COMMITTEE ON SCIENCE AND TECHNOLOGY FIELD HEARING
Testimony of Fire Chief Manuel Navarro
City of Colorado Springs Fire Department
Colorado Springs, Colorado

Introduction

Thank you for the opportunity to appear before the Committee on Science and Technology and discuss with you some of the experiences that the City of Colorado Springs and the Colorado Springs Fire Department have encountered in applying remote sensing and geospatial information systems to improve our emergency response and preparedness.

My name is Manuel Navarro; I am the Fire Chief of the Colorado Springs Fire Department. As a 41-year veteran of the fire service, I am honored to present to you today. Across my career and as the Chief of the Colorado Springs Fire Department, I have had the privilege to lead firefighters and emergency response personnel in dangerous and life threatening situations with a constant focus on our responsibility to protect lives and property from fire, medical, and disaster events. Finding new ways to plan for, prepare, and respond to emergency situations is something that I have charged my department with from the day I arrived in Colorado Springs. I think we have made some impressive advances in improving citizen preparedness, community resiliency, emergency response planning and operational situational awareness that I would like to share with the committee. At the same time, we have encountered some hurdles and lessons along the way that I would also like to share.

In my presentation to the committee, I will discuss the importance of gaining and maintaining situational awareness of the environment necessary for effective and safe firefighting. In the City of Colorado Springs, we have realized that remote sensing technology and geospatial information are key tools in improving our ability to shape the environment that we operate in. We now rely on these tools to help us prepare and plan for potential hazard and risk events, communicate with our citizens and adjacent emergency response agencies, and make the right decisions while deploying in initial attack or during sustained operations during a large scale wildland fire.

Before I offer testimony regarding the aforementioned issues, I think it is important that we establish a common understanding of the complexities involved with managing fire service response to emergencies, 24 hours each day, 7 days each week. As we deliver emergency services, there can be no excuses regarding our response – lives and property are at stake; it must be timely, we must get to the proper address or location and we must be proficient in rendering the services we provide. With that said, we have grown to understand the value that planning has for our organization. We must respond, we will respond, we will make tough decisions – but there is no need for us to have to make those kinds of decisions without the benefit of a very strong planning process. One bit of institutional humor for us is that the fire service represents 150 years unimpeded by progress. Well, fortunately, we have undergone a sea-change in our thinking where we have come to understand that planning and mitigation work literally "shapes the battlefield" in which we operate tactically. For Colorado Springs, the operational response mission must be accomplished, in our case, from a network of twenty fire station locations housing fire companies that are staffed by three different working shifts. But it doesn't require that we make our hard decisions without the benefit of thorough analysis and thoughtful response. Management of the training, logistics and standard operating procedures of fire companies to support this mission is challenging for any fire chief.

Emergency Response

When we receive a 911 call for emergency services, the appropriate emergency unit must be notified and that crew must correctly navigate heavy apparatus through heavy traffic conditions and difficult weather conditions at any time, day or night, to the address or location. Accurate maps, occupancy of buildings and location of response vehicles is essential in completing our mission and to ensure the safety of the responding firefighters.

The Colorado Springs Fire Department has employed geospatial technology for 25 years to create the most accurate map for the city and adjacent areas. As our city has experienced significant growth and development over the last several decades, the ability to accurately map new and changing streets have proven to be critical in dispatching emergency apparatus rapidly, effectively, and efficiently. Using the accurate base maps, we employ additional GIS technologies to layer critical information that can be utilized to provide additional information associated with that location or address to responding fire companies.

I cannot adequately express to this committee how important it is to provide responding fire officers with critical information regarding a specific building or hazard. The information allows fire officers to efficiently make critical decisions on the way to and at the scene of an emergency. Those decisions based on accurate information, coupled with the education and experience of the fire officer, lead to safely controlling emergencies while at the same time limiting property damage, saving lives and providing for the safety of responding emergency personnel.

