EARTHQUAKE PREPARDNESS FOR THE SOUTH DAVIS METRO FIRE AGENCY

Earthquake Preparedness for the South Davis Metro Fire Agency

South Davis Metro Fire Agency, Bountiful, Utah

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CERTIFICATION STATEMENT

I herby certify that this paper constitutes my own product, that where the language of others is set forth, quotation marks so indicate, and that appropriate credit is given where I have used the language, ideas, expressions, or writings of another person.

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Abstract

The problem is that South Davis Metro Fire Agency does not have a comprehensive earthquake response plan. The purpose of this research is to identify the earthquake areas within South Davis Metro Fire and to develop such a plan. Using descriptive research the areas at risk were identified, other fire departments were surveyed on their response and preparedness, the needs of South Davis Metro Fire to support their personnel and citizens were identified and an emergency response plan specific to earthquakes was determined. The research was conducted with literature reviews, and interviews of people with specific knowledge in the earthquake issues in the state of Utah. The results determined South Davis Metro Fire needs an in depth comprehensive plan to respond and support the needs of personnel and the community that is served. Recommendations included developing a detailed response and mitigation plan for earthquakes, develop a food and water storage plan to sustain the needs of emergency personnel and staff, and to outline the areas within the protection of South Davis Metro Fire that are affected by the Wasatch Fault and begin a public information media campaign to inform the citizens of the danger zones.

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Earthquake preparedness for the South Davis Metro Fire Agency

In the last couple of years earthquake preparedness in the state of Utah has taken front stage. In January of 2008 the state Capitol building was rededicated after being closed for three years. During those three years the building was torn apart and rebuilt to earthquake standards (Rouche, 2005). The state spent 200 million dollars to retrofit the state capitol building, installing shock absorbers that will enable it to rock back and forth in an earthquake (Rouche, 2005). During this remodel crews installed 265 base isolators beneath the capitol which allows the building to move up to 24 inches in any direction during an earthquake. The isolators allow the capitol to withstand a 7.3 magnitude earthquake and reduce the seismic impact on the building by 75 to 80 percent (News, 2008). This set the stage for all state and local authorities to plan and prepare for earthquake hazards. In recent years many geoseismic discoveries have been made along the Wasatch front. The Wasatch front is considered from Ogden, Utah to Draper, Utah. The most significant is that of frequent seismic activity along the east benches of Salt Lake. Recent advancements in seismic instrumentation and equipment sensitivity have revealed that there are approximately 700 earthquakes in the state of Utah each year (Associates, 1993). Utah's longest and most active fault is called the Wasatch Fault. This fault lies in the most heavily populated Wasatch Front including the Provo corridor, St George and Cedar Cities which are in the southern part of the state; this puts most of Utah's residents at risk (USGS, 2008).

The problem is that South Davis Metro Fire Agency does not have a comprehensive earthquake response plan. The Wasatch Fault carries through each of the cities that are in the protection district of South Davis Metro Fire.

The purpose of this research is to identify the earthquake areas with the South Davis Metro Fire and develop a emergency response plan. Using descriptive research the following questions will be answered. a) Identify the areas within the South Davis Metro Fire that are at risk of an earthquake, b) How do other departments and communities respond to earthquakes, c) How will South Davis Metro Fire support the needs of personnel during an earthquake event, and d) How will South Davis Metro Fire develop a emergency response plan to specific earthquake response.

Background and Significance

South Davis Metro Fire Agency was organized in January 2005. The Department was created by merging two fire departments, Bountiful City fire department and the South Davis Fire District, into one working fire department. South Davis Metro Fire provides fire and emergency medical response to the cities of Centerville, West Bountiful, Bountiful, Woods Cross, North Salt Lake, and the unincorporated areas of Davis County. These cities have a wide variety of target hazards such as, hospitals, nursing homes, five full scale working refineries, two interstate freeways and commuter rail. There is a wildland urban interface area within the cities of Centerville, Bountiful and North Salt Lake, these areas are all residential and contain residential structures up to 53,000 square feet, built along the hillside of the east bench in these cities. There is a residential population of 95,000 residents (US Census, 2009) in the

response area which will increase during daytime hours. South Davis Metro Fire provides Hazmat team response to the region which includes the counties of Davis, Rich, Box, and Weber. Local response includes Fire, paramedic services, ambulance transport; inter facility transports, high angle rescue team and a confined space rescue team. There are nineteen personnel on duty working from five fire stations. South Davis Metro Fire has 50 full time employees and 47 part time paid employees. During times of significant incidents such as working fires, full and part time staff are called back to fill stations and continue responding to incidents as they occur.

The protection area of the South Davis Metro Fire Agency is located in the southern part of Davis County. South Davis Metro Fire does respond into the Salt Lake City on mutual aid response. The protection area is adjacent in boundary to the Salt Lake Valley or Wasatch front. The Salt Lake Valley lies in the Central Wasatch Front portion of the Intermountain Seismic Belt; this fault runs from Montana through Utah to Southern Nevada and Arizona (Smith, 1991). The largest historical earthquake in the Wasatch Front was the 1934 Hansel Valley which generated a 6.6 magnitude earthquake. 80 miles away in Salt Lake City this earthquake produced ground shaking, caused six to ten story buildings to sway and batter against each other. Scientists say the Wasatch Front faces a 1 in 7 chance of being hit by a magnitude 7.0 earthquake within the next 50 years. Computer models estimate that it could kill 3,000 people, injure 42,000, damage a third of all buildings and cause at least 35 billion in economic loss (Davidson, 2010).

