters where needed
- Provide at a minimum, the equivalent system coverage that exists today, while improving mobile, portable on-street, and portable in-building coverage in areas where inadequate coverage exists
- Leverage existing licensed frequencies, and adding additional channels as needed to achieve public-safety grade of service of less than or equal to 1% for blocked or queued calls
- New P25 repeaters, with new antennas, transmission lines, combiners and multi-couplers
- New microwave backhaul, including loop protected rings and monitored hot standby spurs (if applicable) and new antenna systems, DC power plants, and dehydrator systems
- Install new mission-critical, IP-based dispatch consoles compatible with a standards-based P25 radio system, each with a backup control station
- Upgrade and/or replace existing subscriber equipment for P25 operation

4.1.3 ALTERNATIVE 3 – JOIN THE STATEWIDE NSRS P25 SYSTEM

- LG, FD, and SO system users migrate to the statewide NSRS P25 system
 - NSRS responsible for coverage guarantee within the City and County boundaries
 - NSRS responsible for system capacity to handle the City's existing and future subscriber units
 - NSRS responsible for system reliability including system core, RF sites, and backhaul network
 - Carson City responsible for any NSRS usage fees (one-time and/or recurring charges)
- Maintain existing conventional systems for interoperability with other regional agencies
- If needed and allowed, new network management terminal(s) to manage City subscribers on the NSRS core
- Install new mission-critical, IP-based dispatch consoles compatible with a standards-based P25 radio system, each with a backup control station
- Upgrade and/or replace existing subscriber equipment for 700/800 MHz P25 Phase 2 operation

4.2 BEST ALTERNATIVE

After thorough review of all factors, joining the Statewide NSRS P25 System was selected as the best alternative. The City is proposing that it migrate operations from the existing system to the statewide system. The migration process will consist of a series of phases. Each phase will have a number of actions and steps that must be completed in order to advance. The duration of each phase is not based on a schedule but rather on completion of certain requirements or milestones. A number of external factors directly affect milestone completion.

4.2.1 PHASE 1 – MULTI-BAND OPERATION

In order to provide interoperability with regional partners it is necessary to support operation on multiple frequency bands including VHF and 800 MHz. Departments may shift primary operations onto the statewide 800 MHz system as soon as they are satisfied that the delivered level of service meets their requirements. VHF infrastructure will need to be maintained to support City functions and interoperability with regional VHF users. Specific actions required to initiate and support this phase include:

1. Statewide Radio System Operating Agreement
2. Subscriber Radio Replacement
3. Radio Console Replacement
4. VHF Infrastructure end-of-life equipment replacement
5. Voice Logger Licensing Upgrade
6. Channel to talk-group patching
7. Network redundancy improvements

4.2.2 PHASE 2 – OPERATION ON STATEWIDE 800 MHz WITH VHF INTEROPERABILITY

This phase represents the period where the City will utilize the statewide radio system as the primary form of public safety communications but regional VHF users will still require full support for VHF interoperability. Specific actions projected to occur during this phase include:

1. Buildout of the new statewide radio system for the Carson City region
2. Indoor coverage improvements for critical heavy buildings
3. Re-purpose VHF infrastructure from primary capability to interoperability support
4. Regional VHF agency migration to the statewide radio system

4.2.4 PHASE 3 –800 MHZ REGIONAL OPERATION

The third phase represents the mature state of the region on a current generation P25 800 MHz fully interoperable system. Due to external agency autonomy this phase may never be realized. Specific actions projected to occur during this phase include:

1. Technical and operational refinement
2. Maintenance and sustainment activities including normal lifecycle equipment replacement

4.2.5 PHASE 4 –FUTURE TECHNOLOGY

The rapid growth of technology in our lives will continue to impact mission critical communications. The future systems are likely going to be built onto and integrate with P25 technology. The statewide system is built on the latest standards and capability and is positioned to leverage these advancements as they become necessary. The cost to the City for these future improvements should be less than if the City were to implement them independent of the statewide system and its user agencies.

5 DETAILED ACTIONS AND COST ESTIMATE

The City has identified and planned the activities necessary to initiate the first phase of improvement. A detailed overview of the actions is presented along with cost estimates and funding status.