Lacking local resources to develop this additional functionality was a challenge for us here in Colorado Springs. The city's Public Works Department recently received a federal transportation grant to develop Automatic Vehicle Location System (AVL) technology. The fire department had an opportunity to collaborate with our own City Traffic and Public Works Divisions in the development of the AVL system that provides the following functionality:

- o Locates every emergency that is identified by the Emergency Dispatch Center and transmits it to the traffic signal system computer
- o Provides every dispatched emergency unit with a map display showing a route to the location
- o Pre-emption that signals the traffic lights along that route to turn green as the emergency unit approaches the intersection
- o An onboard touch-screen computer developed by the department's I.T. staff, mounted in each emergency vehicle to archive and display additional layers of information
- o Situational awareness delivered through the onboard computer which displays available data for the scene.
- o Wireless, hands-free data updates (each fire station has been linked so that data can be updated to the onboard computer).

The base map originally developed with geospatial technology has been leveraged to work with the AVL system. It now provides routing capability for emergency vehicles to the location of an emergency and provides safe emergency response by controlling intersections. The base map is also used to identify individual addresses which in turn is used to access the base for layers of GIS information essential to safe and effective emergency operations. In the near future, fire companies will be able to develop pre-plans for individual occupancies that will be added as additional layers of information available in the apparatus to responding fire officers.

We are in the final process of reconciling our map centerline data in our computer aided dispatch (CAD) system to provide automatic vehicle location dispatch and move away form the current CAD tabular dispatch system. Once we have moved to that technology we will be able to improve response times without adding additional responding units to the department by always dispatching the nearest appropriate emergency unit.

Wildfire Risk

The department has also employed remote sensing in the form of hyperspectral imagery to study the city's wildland-urban interface areas and watersheds. This remote sensing technology provides us with detailed mapping of fuels, construction features, vegetation types, densities and locations that previously could only be categorized and mapped by laboriously walking and inspecting each area. Hyperspectral remote sensing data is one of the most promising data collection sources for planning and mitigation efforts related to wildland fire, community risk, and environmental hazards. As a remote

sensing data source, hyperspectal information allows communities to collect high quality data and extract multiple information elements from a single flight. We have collected and analyzed hyperspectral data to detect and map specific features such as the type and status of wildland fire fuels, the densities and location of high risk vegetation species, and the conditions and physical traits of at-risk structures and access roads. All of these traits are of special concern during active fire fighting operations and typically are unavailable prior to incident operations. Highly accurate and data rich remote sensing sources like hyperspectral systems provide decision makers with true situational understanding and awareness of the terrain, access, fuel and vegetation layers and building arrangements and locations. Within the Colorado Springs Fire Department, this data is used across almost all of the department's operations ranging from mitigation to response.

CSFD staff is currently developing a wildland urban interface (WUI) plan for the drainage areas and neighborhoods in the city's wildland urban interface. We will integrate the layer of fuels data provided by the hyperspectral imagery with current information on fire behavior to provide responding command officers with planning and operational situational awareness. We are also developing a map layer with specific information to assist command officers in positioning staged apparatus, evacuation zones and safe refugee areas, as well as displaying other potential fire control and resident safety issues.

Community Education

The department's Community Services staff has also employed this technology to inform and motivate community members to "FireWise"[1] their property. We have created an interactive web site that maps each individual property and their risk rating with regard to wildfire risk. Individual property owners can then access the information utilized to develop the risk rating of that property and, more importantly, how that rating can be improved by employing FireWise risk-reduction treatments to the property.

We have employed technology to leverage the efforts of staff in educating the thousands of households in the Colorado Springs wildland-urban interface areas. Here in Colorado Springs we have approximately 40,000 residential properties in these interface areas. Effective use of technology has greatly enhanced our efforts in community education with regards to wildfire mitigation. I think this is an important distinction to make. We have transitioned the use of remotely sensed information from purely reactive and tactical to a forward thinking, mitigation and planning effort. I think it is understood by this group that remote sensing technologies are tried and true in the operations arena – particularly the larger the incident is. However, we have come to see much more value that these rich datasets can provide to us long before the incident begins. Our focus has increasingly transitioned toward using the information provided by remote sensing as a real asset in our planning and mitigation work. Our use of hyperspectral data is just one example of how a local jurisdiction provided the specific information with which we could employ our risk analysis and thus educate individual property owners.

The use of these technologies has provided us with an opportunity to change our approach to creating a safer community. By employing innovative uses of remote sensing and geospatial technologies, citizens in our city are educated and motivated to treat their own property and not rely on local government to provide that service. We have developed a culture in our city that encourages citizens to partner with local government to provide public safety. By creating our web site we have greatly improved our efforts in getting individual property owners and neighborhood associations to partner with us in mitigating the fuel in these interface areas. Perhaps this seems subtle, but it is an important note: these efforts have created an environment in which our citizens actively participate in their own outcome, effectively sharing the responsibility – and that, after all, is the very definition of community.