With this type of predication the needs of the citizens and local and state government will be great. Food, water and shelter will be limited; communications will be down due to

cellular antennas being damaged or the system being overloaded. The sick and injured will be in mass quantities; this type of hit will devastate any emergency response. Large earthquakes can happen anywhere at any time but they are more likely to happen in a seismic belt and Utah is right in the middle of the belt (USGS, 2008)

This research incorporates unit four from the National Fire Academy (NFA) Executive Leadership student manual, fifth edition, first printing October 2005. Unit four introduces developing decision making skills. This Applied Research Project relates directly to the National Fire Academy Executive Leadership course and curriculum discussed in the Executive Leadership course. This research corresponds to the United States Fire Administration (USFA) operational objectives goal 2 to promote within communities a comprehensive, multi hazard risk reduction plan led by the fire service organization.

Literature Review

The purpose of the literature review is to determine the best practices for earthquake preparedness. The literature review collected information from the private and public arenas to determine all methods for preparedness. The review began at the Learning Resource Center (LRC) at the NFA. The review included published books, journals and executive fire officer applied research projects. Further research included internet searches, books available at the Davis County Library system, University of Utah Library system and books from the Federal Emergency Management Agency. Research from the United States Geological Survey and a request for information from California fire departments that have experienced earthquakes first hand was obtained.

Earthquakes are measured in two types of scales Ritcher or Modified Mercalli. While an earthquake only has one magnitude it will have many intensity values that decrease with distance from the epicenter (Watson, 2007). Intensity is defined as the strength of seismic shaking at a given location. Earthquakes will have a single magnitude with much different intensity at different locations. The closest epicenter experience is the highest intensity and shaking diminishes in strength farther away. Magnitude is a measurement of the energy released by an earthquake (Southern Illinois University Carbondale). The first earthquake scale was the Ritcher scale. This scale is based on the amplitude of seismic waves; the stronger the wave the higher the numerical number is achieved. The Mercalli scale is used for measuring earthquakes based on the distance to the earthquake with the highest level being the epicenter. Data is gathered from individuals who have experienced the earthquake and an intensity value with be given to their location. (Intensity Scale). An earthquakes magnitude is measured using Arabic numerals. A 1.0 magnitude is low while each increase represents exponential expansion (Watson, 2007). Typically each earthquake is assigned one magnitude on direct measurements, but one earthquake can have several intensities, each based on the observed extent of local damage and disruption (Senchyna, 2006).

Earthquakes lay where plate bends below plate, or where one plate slide against another plate (Morton, 1996). Such a plate is the San Andreas Fault. This is where North America plate slips by the Pacific plate, carrying a piece of the West Coast steadily northward. Most movement along the San Andreas Fault and most other faults occur in fits and starts, not under constant sliding. The fits and starts are the rocks snapping under decades of pressure to let loose earthquakes (Morton, 1996).

Utah has experienced sixteen earthquakes greater than magnitude 5.5 since 1847 and geologic studies of Utah's faults indicate a long history of repeated large earthquakes of magnitude 6.5 and greater prior to settlement. Utah is not on a boundary between tectonic plates where most of the world's earthquakes occur, but rather is in the western part of the North America Plate. Utah in earthquakes is indirectly caused by interactions with the Pacific plate along the plate margin on the west coast of the United States (USGS, 2008).

The Salt Lake Wasatch Front consists of cities from Ogden, Utah stretching to Provo, Utah. This is an 80 mile area that follows interstate I-15 the only interstate that travels this distance. The Wasatch Fault is one of the world's longest and most active faults in the world. It extends from Malad, ID to the Southern city of Fayette, Utah. The fault is subdivided into ten segments averaging twenty five miles in length; each segment is generally thought rupture independently and is a separate source of large earthquake (USGS, 2008). From the sky you can see a scar from millennia of movement where the east bench of Salt Lake City ends and the mountains begin in the Salt Lake Valley (Steadham, 1996).

Utah has experienced damaging earthquakes in the past and geologic evidence indicates that earthquakes larger than any experienced locally in historical time are likely in the future. Large earthquakes are possible anywhere in Utah, but they are more likely in a seismic belt about 100 miles wide extending north-south along the Wasatch Front (Commission, 1995). Earthquakes produce a variety of hazards that will threaten life and property. Hazards include ground shaking, surface fault ruptures, landslides, floods, gas leaks, fires, and flooding.

Earthquake hazards are greatest along the Wasatch Front area because of the greater earthquake probability and because of the extensive areas where geologic conditions pose the potential for damaging, earthquake induced effects (Commission, 1995).

All of the cities South Davis Metro Fire protects are located in Davis County. Davis County is located in the heart of the Wasatch Fault between the shores of the Great Salt Lake and the Foothills of the Wasatch Mountain Range. The majority of the population lives within five miles of the fault (County, 2003). There are numerous water and petroleum pipelines that cross over or run within one half mile of the fault. Five petroleum refineries are located in the area and are subject to sever damage from ground movement and liquefaction. A major earthquake in the area would result in hundreds of billions of dollars on damage to residential structures, industry, critical infrastructures and loss of life (County, 2003). Maps show (Appendix A) all of the south end area of Davis County is in the Wasatch Fault. Numerous homes built in the mountain areas would be at risk of landslides, roads to these areas are at risk for responders to gain access to these areas during such an event.

The Utah Epicenter or Earthquake Preparedness Center is committed to seismic safety throughout the State. The goals and objectives of the Epicenter are to inform and help prepare citizens for the possibility of an earthquake. This is accomplished through information to the public, implementation of broad based specific proposals regarding preparedness and mitigation, and acting as a resource to the state and local governmental agencies, schools, and business involved in earthquake preparedness (Utah Department of Public Safety).

In 1993 a study was performed to determine the capability of the Utah State Capitol building and how hit would survive an earthquake. Computer modelings, ground samples, building codes at time of construction, were all completed to determine the stability of the Capitol. The results showed the Capitol building does not have the characteristics that would enable it to perform adequately during a significant earthquake (Associates, 1993). Many structures near the Wasatch Fault were constructed at a time when there was little or no knowledge of the potential seismic activity. The standards of design and construction in terms of seismic safety have only recently become part of the standard building practice in terms of typical building life spans. Many buildings near the Wasatch Fault including the State Capitol building are particularly vulnerable to life threatening damage due to seismic activity (Associates, 1993).