5.1 INTERLOCAL AGREEMENT – STATEWIDE RADIO SYSTEM

The Statewide Public Safety Radio System (Nevada Shared Radio System) through its members Washoe County, Nevada Department of Transportation (NDOT), and NV Energy has contracted Harris Corporation to build a new P25 Phase 2 radio system. The new Radio System is comprised of 127 communication sites, a geographically redundant communication core, 24 dispatch centers, emergency readiness assets including six Site-on-Wheels, and additional interoperability and asset management components.

NDOT alone has invested over \$55M into the new Radio System. Joint use of the Radio System provides for efficient use of resources and specifically addresses the needs identified by Carson City radio users including capacity, coverage, capability, and reliability.

The City may participate on the statewide radio system as a user under NDOT. A user agreement has been drafted that will allow the City to operate radios on the system for an annual fee based on the number of radios activated on the system. The City will be a voting member of the NSRS user group and will be a non-voting member of the NSRS technical advisory committee.

COST: Cost will be based on the number of radios activated on the system each year. Current cost per radio is \$705. The City intends to operate less than 900 radios on the system and is committed to controlling the size of the subscriber radio inventory to meet level of service requirements without excess. The agreement for approval is capped at \$5,076,000 for the initial ten-year term.

5.2 RADIO CONSOLE REPLACEMENT

The existing radio dispatch console system is beyond end-of-life and is no longer supported by the manufacturer. The system is considered critical as it is necessary to support PSAP operation. The radio console is used by the PSAP to dispatch and communicate with public safety responders via the radio system. The console also provides the interface to the 911 phone

system and is necessary for dispatchers to communicate with the public. Radio consoles connect to and communicate with a radio core network. The proposed solution will connect to the statewide public safety radio system's geographically redundant core network. Utilizing the Statewide System core will provide savings in excess of one million dollars over the initial 10-year period when compared to purchasing and maintaining a City owned radio core. Six back-up radios will also be installed and configured to provide fallback communications capability to ensure that a disruption in connectivity to the statewide system core will not prevent dispatchers from talking to public safety responders.

The proposed solution will be purchased under the terms and conditions of the state contract with Harris Corp. optimal delivery of services and discounted pricing.

COST: The purchase includes \$458,563 for equipment. Engineering, project management, installation and training are covered by state contract #P697-16-016. The ongoing cost for support and services is anticipated at \$21,862 per year starting year three. Each console will also require an annual radio unit fee to NDOT for operation on the statewide system estimated at \$705 each or \$4,230 for six consoles annually. The available budget in 5603055-507745 is \$600,000 and was approved in FY18 CIP.

5.3 SUBSCRIBER REPLACEMENT

Replacement of existing subscriber radios is required in order to support multi-band operation and communicate on the statewide system. The City will not be able to complete phase 1 and transition to phase 2 until existing radios are replaced. Three year replacement is proposed to coincide with the buildout of the new statewide system for the Carson City region.

The City proposes to execute a joinder to the state contract with Harris Corp. to realize significant savings. The purchasing contract includes a 72.2% discount on subscriber equipment. Historical discounts available to the City have been in the range of 26-30%.

COST: \$2.1M over three years. \$700,700 approved FY20 CIP to replace 33%. Revised business practices may result in a reduction in inventory and reduced outlay in year three.

5.4 VHF REPEATER-INFRASTRUCTURE REPLACEMENT

Existing end-of-life equipment should be replaced to ensure reliable performance through phase 1 and phase 2 of the migration. The equipment will be purchased through joinder to the state purchasing agreement with Harris Corp. in order to leverage the equipment discounts and guarantee compatibility.

The most important repeater and infrastructure components are the ones that are used to deliver the primary law enforcement and fire department channels. The equipment includes mountain top repeaters and the distributed receive system (voting system). The equipment that comprises each resource must be replaced at the same time in order to maintain the delivered coverage and capability of the channel.

After the primary repeater equipment is replaced the control station and public safety complex repeater will be replaced. Detailed design and planning for this second phase of replacement is not complete. As a result remaining funds will be utilized this year to start the effort and additional funding will be requested in FY21 if necessary.

COST: \$197,569 estimate for primary repeater replacement. Approved in FY20 CIP.

The discounts attained on the radio console replacement will result in a savings of \$141,437. The balance will be utilized before the \$197,569 approved in FY20 in order to satisfy bond requirements. The remainder will be utilized towards replacement of control stations and the public safety complex repeater.