---

[1] "The national Firewise Communities program is a multi-agency effort designed to reach beyond the fire service by involving homeowners, community leaders, planners, developers, and others in the effort to protect people, property, and natural resources from the risk of wildland fire – before a fire starts. The Firewise Communities approach emphasizes community responsibility for planning in the design of a safe community as well as effective emergency response, and individual responsibility for safe home construction and design, landscaping, and maintenance." (www.firewise.org)

Grant Proposals

The layers are also used to develop grant proposals utilized to secure funding which support community wide fuel mitigation projects. In a recent example, the City of Colorado Springs was awarded a one million dollar mitigation grant by FEMA. That FEMA grant was the only one of its kind in the nation. I firmly believe we would not have been successful in winning that grant had it not been for the robust data we were able to employ in the planning and justification for the grant. It was successful in large measure due to the capability we developed with our risk analysis of wildland fire issues using hyperspectral data. We were able to leverage our investment in remote sensing to make a strong case to FEMA that we knew both the nature of our problem and how to fix it.

Community Risk

Additionally, we have also embarked on developing a very sophisticated community risk assessment model. The model uses geospatial data[2] which are evaluated by all community stakeholders, to assess and categorize risk. It is a mixed-methods approach that couples the input from subject matter experts and the community inputs (qualitative) with mathematical models (quantitative) that describe not just where events have happened, but the very causes of those events.

The results of these assessments are clearly displayed on a map with shadings indicating the degree of risk severity. The visual display quickly communicates the location and extent of community risk so that citizens and policy makers can openly and with confidence discuss mitigation strategies. This is an important success for us to highlight. This illustrates the success we have in communicating with our public due to our use of GIS and remote sensing technologies. If a picture is worth a thousand words, how much is a dynamic living picture of risk and exposure worth to a community that can access it 24 hours a day, 7 days a week. We prepare to respond 24x7, so why wouldn't we mitigate and communicate the same way.

One of the innovative approaches that we are taking is that the results of the qualitative criterion can be displayed next to quantitative criterion and where there is convergence; policy makers can have assurance that they are developing a good decision that represents realistic informed consent in the affected communities. Where the data does not converge, policy makers can call out subject matter experts and citizens to discuss the difference in opinions.

Funding

Locally, we have been challenged in developing the technology needed to provide operational decision makers and policy makers with accurate, current and comprehensive data. Grant funding for the AVL system came to us by happenstance through our Traffic Department. They had a 900 MHz radio system and wanted to develop the vehicle location technology. We were able to place staff on the project and not only developed and tested their applications but developed the application for our emergency apparatus. We were very fortunate to be able to take advantage of that transportation grant (Congestion, Mitigation and Air Quality – CMAQ) as such funding is not available locally, through the state or through National Fire Administration grants.

The funding necessary for the geospatial and remote sensing over flights was carved out of current operational budgets and partnering with other interested city departments. We were very limited in the amount of resources we could employ to gather this data. Again, this technology and data is vital to our public safety work but we found very little support in the form of grant dollars to complete this work.

As my staff discusses the issues regarding development and use of technology in the fire service, they portray the problem in clear and concise terms; there is no staff dedicated to these projects, there is little additional time to allocate to these projects, and there is no funding to have the work completed by others and yet we have this essential mission to complete.

---

[2] Includes geospatial data describing the city's natural, social, and built environments.

Education

I would add that employing current technology is also a significant educational challenge for the fire service. Few, if any, fire service officers that are adept and capable in emergency operations work have formal education or experience with modern technology. We have been fortunate to have an accomplished information technology staff in-house that supports our public safety mission. The collaboration between experienced fire officers and a very sophisticated information technology staff has allowed us to take advantage of finite resources and create innovative approaches to community safety employing new technology.

IT Staff

When I took command of this department some 14 years ago, I had a departmental information technology division. We had fire operations staff working side by side with a very talented group of IT and GIS staff. The combination of those two groups of very talented employees allowed us to investigate, research, and create opportunities to employ technology in the work we do. The results are that this department is on the leading edge of utilizing technology to improve the effectiveness and efficiency of the department.