The Davis County Emergency Response Plan outlines the needs of critical infrastructure buildings. A number of fire departments do not meet current building criteria and could sustain considerable damage or suffer total destruction from ground shaking. The fire departments in these criteria are Clinton, South Weber, and Layton City. Currently South Davis Metro Fire has three out of the five stations that are designed to current seismic standards (County, 2003). The other two fire stations are not in compliance with current seismic standards. Recent budget restrictions prevent the budget needed to replace the two fire stations. South Davis Metro Fire has applied for funding to replace the two stations from federal fire station grants but was denied because the economic downturn in the area did not justify the grant.

The only plan in place for earthquake mitigation by any fire agency within Davis County is the Davis County Emergency Response Plan (DCERP). No internal plans by individual fire departments have been compiled. The DCERP has been adopted county wide as the response plan to earthquakes. The plan overall focus an all hazards plan. No specifics on responses to those in need. The county overall has automatic and mutual aid agreements in place to support each other in times of need.

All public services, citizens' expectations, and outside influences require anticipating the future needs as well as developing a plan and identifying the funding programs to meet these expectations (Shubin, 2009). Natural disasters create numerous training needs on fire departments. Trench rescue, confined space, hazards materials, confined space rescue, and mass casualty response are just a few areas that departments need to be prepared for. South Davis Metro Fire currently trains and has specific teams in place for such hazards. In 2009 federal funding was approved for training in each of these hazards and to create a task force team with in the region. As of date, the training is ongoing in creating an Urban Search and Rescue Team so when a disaster does occur there are qualified people to respond.

Training is essential to firefighters. Training gives firefighter and rescuers the ability to respond to the needs of those we protect. Fire departments need to have the ability to sustain those efforts by firefighters. There are numerous needs while operating an emergency scene. Food, water, and shelter are a primary needs. The Federal Emergency Management Agency urges all citizens that 72 hour kits are necessary for each individual in a family to sustain themselves during events of natural disasters (Ready America). The same would apply to fire

and emergency agencies to supply such needs for personnel for 72 hours. During and after a disaster, it is vital that strength is maintained. The Nutrional needs of individuals are to eat at least one well balanced meal each day, drink enough liquid to enable your body to function properly which under normal exertion is two quarts or half a gallon each day, take in enough calories to enable you to do any work and to include a vitamin, mineral and protein supplements to ensure adequate nutrition (Federal Emergency Management Agency (FEMA) 2004). Ready to eat canned meats, fruits, and vegetables, protein and fruit bars, dry cereal, peanut butter, dried fruit, nuts, crackers, canned juices, non perishable pasteurized milk, high energy foods, vitamins, and comfort / stress foods are all recommended foods needed for storage (Ready America).

Human Bodies are 80 percent liquid (Barkdull, 2003) Water loss in humans occurs three ways: perspiration, respiration, and urination. Within three days of water depletion or water loss the body and organs can experience severe damage (Barkdull, 2003). Having ample supply of clean water is a top priority in an emergency. A normally active person needs to drink at least half a gallon of water each day (FEMA, Food and Water in an Emergency, 2004). During times of exercise or any activity that makes you sweat, you will need to drink extra water to compensate for the fluid loss. During long bouts of intense exercise, its best to use a sports drink that contains sodium, as this will help with replacing sodium lost in sweat and reduce the chance of hypothermia (Mayo Clinic) Water is needed to drink but there are other needs such as cooking, personal hygiene, sanitation, and for cleaning wounds. The average person uses 100 gallons of water each day for drinking, bathing, laundry, watering lawns etc. (Barkdull, 2003). To supplement this in an emergency 14 gallons of water per day per person for all needs

is necessary (Barkdull, 2003). The safest and most reliable emergency supply of water is commercially bottled water (FEMA, 2004).

During times of natural disasters emergency services may be unable to reach all citizens for various reasons and it is essential that all individuals and neighborhoods be prepared to be on their own for a minimum three to five days (Shubin, 2009). Home emergency kits should include drinking water, first aid supplies, medications, hygiene items, emergency lighting, battery operated radio, canned and packaged foods, items to protect you from the elements, heavy duty plastic, work gloves and safety goggles (Shubin, 2009). The same needs should be addressed by emergency responders.

Procedures

The purpose of this project was to gather information to identify the areas at risk of an earthquake and to gather information to assist South Davis Metro Fire in preparing an emergency response plan for earthquakes. Information initially was obtained at the learning resource center at the National Fire Academy in Emmitsburg, Maryland. Applied research projects by other Executive Fire Officers, published books, and evaluating other fire department emergency response plans were obtained and reviewed. Internet searches for published materials and websites of public safety agencies, emergency management agencies, and private businesses was conducted.

A descriptive research methodology was used to answer the following questions: a) Identify the areas within South Davis Metro Fire Agency that are at risk of an earthquake, b) How do other departments and communities respond to earthquakes? c) How will South Davis

Metro Fire support the needs of personnel during an earthquake event? d) How will South Davis Metro Fire develop a emergency response plan specific to earthquake response? This Applied Research Project was prepared in accordance with the guidelines from the American Psychological Association Manual, fifth edition.

This author sent out an email request for earthquake response plans and procedures to fire departments in the state of California and Utah. This allowed for a review of the other fire departments policy's and procedures in regards to earthquakes. The local Davis County all Hazard Mitigation Plan was obtained to review the policies in regards to earthquakes at the immediate local level. There are earthquakes all over the world, but to scope the project California was chosen due to the amount of earthquakes in that state. Local request was made so other fire department policies and procedures could be evaluated.