5.5 RECORDING LOGGER UPGRADE

The existing Recording Logger is connected to individual VHF control stations via analog four-wire audio. P25 systems are digital and provide a significant amount of information along with call audio. This information includes unit identification (ID), affiliated radio sites, talk group information, and other data that may be useful in the event that the call needs to be recalled and reviewed in the future. The existing logger requires additional licensing to support P25 recording. The storage array on the logging recorder is also at end-of-life and the manufacturer has advised that it should be replaced as they are no longer able to provide support. Additional channel licenses are also required to support the addition of new talk groups needed for phase 1 multi-band operation.

COST: \$119,840 Approved in FY20 Budget

5.6 COMMUNICATION STAFF RESOURCE ADDITION

The City has one Communication Technician within Public Works assigned to the Control Systems Division. The position has been vacated and filled twice in three years. Exit interviews have reflected that the City is asking too much of this position and that the workload is not reasonable.

The City does not have a technician on-call to respond or maintain the radio system after hours. Modern radio systems are very sophisticated and technical and require specialized training and experience to ensure reliable operation. The City has relied upon a radio service shop in Reno for response maintenance. Calls for service are often met with technician unavailability and delay. Delays of weeks have become normal and the lack of availability regularly inhibits unit productivity and detracts from operational readiness.

Public Works intends to request the addition of a Communications Foreman during the FY21 budget cycle. The position will be instrumental in delivered success through the phased migration and improvement of the radio system and will ensure that a technician is always on duty to provide reliable public safety communications.

COST: \$90,255 for salary and benefits for FY21. This is not funded and will be requested during the FY2021 budget development cycle in accordance with policy.

5.7 FIRE STATION ALERTING CAD INTEGRATION

The City currently uses audible tone paging for fire station alerting and automation. Most agencies have moved away from tone based paging due to inherent limitations to include:

1. Incompatibility with P25
2. Lost air-time
3. Delayed radio traffic
4. Inability to scale without complex/expensive station control systems

The Fire Department is currently in the second phase of upgrading the station alert systems. The capabilities implemented so far have been limited to soft tones and selective dorm control. The third phase of station alert system improvement will integrate the Computer Assisted Dispatch

(CAD) system with the station alert systems via IP connection. This will enable the department to shift operations to P25 channels and increase automation capability, and flexibility.

COST: Projected costs are \$100,000 including \$50,000 to ComTech Communications for fire station alerting system equipment and implementation services and \$50,000 to Central Square for CAD licensing and implementation services. This is not currently budgeted and will be submitted as a FY21 CIP request.

5.8 INDOOR COVERAGE IMPROVEMENTS

Portable coverage is more limited than mobile coverage. Portable radios typically are limited to transmitter power output (TPO) five watts, compared with mobile radios, which typically have a TPO of 50 watts. Due to a less-effective antenna system, a portable radio needs significantly more received signal power compared with a mobile radio to clearly receive a signal.

Indoor coverage is the most limited radio coverage level. Public safety radio users often need to communicate within buildings. Buildings further impede the radio wave, making it more difficult for the portable radio inside the building to interpret the signal. A plethora of building factors—such as the type of construction, number of floors, number of windows, location of the building relative to tower sites, placement of fire-walls, location of electrical wiring, and the location of the user within the building—impact the path of the radio wave and the ability of the radio to interpret a received signal. When designing a radio system, buildings typically are quantified as to how much they degrade a radio signal. Because there are so many factors associated with in-building coverage losses, there is no perfect way to quantify such coverage. Typical building losses range from 6 dB of signal reduction to 24 dB. Losses within a building may differ dramatically from one location within a single building to another. Radio systems are designed to meet categories of average building-loss specifications. Coverage within individual buildings may be enhanced through bidirectional amplifiers (BDAs) that reradiate received signals from outside the building to inside the building.

Assessment of indoor coverage for the new statewide radio system will be required as the new and refreshed sites are brought online. The City will likely need to work with building owners to install BDAs in order to ensure satisfactory coverage.

COST: Unknown and unfunded

This is an anticipated and projected need. Requests will be submitted as needs are identified.

The cost of indoor coverage solutions is impossible to predict due to the variations in different buildings. BDAs operating on the statewide 800 MHz band are significantly less expensive than

BDAs for VHF systems. Additionally, building owners may be required to cover the costs of these solutions based on local ordinance and fire code.