Training

Operationally, fire officers rely on training, education and experience as a foundation in making decisions regarding management of a variety of emergency situations. Then at the scene of an emergency, officers and firefighters must apply that training and situational understanding to the facts and observations made at the incident to develop situational awareness.

Technology can provide a large quantity of data through GIS layers supported by remotely sensed information and associated with a specific site and a specific type of incident. That information will not be easily processed nor understood unless we begin to train fire officers on how to recognize that information and use it in a situational awareness process. The fire service currently lacks that training and I know of no support for that training.

2008 California Fire Siege Example *(move to emergency response and operations section)*

The information available with the use of technology must also be employed in the operational planning process prior to an emergency and as the emergency involves. We saw a graphic demonstration of this application in the recent California wildfires. At that fire, overhead assets in the form of satellite platforms, unmanned aerial vehicles (UAVs) from NASA and DoD, National Guard, civil and commercial fixed wing and space-borne assets were able to bring into the planning process of the command post real-time data including full-motion video. Technology available to the military that provides situational awareness was deployed in California and from my opinion has the potential to greatly improve our ability to manage and control these large wildland fires – particularly if these assets are directed by local and state authorities with a mechanism to quickly capture, store, and disseminate the information. It doesn't really matter if we have this powerful remote sensing capability and we don't put the information in the hands of the actual boots on the ground when they need it. We should thoughtfully consider how we could institutionalize this capability vice scrambling when large events inevitably overtake us.

Personal Experience

I can tell you from experience that management of large wildfires is a most difficult task and having current and comprehensive data, maps of predicted fire behavior, and fire location and live video feeds are of tremendous assistance in managing the fire, saving citizens at risk, and controlling the position of fire apparatus and firefighters. In 1991, I was a command officer with the City of Oakland when in one afternoon we lost over 3,300 residential properties and the lives of twenty five people.

We did not have a map of the fire's perimeter or know the extent of damage until late that night. The perimeter of the fire was drawn by hand over an existing city map by a fire officer hanging out of a helicopter as it flew the area.

There are significant issues with bringing this technology to the fire service. As stated, there is a lack of resources and funding to acquire the technology and to gather the data. There is also the issue of training fire officers to understand and employ that data in their decision making. We also have an issue with standards.

Standards – *move above Personnel Experience*

In association with the International Association of Fire Chiefs, there has just recently been established a Technology Advisory Council to standardize data collection, storage, and exchange. The National Fire Protection Association has also begun to appoint a technical committee on Fire and Emergency Service Geographic Information Systems that will explore geospatial data needs and current applications to develop common fire service standards and protocols for exchanging geospatial data between GIS user agencies and organizations during emergencies. Perhaps for the first time, essential data elements gathered by local responders can be utilized by incoming mutual partners whether they are local, state, or federal. The development of standards is an essential step in developing GIS information that can be utilized by the fire service.

We recently hosted a meeting of many individuals involved with these projects so that they could share their individual efforts in order to develop a National Fire Service Data Model for gathering this data. That effort should receive continued support as we explore the development of this standard and look towards implementation at the local level.

Personal Comments

I perceive in the implementation of remote sensing technology that there are many issues regarding the use in the fire service for response and mitigation activities. I do not profess to have sufficient expertise to comment on the technical aspects of development of such technology. I can tell that you what we have done here in Colorado Springs has greatly leveraged our ability to provide the best in public safety with regards to fire control and suppression and community education.

I will offer that the leadership in the fire service and the emerging leadership must be trained so that they can fully employ the available emerging technology. Most fire officers have learned their trade through training, classroom and didactic, and with application of that training in practical experience. The introduction of remote sensing and GIS into the work we do must be accompanied by training and practice. That training will come at some cost. As with any training program, we must provide the training staff, develop the curriculum, and pay for the wages of the attendees. The training then has its associated cost, all of which must be provided with finite resources currently available to local government.