Personal interviews were conducted with professionals from the Utah Department of Homeland Security (UDHS). The UDHS has established statewide emergency operations centers and statewide response plans for an all hazard situation. In the year 2012 "The Great Shake Out" is a state wide earthquake response drill that will take place to test the capabilities of all emergency responders (J. Valenzuela, personal communication, January 2011). This drill will show what agencies within the state can do on their own and what they can do with state support and the activations of state wide plans and emergency operations centers.

Numerous web sites which store and publish information on earthquakes were researched. UtahEarthquake.org, University of Utah seismograph stations, US Geological

survey web sites was all informative with information in regards to the questions of the research.

Assumptions and Limitations

It was assumed that all fire departments within the state and the state of California had earthquake response plans and or guidelines. It was assumed that all requests for information would be returned in a timely manner. It was assumed that the amount of information in the state of Utah in regards to earthquakes would be overwhelming.

The research in this project in relation to earthquakes was plenty, however, the research regarding earthquakes and earthquake response in the state of Utah was limited. The state of Utah has not had a significant earthquake in hundreds of years and with no disaster action to take, the research was pointing to how earthquakes happen and where. There were limitations in regards to response plans from other agencies, it was discovered many agencies have none or use a generic plan. There were limitations to access the state earthquake preparedness director, numerous calls and emails were made with no response. The ability of electronic feedback through surveys and was a limitation to the author, since there is limited knowledge on how the electronic surveys work and what the accurately is of such instruments. This is the reason emails and telephone calls were made to obtain the research needed from outside agencies, this too was a limitation as not all agencies returned the email request or had no such answers to them. A significant limitation was the time the author had to do such work.

The last limitation is to the author of this research. Living in the state of Utah where no such event has happened there is limited knowledge of earthquake events in the state. This

author was living in Oakland, California at the time of the 1989 Loma Prieta earthquake which was a 6.9m earthquake, killed 63 people, injured 3,757 people and left 3,000 -12,000 people homeless (Wikipedia, 2010). The author knows the amount of damage earthquakes can do in just a few seconds, the limitation is to the own bias of the author in regards to this research.

Results

The first research question needed to identify the areas within South Davis Metro Fire that are at risk of an earthquake. South Davis Metro Fire protects the cities of Centerville, Bountiful, West Bountiful, Woods Cross, North Salt Lake and the unincorporated areas of South Davis County. The Wasatch Fault follows interstate I-15 and runs five miles either side of the freeway depending on the geography (USGS, 2008). Interstate 15 runs through all of the cities and the unincorporated areas of South Davis County. Maps obtained through the Davis County Emergency Response Plan the liquefaction hazards for these areas are high to moderate (County, 2003). The map shows all of the protection areas of South Davis Metro Fire range from the high to moderate range, no matter which city you are located in. The entire area has a potential for widespread damage and disruption of services.

There are five stations in the South Davis Metro Fire Agency. Three of the five are new construction and met seismic hazards when constructed. The remaining two stations do not meet earthquake building regulations and are at risk of destruction during an earthquake event (County, 2003). The stations at risk are fire station 83 in Centerville and fire station 84 located on the east bench of Bountiful City. Additional concerns with fire station 84 is the location, station 84 is located in the mountain area of the city and would be at risk of landslides, earth

movement and total loss of building. Destruction of these buildings in an earthquake event would limit or not allow response from firefighters depending on the severity of the building, equipment inside the building and the safety of personnel assigned to those stations.

The second question was in regards to how other departments and communities respond to earthquakes. During local Statewide Chiefs convention personal communications were held with various fire chiefs throughout the state. No department had a specific response policy in regards to an earthquake event. General response plans and policies are in place for all hazards but no specific response plans were in place. Emails were sent to fire departments in the state of California, requesting policy, response plans or guidelines as to how responses to earthquakes are conducted. This was done through the California fire chief's website calchiefs.org. No response was obtained. The author then sent out personal email requests to Los Angeles fire department, Los Angeles county fire, San Diego Fire, Huntington Beach fire, and Oakland fire department. From these agencies two responded back, San Diego and Huntington Beach. Both of the policy and procedures first directed acting battalion chiefs to due internal audits of their stations, equipment or resources and personnel. This was to be done immediacy before any incident response was dispatched. According to the Huntington Beach policy no company shall commit to a incident without authorization from the shift battalion chief (Mettler, 1993)

Both agencies established a procedure for area commands to be established if significant damage or widespread catastrophic damage to areas. Once this was done the senior staff would be activated along with the Emergency Operations Centers or Department

Operations Centers. Both policies included a "windshield survey plan" which is a standardized format for locations of critical infrastructures, routes to drive, locations of commands to be established and evaluation of department needs (Mettler, 1993).

The third question was how South Davis Metro Fire will support the needs of personnel during an earthquake event. The background to this question is how South Davis Metro Fire will provide the basic needs to those emergency responders working an incident. The focus of this question was in relation to food, water and bedding. No research as to how other fire departments do this was found in state. There are no established guidelines as to how much food, water, and bedding is needed for every member employed. Research obtained from San Diego and Huntington Beach fire departments had no such information either. Michael Pacheco from San Diego fire said "there is nothing specific to food or water post earthquakes". Information gathered from Huntington Beach resulted in a logistics issue. Meaning it was up to logistics to figure out how to accomplish the food and water needs during such an event.

The last question was how South Davis Metro Fire will develop an emergency response plan specific to earthquake response. Currently South Davis Metro Fire has no plan in place. It was discovered through research the entire county has adopted the Davis County Emergency Response Plan as an all hazards plan. In this is the earthquake response plan and maps outlining the county and the hazards of each (appendix A). South Davis Metro Fire has such a wide area of coverage further research should be done to have a specific plan in place. This would include such a document as the windshield survey document from California fire departments which is a standard form used to evaluate the immediate needs and then

conditions of the departments. It outlines main routes for escape and locations needed for mobile command centers and the needs to establish or staff Emergency Operations Centers. It is impossible to predict the outcome of an earthquake and what will be damaged. However, establishing location points, travel routes, pre planning the entire protection area of South Davis Metro Fire is needed to give emergency responders the basic footprint to respond and act. This can be accomplished by working with local city engineers to determine what buildings are up to code with earthquake standards and determining the actual fault line in every city.