6 FINANCIAL CONSIDERATIONS

6.1 PROGRAM FUNDING

The radio program is funded through internal service charges that are assessed upon the end user departments based upon the total number of Radio Equivalency Units (REUs) assigned to their radio inventories. The REU for each radio is determined through consideration of three different costs. The budget for the radio division is divided by the total number of REUs in order to determine the cost per REU for the budget year.

6.1.1 Operation and Maintenance

The amount of effort and costs associated with maintaining the radio is considered. Radios that require more effort to maintain are assigned a higher REU.

6.1.2 STATEWIDE RADIO SYSTEM OPERATION

The City will be assessed a fee by NDOT annually for each radio that is registered and activated for operation on the statewide radio system. Radios that are not configured for operation on the statewide system will not be assessed this fee. Radios that operate on the system will be assigned a higher REU.

6.1.3 RADIO REPLACEMENT FEE

Each radio maintained by the City is assigned a useful life. The purchase cost of the radio will be divided by the years of useful life in order to determine an annual depreciation cost. When a radio reaches the end of its useful life it will be replaced by the radio program at no cost to the user department. The City anticipates a 10 year service life for subscriber radios. More expensive radios will be assigned a higher REU.

6.2 BUDGET PROJECTIONS

The following figures represent the projected costs in accordance with this plan.

6.2.1 TEN YEAR BUDGET

		Fleet Radio (FY20-FY29)	11/5/2019										
Org	Object	Project Description	FY2020	FY2021	FY2022	FY2023	FY2024	FY2025	FY2026	FY2027	FY2028	FY2029	10 Yr Total
5603055		Radio Console Replacement	\$ 458,563	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ -	\$ 458,563
5603055		Subscriber Radio Replacement	154,855	154,855	154,855	-	-	-	-	-	-	-	464,565
5603055		PS Radio Voice Recorder P25	26,485	-	-	-	-	-	-	-	-	-	26,485
5603055		PS Legacy Radio Repeater Replacement	197,569	-	-	-	-	-	-	-	-	-	197,569
		Total Capital	837,472	154,855	154,855	-	-	-	-	-	-	-	1,147,182
5603055		Communications Foreman (T5)(New)(100%)		90,255	94,608	99,177	103,983	109,032	114,339	119,916	125,784	131,952	989,046
		Communications Technician (T2)(100%)		78,887	82,730	86,770	91,020	95,489	100,191	105,137	107,333	110,278	857,835
		Salaries and Benefits³		169,142	177,338	185,947	195,003	204,521	214,530	225,053	233,117	242,230	1,846,881
5603055	500309	Professional Services ⁶	25,000	25,000	25,000	25,000	10,000	10,000	10,000	10,000	10,000	10,000	160,000
5603055	500330	Training	5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000	50,000
5603055	500427	Microwave/Ethernet Maintenance ²	20,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000	15,000	155,000
5603055	500430	Equipment Repair & Maintenance	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	2,000	20,000
5603055	500433	Software Maintenance Contract ^{4,5}	20,586	20,586	20,586	42,000	62,000	62,000	62,000	62,000	62,000	62,000	475,758
5603055	500436	Facility Maintenance ¹	-	5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000	45,000
5603055	500437	Radio Maintenance	70,000	70,000	70,000	70,000	70,000	70,000	70,000	70,000	70,000	70,000	700,000
5603055	500504	Subscription Services ¹	-	211,500	352,500	564,000	634,500	634,500	634,500	634,500	634,500	634,500	4,935,000
5603055	500625	Operating Supplies	5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000	50,000
5603055	500674	Small Tools/Instruments	3,000	3,000	3,000	3,000	3,000	3,000	3,000	3,000	3,000	3,000	30,000
5603055	500676	Technical Equipment	200,000	-	-	-	-	-	-	-	-	-	250,000
5603055	508101	Principal - Fleet & Cap Proj Tax Fund	120,000	122,000	125,000	-	-	-	-	-	-	-	367,000
5603055	509101	Interest - Fleet & Cap Proj Tax Fund	7,818	5,045	2,441	-	-	-	-	-	-	-	15,304
		Services & Supplies and Bond Payments	478,404	489,131	630,527	736,000	811,500	811,500	811,500	811,500	811,500	1,061,500	7,453,062
		TOTAL FLEET RADIO DEPARTMENT EXPENSES	\$ 1,315,876	\$ 813,128	\$ 962,720	\$ 921,947	\$ 1,006,503	\$ 1,016,021	\$ 1,026,030	\$ 1,036,553	\$ 1,044,617	\$ 1,303,730	\$ 10,447,125
		Working Capital	(237,472)	(154,855)	(154,855)	-	-	-	-	-	-	-	(547,182)
		Debt Service obtained for Radio Equipment	(600,000)	-	-	-	-	-	-	-	-	-	(600,000)
		Total O&M Charge	478,404	446,773	455,365	357,947	372,003	381,521	391,530	402,053	410,117	419,230	9,299,943
		Total Subscriber Replacement Charge	-	-	-	-	-	-	-	-	-	250,000	250,000
		Total NSRS Subscriber Fees	-	211,500	352,500	564,000	634,500	634,500	634,500	634,500	634,500	634,500	4,935,000
		CAPITAL paid from 210 Fund - (anticipated to be paid in FY21 & FY22)											
2100000		Subscriber Radio Replacement	545,845	545,845	545,845	-	-	-	-	-	-	-	1,637,535
2100000		PS Radio Voice Recorder P25	93,355	-	-	-	-	-	-	-	-	-	93,355
		TOTAL CAPITAL PROJECTS FUND INVESTMENT	639,200	545,845	545,845	-	-	-	-	-	-	-	1,730,890
		TOTAL ESTIMATED RADIO SYSTEM 10 YEAR PLAN	\$ 1,955,076	\$ 1,358,973	\$ 1,508,565	\$ 921,947	\$ 1,006,503	\$ 1,016,021	\$ 1,026,030	\$ 1,036,553	\$ 1,044,617	\$ 1,303,730	\$ 12,178,015
	Notes												
		1 FY21-Add new accounts for Facility Maintenance and Subscription Services(NSRS User Fees)											
		2 FY21-Reduce Microwave and Ethernet Maintenance											
		3 FY21-Salaries and Wages-1 New FTE Communication Foreman, 1 Existing FTE Communication Technician, (Assuming no termination 4.5% Merit increase every year)											
		4 FY23-Radio Console Warranty Coverage Ends, Warranty Extension Cost \$21,434/Yr (Software Maintenance Contract)											
		5 FY24-Subscriber Radio warranty's begin to expire. Harris Technical Support Services required \$20,000/Yr (Software Maintenance Contract)											
		6 FY24-Professional Services reduced due to decreased need due to system migration											

