

The Recovery of Wells, Nevada from the 2008 Earthquake Disaster

by

Craig M dePolo
Nevada Bureau of Mines and Geology,
University of Nevada, Reno

2011

ABSTRACT

The successful ongoing recovery of the community of Wells from the effects of the February 21, 2008 Wells earthquake is a model for the recovery of a small town from a disaster in many ways. The success can be attributed to the attitudes and capabilities of individuals working on the recovery, in-place systems designed to support the community after the earthquake, and good media support. Whether it was rolling up their sleeves to clean up and stack bricks, filling out the nth application form for disaster relief, bringing in high-value donations for a relief-fund auction, processing the applications at the state level, helping the community decide how the relief monies were allocated, or leading the community through to the recovery process, many dedicated high-caliber individuals assisted in the recovery of Wells. People approached recovery with a “pioneering spirit”—an enduring will, commitment, and capability that carried them through to the other side of the challenge. Financial assistance was provided through earthquake insurance, state disaster funds for homeowners with major damage, small business loans for affected businesses, and state emergency funds. All of these provided some financial relief for the emergency response operation and were critical post-earthquake resources for the recovery from the Wells earthquake. Local media (principally newspapers in Wells and Elko and television stations in Elko and Salt Lake City) covered the earthquake and its aftermath very well, kept the message of recovery alive, and engaged a regional audience for over a year.

An estimate of the overall cost of the Wells earthquake is \$10,571,000; this includes the emergency response, restoration of damaged buildings, revenue losses, personal and business losses, allocated relief funds, grant and loan amounts, and anticipated repair costs for the remaining buildings. Uncertainties in this estimate include cost estimates for repairs, buildings that may be torn down and not rebuilt, and as-yet undiscovered and/or unaccounted-for damage.

The breakdown of the cost estimate and percentages of total cost are listed below:

<u>Cost Category</u>	<u>Cost</u>	<u>% of Total Cost</u>
Building damage costs	>\$7,889,000	75%
Indirect cost estimates	\$1,235,000	12%
Nonstructural damage costs	>\$496,000	>5%
Revenue losses and recovery costs	\$376,000	4%
Emergency response cost	\$300,000	3%
Content loss costs	\$275,000	3%
<hr/>		
Total Costs	>\$10,571,000	

The largest costs from the earthquake are related to repairing building damage. Adding building damage costs and nonstructural costs together accounts for 80% of the total. A large part of the indirect cost estimate is also related to building damage. The damaged buildings were older and weaker buildings that lacked seismic resistance, whereas modern buildings that were built to code survived the earthquake in structurally sound condition. This underscores the importance

of adopting and using modern building codes with seismic provisions, which are designed to incorporate seismic resistance into buildings, reducing the cost due to earthquake damages.

The principal sources of financial relief for the earthquake disaster and percentages of relief funding and total cost are listed below:

Relief Funding Source	Amount	% Relief	% Total Cost
Nevada Public Agency Insurance Pool	\$4,798,000	72%	46%
2008 Federal Omnibus Bill	\$940,000	14%	9%
Small Business Administration	\$388,000	6%	4%
General Relief Donations	\$148,000	2%	1%
Nevada Emergency Assistance Account	\$145,000	2%	1%
Nevada Homeowners Disaster Assistance	\$123,000	2%	1%
Wells Recovery Rally	\$110,000	2%	1%
Private Insurance	\$37,000	<1%	<1%
<hr/>			
Total Financial Relief	\$6,689,000		

The largest asset for covering the cost of the earthquake was earthquake insurance provided by the Nevada Public Agency Insurance Pool. Earthquake insurance accounted for 72% of the total relief funding and covered 46% of the overall cost of the earthquake. The insurance and relief funds available to date for the 2008 Wells earthquake total \$6,689,000, leaving a monetary gap of approximately \$3,882,000 between relief funding and cost of the event. Most of this will be borne by the City of Wells, private businesses, individuals, and participating agencies, which have paid out over \$1,050,000 to date. Earthquake insurance of public buildings and facilities was important to the overall recovery and should be considered by other communities located in earthquake-prone country.

It is worthwhile to note that only one business failed because of the Wells earthquake; this business was in a damaged building and could not afford to relocate. The city made restoring businesses an immediate high priority and inspected them for structural integrity in the first wave of inspections. Most businesses reopened after three days of being closed and nearly all were opened within two weeks of the event. The city was also very supportive of its citizens through the recovery effort and led the vision of recovery using tools such as community assessment and planning, local committees, and by supporting community events.

A Community Earthquake Disaster Recovery Plan is an important tool that can help foster an effective recovery. This plan can pre-identify recovery resources and issues, and detail strategies and approaches that can help make disaster recovery as rapid and efficient as possible. Many ideas for necessary and useful components of such a plan can also be gained from this review of the recovery of Wells.