I have been asked by the committee to discuss how we have utilized remote sensing data and to also comment on barriers. Briefly, I have discussed with the committee some of our work regarding how we have utilized this technology. With regards to barriers I would comment that there are several:

- o Funding for such work is lacking at the local level. Local government has finite resources that are wholly dedicated to providing services and at the federal level, there are few available resources for this emerging technology in the fire service.
- o As we develop this technology and move to applications for response and mitigation, a national standard should be supported so that local, state and federal response resources can all utilize the data.

o There is a need to develop national policies, standards, and functional models to enable data sharing and coordinated data exchange starting with local agencies for decision support and situational status to incident commanders during escalating events of national significance.

o Implementation of this technology must be accompanied with training of the current and emerging fire service leadership. Perhaps it is possible to fund the U.S. Fire Administration to develop a program through the U.S. Fire Academy that provides support curricula with appropriate GIS and RS training. Additionally, some sort of train-the-trainer program for GIS specialists in the fire service would create capacity nationally.

o The federal grant funding systems could recognize the value of the implementation of these technologies as a key piece in planning and risk-reduction efforts. It has been difficult to use grant mechanisms for these purposes despite the huge successes we have had in our communities when we have used remote sensing and GIS together.

o The geospatial intelligence strategy to support national security and preparedness must start at the local level. This cannot happen until locals have access to effective GIS and remote sensing products that support their daily operational requirements. Effective widespread implementation of fire service technology will require appropriate data, tools, funding, and education delivered to local responder agencies. These components need to be defined by appropriate input from the fire service, for the fire service. This can be accomplished by working through existing national fire service organizations and leadership structures, most of whom have identified GIS and remote sensing as an important technology for supporting their mission.

Conclusion

In closing, the committee was also interested in comments regarding what would be most valuable to the fire service in expanding the use of remote sensing data for the future. We certainly support the use of geospatial information systems and the remote sensing data that feeds data to it. Fire officers will find that information extremely helpful in managing and controlling emergencies. The technology to support those activities in our estimation should be further researched and funding needs to be provided to make that technology available at the local level.

We have been very successful in employing data from remote sensing platforms to enhance our community education programs, to assist in the planning efforts with regards to fuel mitigation, and to provide an easily understood display of community risk to citizens and policy makers. We were able to employ remote sensing to gather data that would take prohibitive personnel and time commitment to gather. We would support further research in the use of this technology to gather additional information such as roof types and other data essential to full development of community risk attributes.

Colorado Springs has shifted from binders on bookshelves to a community-based, geospatially enabled risk-assessment methodology. We have strived to understand the nature and characteristics of risk and then systematically work on risk reduction activities. We are developing mitigation strategies in addition to our response applications. We believe that responding to emergencies without really seeking to know what the underlying causes of the problems are is only part of creating a safer community. We support technology that provides us with the data required to understand and analyze the community risk.

We have been very fortunate in Colorado Springs with developing and utilizing remote sensing technology. We have utilized local staff and collaborated with some extremely talented private sector contractors.

We would strongly encourage the federal government to support these types of activities at the local level in order to improve the fire service's response to public safety as well as provide situational awareness for incoming local, state, and federal assets during major emergencies.

Again, thanks for having me here today, I would be happy to take any questions you might have.

Fire Chief Manuel Navarro
Biography

Manuel Navarro was born in Oakland, California. He was a life-long resident of the San Francisco East Bay area until January of 1994 when he was appointed Fire Chief for the City of Colorado Springs. Chief Navarro's 41-year career began in the San Francisco Bay area in 1966 and he has served as firefighter, lieutenant, captain, battalion chief and assistant chief prior to being appointed Chief of the Colorado Springs Fire Department

Chief Navarro holds an Associate of Arts Degree in Fire Science and a Bachelor of Arts Degree in Public Administration with a minor in business. In 1995, he attended the Kennedy School of Government, Harvard University, being awarded one of four National Fire Protection Association fellowships given that year. He holds a State of California Master Fire Instructor Certification and is certified to teach a number of specialized fire science topics.

Chief Navarro is an experienced and knowledgeable fire command officer and participated as a command officer in three nationally declared disasters (1989 Loma Prieta Earthquake, 1991 Oakland Hills Fire and 1992 Hurricane Iniki, Kauai). The Chief is considered an expert in many technical areas--most notably in the field of Urban Search and Rescue. He was responsible for the management of the Oakland sponsored Federal Emergency Management Agency (FEMA) National Urban Search and Rescue Team and served as a member of the FEMA Urban Search and Rescue Management and Control Committee.