FIGURE 1

6.2.2 FIVE YEAR GENERAL FUND PROJECTION

Budget Worksheet	FY20 FINAL BUDGET	FY21 PROJECTION	FY22 PROJECTION	FY23 PROJECTION	FY24 PROJECTION
Beginning Fund Balance	\$ 10,008,998	\$ 6,524,890	\$ 7,877,605	\$ 7,838,704	\$ 7,804,863
Total Revenues	82,509,893	85,030,565	87,768,651	90,546,928	93,424,617
Transfers In	201,719	143,703	143,703	143,703	143,703
Total Sources	92,720,610	91,699,158	95,789,959	98,529,335	101,373,183
Total Expenditures	74,102,584	75,906,275	78,278,460	80,814,334	83,416,985
Contingency	500,000	500,000	500,000	500,000	500,000
CIP Funding	7,303,718	2,986,449	4,555,432	5,422,372	5,788,704
Fleet REU Impact	-	129,089	243,654	331,024	395,782
Transfers Out	4,289,418	4,299,740	4,373,708	3,656,743	3,664,332
Ending Fund Balance	6,524,890	7,877,605	7,838,704	7,804,863	7,607,380
Total Uses	\$ 92,720,610	\$ 91,699,158	\$ 95,789,959	\$ 98,529,335	\$ 101,373,183
Ending Fund Balance as a % of Expenditures	8.81%	10.38%	10.01%	9.66%	9.12%

FIGURE 2

6.2.3 RADIO INVENTORY

Inventory	Count of Radios
City Hall	1
Facility Maintenance	12
Parking Enforcement	2
Engineering	12
Fire Department	190
Fleet Services	9
Sheriff's Office	333
Parks and Recreation	70
Landfill	17
Alternative Sentencing	27
Code Enforcement	2
Fire Ambulance	9
Health and Human Services	20
Juvenile Services	32
Streets	87
Wastewater	45
Water	57
Grand Total	925