Discussion

An earthquake is the abrupt shaking of the earth caused by the sudden breaking of rocks, when they can no longer withstand the stresses built up deep beneath the earth's surface (Utah, 2009). Many Utah residents discount the earthquake hazard based on the near absence of moderate to large earthquakes, along the Wasatch Front (USGS, 2008). Most people living in Utah have not experienced a damaging earthquake in the state. Comparing the average recurrence interval with the amount of time since the last large earthquake indicates the next large earthquake is becoming more likely in certain parts of the Wasatch Fault (USGS, 2008).

Surface Fault rupture along the Wasatch Fault is expected for earthquakes with a magnitude of 6.5 or greater. The largest probable earthquake could strike Utah is anticipated to be an earthquake with an estimated magnitude between 7.0 and 7.5 and would occur on the Wasatch Fault (Utah, 2009). An earthquake of that magnitude would create surface fault rupture with a displacement of around six to ten feet high and twenty to forty miles long. To

date, surface fault has only happened once in Utah, the 1934 Hansel Valley earthquake which was a 6.6 magnitude with 1.6 feet of vertical offset (Utah, 2009).

The Wasatch Fault is one of the longest and most active normal faults in the world. It is 240 miles long extending from Malad, Idaho to Fayette, Utah. It is divided into ten segments averaging twenty five miles long and each segment is generally thought to rupture independently and is a separate source of large earthquakes (USGS, 2008). This fault follows interstate 15 which is the only north-south interstate across the entire state. This interstate goes along the Wasatch Front of Salt Lake City. Meaning this fault is centrally located across the Salt Lake City Valley area.

The estimated 7.0 to 7.5 magnitude earthquake will be devastating to the entire Salt Lake Valley areas. When this occurs emergency responder will be looked to for help in many situations. Public safety as a whole, must prepare, plan and practice for such an event. The primary responsibility for community education, preparedness and helping its citizens recover from the devastation of a disaster rests with the local government (FEMA, 2005).

The entire protection area of South Davis Metro Fire is at risk of a large earthquake. Such predictions of a 7.0 to 7.5 magnitude will overwhelm the emergency response system. The department needs to understand the need for community involvement with the planning of a large scale earthquake event. Organizations such as citizen's emergency response teams (CERT) and medical corps need to be involved to help citizens help themselves during events of significant disasters. South Davis Metro Fire currently teaches CERT classes on a continual basis to educate the citizens on what the capabilities of the fire department are and how they can

support each other during large scale earthquakes. There needs to be a wakeup call to the public regarding earthquakes in the state of Utah. The fact that no significant earthquake has happened in the state should not matter to public safety agencies who fail to prepare and educate their citizens. This education campaign begins at the public safety level and must outreach the public.

Social media is widely used to send out information. South Davis Metro Fire website has no information regarding specific hazards within the community. The city of San Francisco has an innovative web site that educates people for many types of hazards and includes access points for citizen notification for damage assessments (CCSF, 2008). Public safety agencies should be sharing the knowledge and skills to conduct social media programs with each other. Sharing policies and procedures with each other and not making it difficult to share the knowledge other agencies have gone through with similar experiences.

South Davis Metro Fire provides fire and emergency medical services to the citizens of South Davis County. Within the county there is a mutual and automatic aid system in place. In that system there are fire departments with specific assignments. One example is rehabilitation. During a large scale event or an event that needs assistance from others one agency will respond and establish a rehabilitation center. Medical evaluations, food, water, heat, fans, blankets are available once set up for the emergency responders. One example of this was a refinery explosion South Davis Metro Fire responded to on January 12, 2009. This was a large scale event that taxed the resources of South Davis Metro Fire. Mutual aid was called in to establish a rehabilitation center for the firefighters. The American Red Cross

responded to assist with food and water for citizens affected and firefighters working at the fire. That system worked, but it was a single event for a single fire department. In the large scale if this was an earthquake, the automatic or mutual aid system would not work as agencies would be handling incidents within their own cities. This would mean each department would be responsible to obtain food, water, shelter for their employees who are working on the job. During an earthquake this would be difficult as South Davis Metro Fire has no backup food or water supply, or enough beds and blankets to house all 100 employees if all employees came back to work during such an event.

During the state fire chief's convention in St George Utah, 2010, this author interviewed chiefs from around the state. Of the chiefs interviewed no one had a food, water, shelter plan to sustain the needs to personnel during a disaster event. Research was obtained from the San Diego and Huntington Beach fire departments which also showed no plan was in place to sustain those needs.

South Davis Metro Fire employees 100 people. 97 are operational response employees. There are 19 personnel on duty each day. Every day the department is responsible for those 19 employees and during events where off duty personnel are called back into work that number will go up. There is a need to sustain those employees so they can provide the care needed to the citizens they protect. On a daily basis each response vehicle is equipped with coolers of bottled water and during long term events where food is needed; the department will go to local vendors and pick up food. During an earthquake event where stores may be closed, fire

departments will need alternative resources to provide food; water and shelter to staff that are working and responding to incidents.

According to Ready America a three day food supply of non perishable food is needed per person. Foods that require no refrigeration, preparation or cooking and little or no water are recommended. Foods should include ready to eat canned meats, fruits and vegetables. Protein bars, dry cereal or granola, peanut butter, dried fruits, nuts, crackers, canned juices, non perishable pasteurized milk, high energy foods, vitamins, and comfort or stress foods should be in the three day of food supply per person (Ready America).