INTRODUCTION

The community of Wells, Nevada, population 1,657 (City of Wells, 2009, pers. comm.) experienced a damaging magnitude 6 earthquake on the morning of February 21, 2008. Nearly half of the approximately 80 non-residential buildings in town were damaged; 10 of these severely (figure 1). Three homes were destroyed or a total loss, several had major damage, and most houses had cracks in interior and exterior walls from the shaking. The earthquake caused multiple water main breaks as well as other localized damage to infrastructure.

The Wells community, Elko County, and others responded immediately and effectively to this event and began transitioning into recovery activities by the third day after the earthquake. Like the response to the earthquake, the recovery of Wells a little over two years later has been successful, and what was lost in the community is being restored.

The Wells earthquake was declared a disaster by the City of Wells, Elko County, and the State of Nevada. It was felt the disaster could be handled “in-state” so there was no request made for a Federal Disaster Declaration. The recovery of Wells was handled by the citizens of Wells, the City of Wells, Elko County, the Nevada Public Agency Insurance Pool, Nevada state disaster assistance programs, and the Small Business Administration. The citizens and businesses of Nevada, Utah, and Idaho donated over \$100,000 in a little over a month to an earthquake relief fund set up by the local bank. About a year later, significant federal funds were allocated through legislative appropriations to the 2009 Federal Omnibus Bill to help Wells recover from the earthquake effects.



Figure 1. Bricks thrown down inside the high school gymnasium from an upper, unreinforced masonry wall that was starting to breaking up during the 2008 Wells earthquake. The high school buildings sustained \$2.48 million in damage. These buildings were restored and back in use within six months.

This paper reviews the recovery of Wells from the earthquake, including the cost of the earthquake, sources of recovery funding, reconstruction activities, and the recovery of a community from earthquakes in general. The goal is to discuss activities that contributed to the success of the recovery thus far, and provide information and guidance for other communities should they be in the same situation.

THE RECOVERY OF THE COMMUNITY OF WELLS

The recovery of Wells was complex and took a lot of human power. It involved gaining a perspective and scope of the damage, prioritizing recovery activities, many volunteers joining in and having a significant impact, dealing with the stress of the earthquake—including its aftershocks—and repairing and rebuilding the damage. There was a lot to do all at once. But with a common purpose, determination, and help from near and far, the community of Wells cleaned up, sought needed resources, and began rebuilding more earthquake-resistant structures.

Important aspects of the recovery are covered in this section. These are the building inspections; clean-up and volunteers; impact on businesses; impact and recovery of the school system; controlling access to damaged areas; media involvement; community efforts to reduce stress; rumors; and a community assessment that was useful. The costs, relief funds and loans, and some of the reconstruction are discussed in separate sections.

Building Inspections

There were about 600 safety inspections of commercial, public, and residential buildings conducted on the day of the earthquake and structural inspections of homes and buildings continued for about a month thereafter using an average of two inspectors per day. Initial inspections were conducted by task forces composed of firemen, sheriff's deputies, and forest and wildland service personnel. Most of the task forces were made up of people that lacked engineering training, so the general approach was to check on the safety of the occupants and to look for obvious damage that could be potentially dangerous.

Building inspectors volunteered from Elko County, Washoe County, the cities of Fallon, Fernley, and Sparks in Nevada, and a group of Utah engineers organized under the title "Utah Engineering Task Force." Inspectors began arriving

shortly after the earthquake and over the course of a few days to weeks checked all structures in Wells and surrounding areas, re-inspected many following large aftershocks, and placarded them with green (safe), yellow (limited entry), and red (unsafe) ATC 20-type placards. The building owners of yellow- or red-tagged buildings then systematically met with inspectors in their homes or businesses to discuss what the problem was and what was needed to fix it. The limited entry aspect was not policed—it was more of a common-sense recommendation. Many yellow-tagged houses had damaged chimneys; threatening parts of the chimneys were taken down and the fireplaces were not used until they were fixed.

Volunteers and Clean-up

Clean-up from the earthquake began immediately by residents, businesses, and emergency response personnel who were no longer needed in the response. Wells recognized its more vulnerable populations that might have difficulty cleaning up (for example, wheelchair-bound citizens) early on, made a list of these homes, and began assigning available personnel to help these people out. This initial clean-up helped people begin to come to terms with their losses and was one of the first actions of moving beyond the event. Dumpsters were placed around town for people to dispose of their debris and damaged things.