FIGURE 3

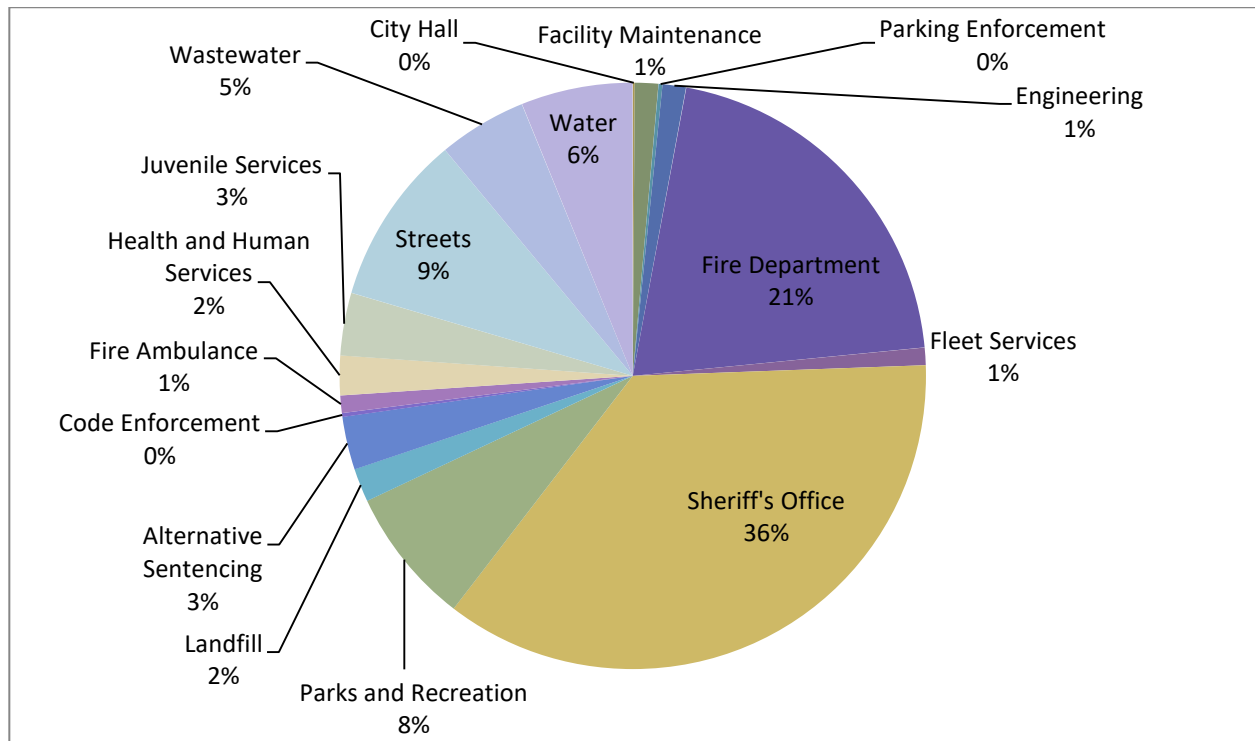


FIGURE 4

6.2.4 REU DISTRIBUTION

2024 Projected	Count of REUs
City Hall	4
Facility Maintenance	59
Parking Enforcement	9
Engineering	41
Fire Department	709
Fleet Services	31
Sheriff's Office	1419
Parks and Recreation	325
Landfill	84
Alternative Sentencing	114
Code Enforcement	9
Fire Ambulance	45
Health and Human Services	83
Juvenile Services	136
Streets	370
Wastewater	198
Water	259
Grand Total	3895