One method of a back up food supply could be the use of Meals Ready to Eat (MRE). Originally designed for government use, these are foods packaged in triple layer plastic / aluminum and have a long shelf life (Barkdull, 2003). MRE pouches have been tested and redesigned according to standards that are much stricter than those used for commercial food. MRE must be able to endure abuse test such as obstacle course traversal in field clothing, outdoor storage anywhere in the world; shipping under extreme conditions, 100 percent survival rating during a parachute drop, 75 percent survival rate during free fall drops, and sever vibration (Barkdull, 2003).

The MRE is pre cooked and sealed at a high temperature so that bacteria are neutralized and the food will be stable when stored at room temperatures. At 60 degrees the MRE can last up to 130 months, a regular rotation of MREs of between five to seven years is recommended (Barkdull, 2003). They do not require cooking, water or any preparation.

There are foods that may be stored indefinitely such as wheat, dried corn, vegetable oils, baking powdered, soybeans, salt, white rice, bouillon products, dry pasta and powdered milk in nitrogen packed cans (FEMA, 2010). These products may not expire but to create a food product to eat with them may be require the use of other food products that do expire. This can create some difficulty when attempting to manage a food storage program.

Water is essential need of everyday life. Used for cooking and preparing food, personal hygiene, personal intake to replace fluids, and so much more. During regular day to day work activities water is readily available at every fire station and vehicles. Water today can be purchased without urgency at any local stores. Bottled water is best to maintain pure, clean water. There should be at least a three day supply of water per person (Ready America).

The human body is 80 percent liquid and dehydration of 6 to 8 percent of the body's weight results in decreased body efficiency (Barkdull, 2003). Within three days of sustained water depletion or loss, the body and organs can experience severe damage. The potential for heart attack and stroke increases, the kidneys begin to fail and the mind begins to hallucinate (Barkdull, 2003).

If a person engages in any activity that makes them sweat, they will need to drink an extra 1.5 to 2.5 cups of water. The average person needs 8 or 9 cups of water to replace normal day to day replenishment (Mayo Clinic). This is just for drinking; the average person needs a total of 14 gallons of water per day for total use, this includes cooking, hygiene, water intake, cleaning of wounds and small laundry (Salsbury, 2006).

During an earthquake event emergency responders will be working with more intensity due to the stress of the incident, or the complexity of a rescue. Without the use of water for the responders they will not be capable to perform their assigned tasks. Water will be needed for wound care, cooking, fighting fires and so much more. The demand for food and water is always evident during times of natural disasters. Public safety agencies need a plan in place to determine how this will take place to ensure the care of emergency responders.

There are five fire stations in South Davis Metro Fire Protection areas. All stations are equipped with diesel powered generators to support the needs of each fire station during times of power outages. These generators can run up to one week before refueling is needed. This allows the fire department to be able to continue with operations. It allows for emergency responders to be sheltered during times of natural disaster. The exception is if an earthquake of 7.0 to 7.5 occurred, two of the five stations would be at risk of collapse or severe devastation (County, 2003). With power to the stations shelter can be provided, food can be cooked with electrical stoves in the event that natural gas is not in service. There are enough beds to allow on duty people an area to rest, in the event of such a large scale earthquake and off duty personnel are called back to work, there are training rooms at four of the five stations to set up make shift sleeping areas. The issue with this is there are no extra beds or cots available to the department to handle the extra staffing.

The research into supporting the needs of the department brought up issues of supporting the public. In the event of a large scale earthquake and fire stations were secure and stable would there be a need to support the citizens they protect. Would there need to be

make shift shelters at each station. Would the citizens look to the fire department as a resource for help? Dailey the fire department is called to up those in needs; this is being done on a continual basis without a natural disaster. When an earthquake does occur citizens will look to the fire departments, local government and federal governments for help and aid. This was shown on television during Katrina. Townsend (2006) discovered the public perception and expectations were disappointing regarding the Federal response to Hurricane Katrina. The mass amount of people looking for help will be great. Routinely, the public looks to public safety and this event will be different from the routine, it will be greater than any incident to date. Public safety agencies must prepare for the worst. Without a plan there is great room for errors and confusion. Leadership along cannot handle this type of event.

South Davis Metro Fire is a community oriented fire department. There are numerous services provided to the citizens. Firefighters are routinely in the public eye, associating and relating to the public they serve. The fire department is involved in numerous community activities and supports involvement with each individual city. South Davis Metro Fire needs to take earthquake preparedness with a serious approach. The State of Utah has taken this type of disaster seriously, to the extent that a state wide earthquake disaster will take place in 2012.

There is a need to create a specific earthquake plan for South Davis Metro Fire. Doing so will avoid the negligence of the department to respond to the needs of the community. Although a county wide mitigation plan has been adopted it is not a detailed response plan. South Davis Metro Fire must continue this research and devlop the needs and means to provide for their employees and their citizens. The earthquake mitigation efforts need to go to a public

format. There is a need to inform the citizens what the fire department is capable of and what them as citizens must do during a earthquake event. Urgency of this is immediate waiting for someone else to create a policy is not acceptable. With so much information from outside states regarding earthquakes, South Davis Metro Fire needs to pursue the research questions and develop a emergency response plan specific to earthquake response.

Recommendations

The problem as previously stated is that South Davis Metro Fire does not have a comprehensive earthquake response plan. The purpose of the research is to identify the earthquake areas within South Davis Metro Fire and develop a emergency response plan.