The post-earthquake volunteer efforts at Wells were extremely impressive. People spontaneously helped each other immediately. On the Saturday following the earthquake, and several Saturdays thereafter, hundreds of volunteers came to help from surrounding communities (figure 2). They met in the Latter Day Saints Church parking lot, where donated supplies had been gathered and volunteer contractors also came. Residents who needed help cleaning up indicated this by putting a white piece of paper or cloth on their car antenna or mailbox. These volunteers worked tirelessly, sometimes in harsh snowy weather. They cleaned up fallen chimneys, neatly stacked the fallen bricks, and helped cart away large broken objects for people.



Figure 2. Volunteers gathered at the local LDS Church parking lot 10 days after the earthquake to help clean up and repair earthquake damage in Wells.

More substantial needs were submitted to a volunteer interfaith group that was formed from local religious leaders. This group decided what kind of relief should be given out and how the relief funds (approximately \$258,000) should be prioritized and distributed for different needs.

Impact on Businesses

All businesses in Wells were closed on the day of the earthquake to clean up nonstructural damage and debris and to await structural inspections. A few businesses opened on the second day, such as the bank and the 4-Way Restaurant and Casino (where the entire staff worked through the night to clean the building up). Most businesses were closed for three days. Nearly all businesses were reopened within two weeks except one that was permanently lost.

There was a two-day temporary boil-water order in part of Wells related to the water main break that added a difficulty to some businesses, such as hotels reopening.

One business was lost because of the earthquake, and others lost rental monies because tenants left. The failed business, a thrift or second-hand store, was located in a damaged building in the historical district. The building was red-tagged, meaning damage was severe enough that no human occupancy could occur in it. The business was forced to relocate and failed in the process. Some businesses lost tenants who either moved out because of nonstructural damage and fear of further earthquakes, or the building they were in was closed because of damage. Other businesses might have failed had the City of Wells not placed a high priority on completing business inspections of them and helping them to get repairs done quickly (figure 3).



Figure 3. The local bar was in use by day three, but the open sign was not lit because of the yellow tag (cracking in side parapets and walls). This was an important social place for many people to gather and talk about the earthquake. Several people who hadn't been downtown in years dropped by, partly to have some company.

The amount of revenue lost because of business closures is difficult to estimate, and in some cases is offset by immediate revenues related to the response and recovery, such as hotel rooms rented to accommodate relief workers and inspectors. There were also some intermittent losses following the earthquake, such as during repairs or the six hours the power to the city had to be shut down to reset a transformer that had been moved by the shaking. Many businesses haven't made specific estimates of their revenue losses. Considering available estimates made by businesses and projecting losses for others with the help of the city manager, a total estimate of approximately \$175,000 in business revenue loss from the Wells earthquake is reasonable.

Impact and Recovery of the School System

The earthquake had a direct impact on the school system in several ways. First, the shaking damaged two buildings at the high school and shifted temporary classrooms on their stands. Second, the initial Incident Command Post and shelter were set up in the local elementary school, which closed it to regular school use and delayed the clean-up and preparation for resumption of classes. As a result, children missed four school days which were made up later; fortunately many of the

incident command and relief activities occurred over a weekend. Overall, getting children back to school was managed very well and was remarkably fast given the circumstances.

The third major impact was the complete closure of the high school for about two months, which forced the high school classes to be moved to the elementary school where temporary classrooms were set up in manufactured buildings that existed on the elementary school campus. The high school students aided in the recovery efforts by readily adapting to the changed situation, which included replacing their lockers with backpacks. Students and teachers alike experienced the mainshock and aftershocks which continued to occur throughout the rest of 2008, causing some stress and disruptions in teaching. On the positive side, the children got a life-long lesson on how to behave during a crisis situation, how to cope with significant adversity, and how to recover as a community and be stronger from the experience. The school administration, the teachers, and the community at large served as excellent, positive role models. High school graduation for 2008 went on as scheduled and was held outside on the school football field instead of in the auditorium, which was under reconstruction. Reconstruction of the high school was completed in late summer of 2008, in time for full use for the following school year. The schools were covered by earthquake insurance and the cost of the reconstruction (\$2.48 million) was paid by the Nevada Public Insurance Pool.

The earthquake was most stressful for people who were home alone at the time, including children waiting to walk to school, teachers, and other school personnel. It was noted that these individuals took the longest time to personally recover from the event and reacted the strongest to aftershock activity.

Controlling Access to Damaged Areas

Initially, damaged areas were cordoned off with police tape. In addition, deputies were posted to keep watch on the historical district area where whole blocks were taped off and the media was concentrated. The historical district contained many old, unreinforced masonry and poorly maintained buildings that collapsed, partially collapsed, or had upper wall failures from the earthquake. This was an area that naturally attracted people viewing the earthquake effects. Damaged buildings in the historical district were fenced off using chain-link fencing after about a week. Initially these fences were placed in the streets, a safe distance away from additional possible topple damage, but after the aftershocks subsided, they were moved to the edge of the sidewalks, providing full use of the street (figure 4). After the initial installation costs of \$2,700, the fencing rental was \$500 per month for Wells. After 10 months, Wells chose to purchase the fencing for a balance of \$1,300, rather than pay ongoing rental fees. Some fences have remained in place for over two years.