FIGURE 5

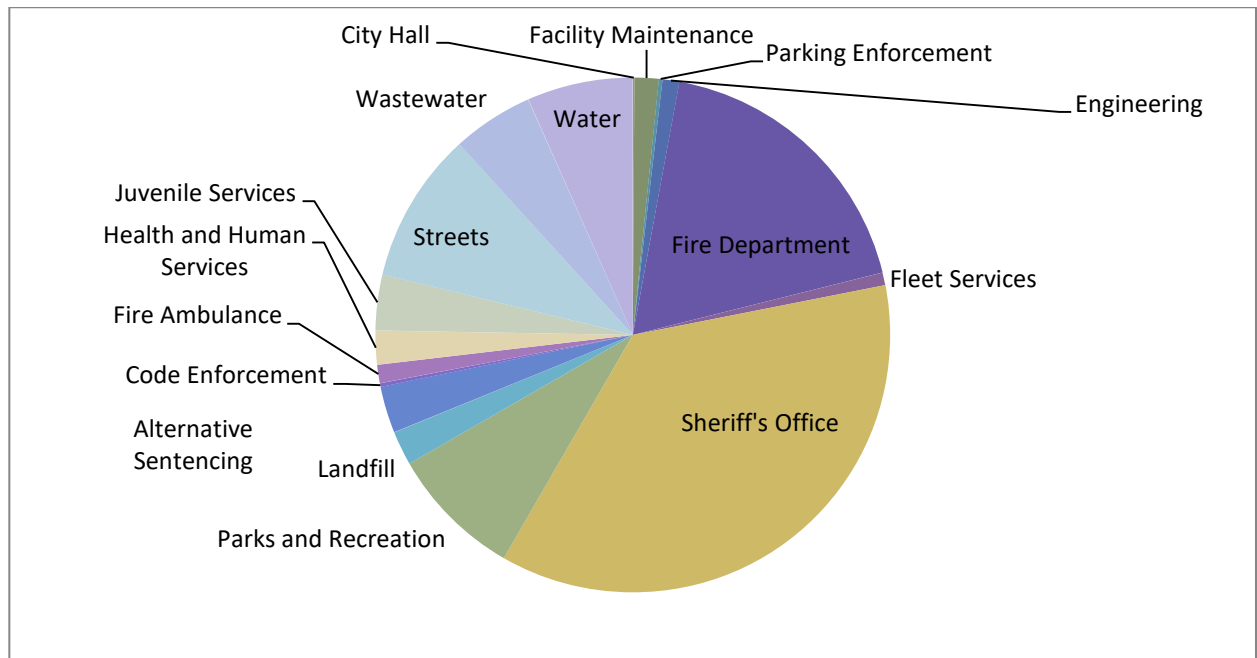


FIGURE 6

6.2.5 REU TEN YEAR DETAIL

REU Detail											
Department	REUs	FY2020 (Current Budget)	FY2021	FY2022	FY2023	FY2024	FY2025	FY2026	FY2027	FY2028	FY2029
City Hall	4	533	676	830	947	1,034	1,043	1,054	1,064	1,073	1,339
Code Enforcement	9	1,065	1,521	1,867	2,130	2,326	2,348	2,371	2,395	2,414	3,012
Sheriff's Office	1419	162,487	239,818	294,316	335,877	366,682	370,150	373,796	377,630	380,568	474,966
Fire Department	709	103,885	119,824	147,054	167,820	183,212	184,945	186,766	188,682	190,150	237,316
Engineering	41	10,655	6,929	8,504	9,705	10,595	10,695	10,800	10,911	10,996	13,723
Juvenile Services	136	17,581	22,985	28,208	32,191	35,144	35,476	35,825	36,193	36,474	45,522
Alternative Sentencing	114	13,319	19,267	23,645	26,984	29,459	29,737	30,030	30,338	30,574	38,158
Parks and Recreation	325	41,021	54,927	67,409	76,928	83,983	84,777	85,612	86,490	87,163	108,784
Facility Maintenance	59	4,795	9,971	12,237	13,965	15,246	15,390	15,542	15,701	15,823	19,748
Health and Human Services	83	10,122	14,027	17,215	19,646	21,448	21,651	21,864	22,088	22,260	27,782
Landfill	84	9,589	14,196	17,423	19,883	21,706	21,912	22,127	22,354	22,528	28,116
General Fund Sub	2983	375,052	504,141	618,706	706,076	770,834	778,123	785,789	793,848	800,024	998,466
Parking Enforcement	9	1,065	1,521	1,867	2,130	2,326	2,348	2,371	2,395	2,414	3,012
Streets	370	44,218	62,532	76,742	87,579	95,611	96,515	97,466	98,466	99,232	123,846
Fire Ambulance	45	5,327	7,605	9,333	10,652	11,628	11,738	11,854	11,976	12,069	15,062
Wastewater	198	10,122	33,463	41,067	46,867	51,165	51,649	52,158	52,693	53,102	66,274
Water	259	15,450	43,772	53,719	61,305	66,928	67,561	68,226	68,926	69,462	86,692
Fleet Services	31	27,170	5,239	6,430	7,338	8,011	8,086	8,166	8,250	8,314	10,376
Enterprise Sub	912	103,352	154,132	189,159	215,871	235,669	237,898	240,241	242,705	244,593	305,264
Grand Total	3895	478,404	658,273	807,865	921,947	1,006,503	1,016,021	1,026,030	1,036,553	1,044,617	1,303,730
BUDGET AMOUNT			658,273	807,865	921,947	1,006,503	1,016,021	1,026,030	1,036,553	1,044,617	1,303,730
Cost per REU		122.83	169.00	207.41	236.70	258.41	260.85	263.42	266.12	268.19	334.72