Based on the research gathered in the literature review the following recommendations are suggested to assist South Davis Metro Fire in developing a comprehensive earthquake response plan: a) The Davis County Emergency Response Plan has maps in place that show the areas at risk of earthquakes in the response area of South Davis Metro Fire, the department should publish these maps via the website and introduce a earthquake preparedness and awareness model on the department website, b) based on the reviews with other instate fire departments, there is no earthquake response plan that is specific, only general all hazards response plan, South Davis Metro Fire should recommended other in state fire chiefs participate in a earthquake response plan such as the “Windshield Survey” in the state of California, c) a committee of local and state level representatives should be created to develop a specific emergency response plan to earthquakes. This should include the state earthquake preparedness director or at least coordination between the mitigation plan and a specific

response plan, d) South Davis Metro Fire needs to develop a food and water storage plan. More research needs to be conducted with outside resources such as Hill Air Force Base as to food storage and water filtration during times of disaster. This is a critical need that cannot be forgotten, e) South Davis Metro Fire should work with local public and private organizations in regards to food and water needs, the Church of Jesus Christ of Latter Day Saints provides food, water, hygiene kits and clothing around the world in times of disaster. Regardless of any religious beliefs they are an organization that has the response capabilities and knowledge to handle this issue on a large scale event, f) South Davis Metro Fire needs to develop a stock pile of cots to provide bedding, a relationship with public and private organizations should be built to provide this need, g) conduct ongoing evaluations of the plan, once created, to ensure it remains focused and that organizations train according to the plan.

Preparing for earthquakes should be thought of as earthquake risk reduction (Orey, 2006). There are numerous areas of emergency response and planning in public safety. Public safety cannot afford to wait and react; they must react now by creating specific response plans and not an all hazard that covers every type of disaster. Each type of disaster will have similarities but in they will have even more extremes when not prepared for.

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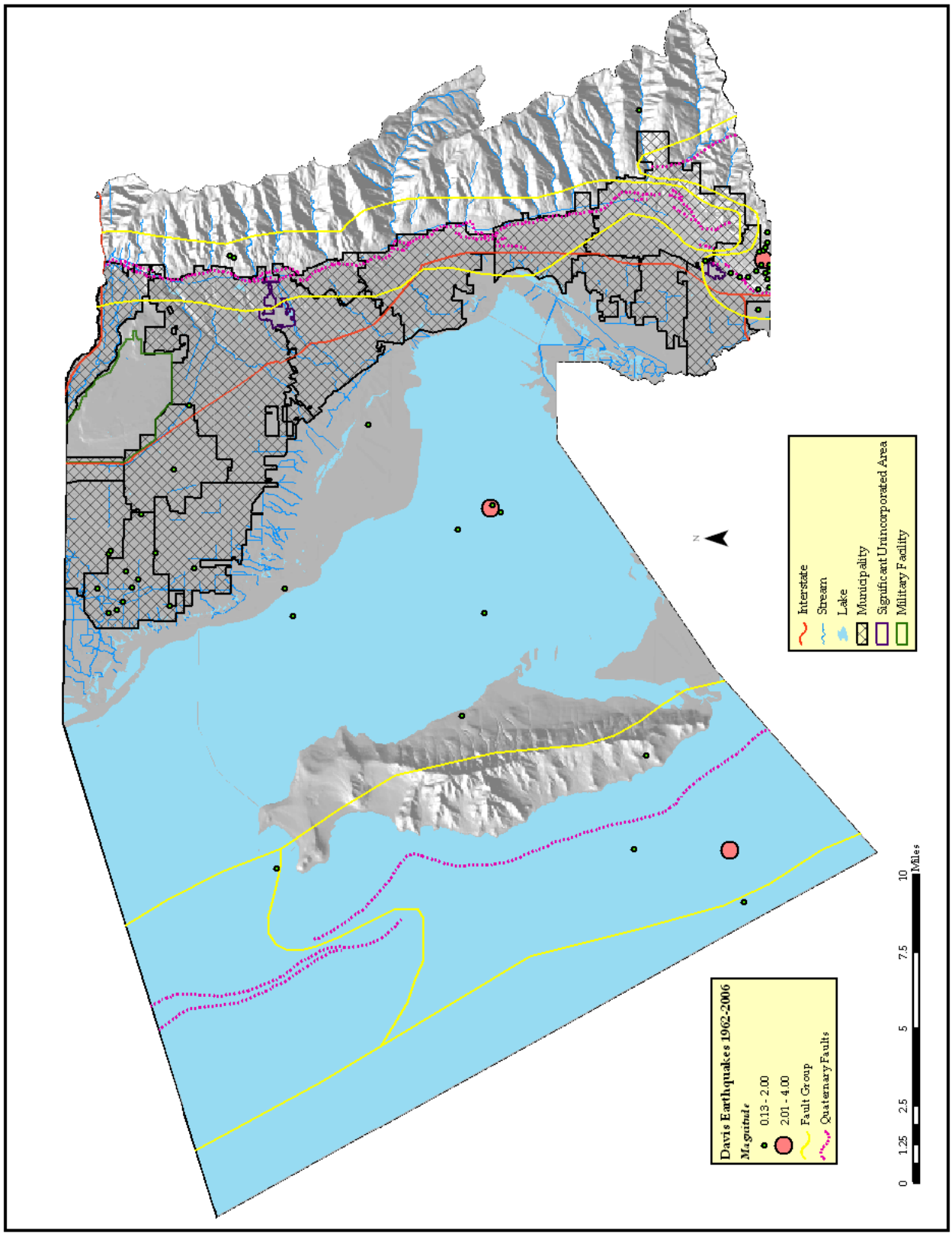
Interstate
Stream
Lake
Municipality
Significant Unincorporated Area
Military Facility
Davis Earthquakes 1962-2006
Magnitude
0.13 - 2.00
2.01 - 4.00
Fault Group
Quaternary Faults
0
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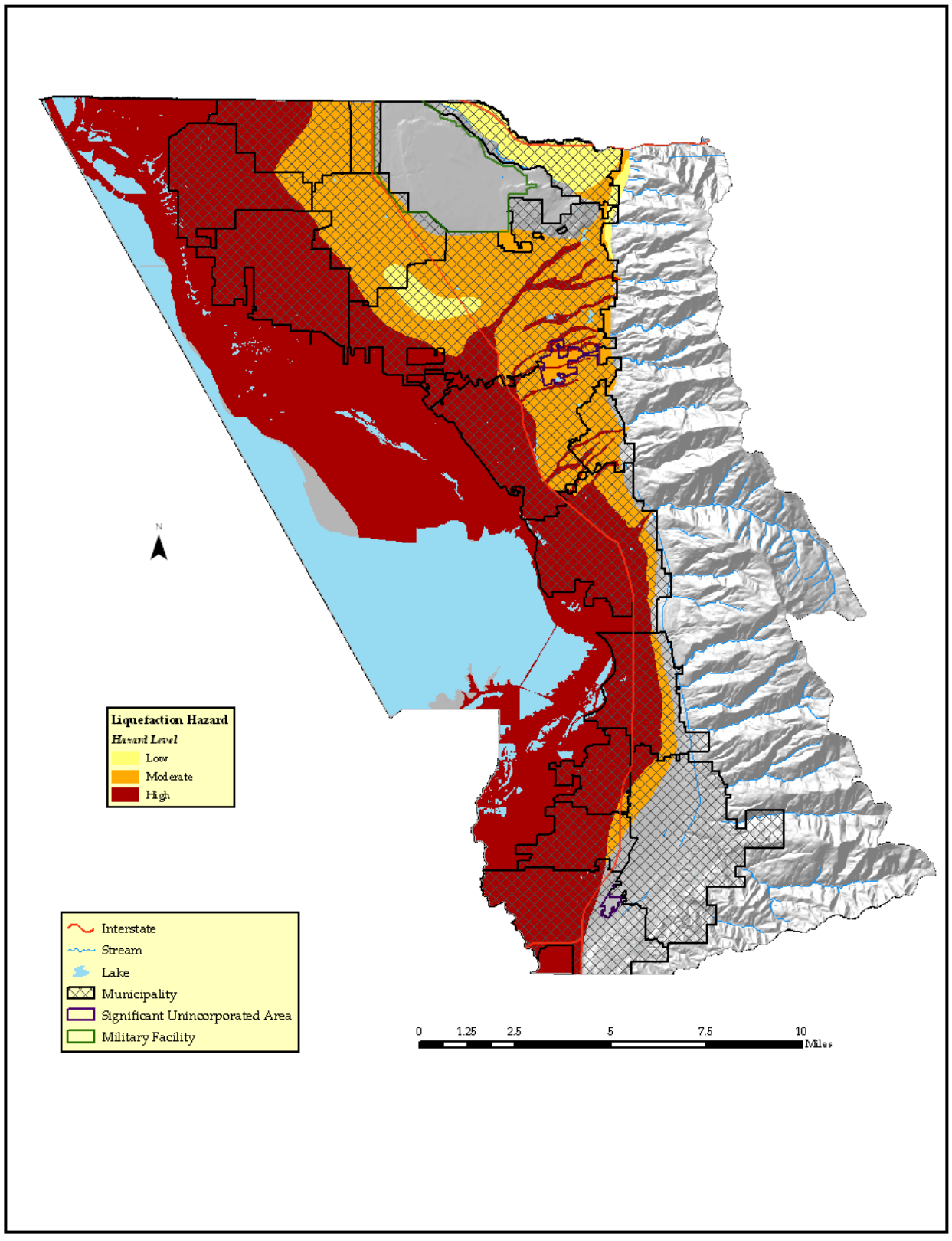
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Part IV. 2003 Mitigation Goals and Objectives Review