FIGURE 7

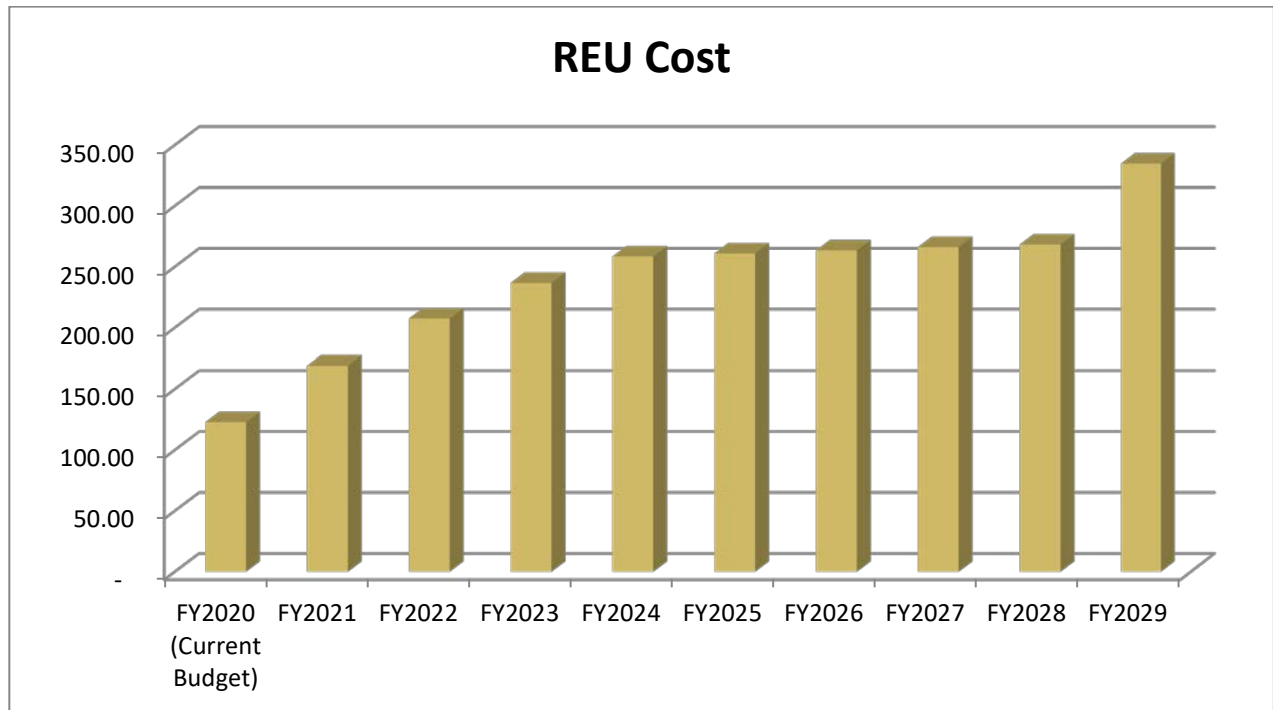


Figure 8

7 CONCLUSION

The public safety radio system users in Carson City have identified radio system deficiencies that exist today, which can and do adversely impact their ability to reliably communicate in both routine and mission-critical circumstances.

Staff executed a needs assessment to better understand the situation and to receive information regarding recommendations that would improve public safety communications capabilities in the city.

With the completion of this report, decisions can be made based on a much better understanding of the needs and proposed solutions.