The 2003 Wasatch Front Pre-Disaster Mitigation Plan required each county to develop a prioritized set of mitigation goals, objectives and actions for each identified hazard. Below is a review of each of the goals and actions and a status update.

Davis County

Hazard: Earthquake

Problem Identification: Davis County is located in the heart of the Wasatch Fault between the shores of the Great Salt Lake and the foothills of the Wasatch Mountain Range. The majority of the population lives within 5 miles of the fault. The only major traffic artery running north and south, and numerous water and petroleum pipelines either cross over or run within ½ mile of the fault. Five moderately sized petroleum refineries located in the south end of the county are subject to severe damage from ground movement and liquefaction. A major earthquake in the area would result in hundreds of billions of dollars in damage to residential structures, industry, and of critical infrastructure, and likely some loss of life.

Goal #1: Reduce loss of life and limit damage to property.

Objective 1.1: Priority HIGH, Provide education on seismic hazards and mitigation, to Davis County residents and homeowners.

Action: Provide earthquake public education

Status: Accomplished. The county distributes printed materials at preparedness fairs, civic and church group meetings

Objective 1.2: Priority MEDIUM Increase quality and quantity of available natural hazards data to facilitate better decision-making.

Action: Update fault zone and liquefaction maps for the county.

Status: Not Accomplished. This action can only be accomplished should the Utah Geological Survey update the maps & data and there is no evidence that has occurred since 2003.

Problem Identification: A number of critical structures, which contain fire apparatus within the county do not meet current building criteria and could sustain considerable damage or suffer total destruction from ground shaking. These fire department buildings exist in Clinton, South Weber and Layton. Identify other at risk critical infrastructure facilities, including water distribution systems.

Goal #2: Protect emergency response capabilities and critical facilities.

Objective 2.1: Priority HIGH Provide fire department with buildings that meet current construction codes, ensuring response capability of fire apparatus and personnel after an earthquake. Identify and prioritize other critical lifeline infrastructure which are at risk, such as water collection, storage, treatment and distribution facilities. *Natural Hazard Pre-Disaster Mitigation Plan Part IV. 2003 Mitigation Goals and Objectives Review 26 Final DRAFT January 2009*

Status: Ongoing. The Layton Fire Department received a PDM Grant in 2007 to seismically upgrade station #53. The South Davis Metro Fire Department has constructed a new fire station, #85, and currently constructing another station, #82, designed to current seismic standards. The former stations were not compliant. Budget limitations have delayed Clinton, and South Weber fire station updates. The Weber Basin Water Conservancy District (WBWCD) received a FEMA grant to prepare a District wide multi-hazard mitigation Plan which will address earthquake and other hazards.