Figure 4. A chain-link fence surrounds the damaged historical district. A caravan of old cars was passing this day as if to pay homage to old friends.

Media Involvement

The media has been credited with being sensitive, honest, and for helping to keep information on the earthquake recovery status, service and fundraising events, and Wells community needs in front of a large, regional audience. This was important for people living in today's times, where we are commonly overwhelmed just keeping up with our current lives and workloads. People in the surrounding region gave support and resources that aided Wells' recovery; the media helped keep the situation alive in people's minds for over a year, which helped the recovery receive appropriate attention. As the recovery progresses, the recovery needs change, causing volunteers with different skill sets to be most useful. For example, the early recovery required able-bodied people. Later, a recovery rally was held that required volunteers with strategic vision, organizational skills, communication skills, solicitation-of-donation-item skills, and so forth. Later in recovery, reconstruction skills become dominant. If potential regional volunteers are kept aware of what is going on in an affected community, they will more easily know that their skill set is needed and rise to the occasion, making recovery more efficient.

Community Efforts to Reduce Stress

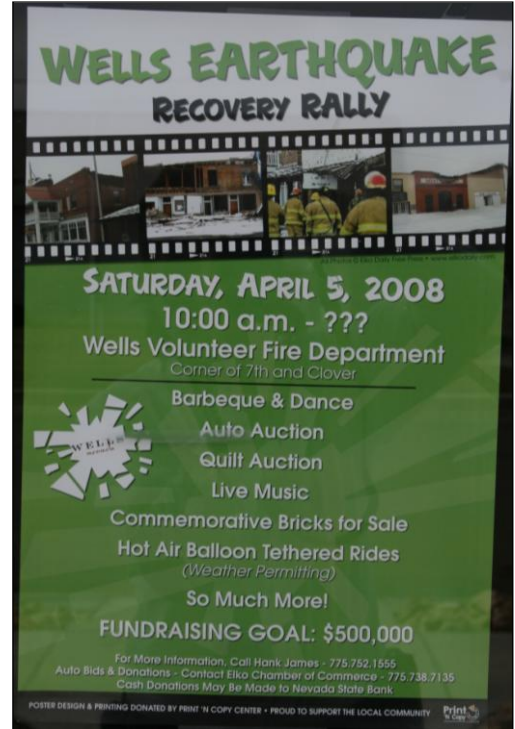
The City of Wells paid a lot of attention to its citizens and how they were recovering, and hosted or co-sponsored a series of milestone events to address people's needs. Early activities included supplying dumpsters at several locations around town for people to dispose of their damaged items; this helped get damaged materials out of sight and helped people clean up faster. Milestone events included the Wells Recovery Rally, re-establishing the streets in the historical district, continuation of annual city celebrations, and a safety fair on the anniversary of the earthquake.

The Wells Recovery Rally was a clear turning point for the community where they could get out, enjoy a meal with each other, and collectively relax; lots of out-of-town friends came to visit and free bus service to the nearest community, Elko, was donated. The Wells Recovery Rally was an event held at the Wells Volunteer Fire Department on April 5 (43 days after the event) that included an auction, food, music, and other activities and sales, all geared towards raising money for the Wells Earthquake Relief Fund (figures 5, 6, 7, and 8). There was direct participation of surrounding communities in the recovery of Wells, and it gave the Wells folks a chance to say thank you. The rally also represented a distinct landmark for the people of Wells in moving on from the earthquake with their lives. People did what they could to support the event; they donated calves, horses, a goat, cars, vacations, paintings, reclining chairs, quilts, oak filing cabinets, and many other items. Donations came from individuals and local and regional businesses. Other services including the cooking of a huge meal and hot-air balloon rides (that couldn't take off because of the wind, but the flame blasts into the air from the baskets helped warm the crowd and wowed the kids). There was food, music by a local band, Wells earthquake T-shirts ("I Survived the Wells Earthquake"), and souvenir bricks from damaged buildings that were painted with the earthquake date by the local Boy Scouts, all for sale or for a donation. Sharing an event, a meal, and working towards a common goal that helped people affected by the earthquake created a positive feeling that could be projected forward. Because of frequent aftershocks and potential topple failure, chain-link fences were placed in the streets around damaged buildings in old town. After the aftershocks subsided, the fences were moved up to the sidewalks and the roads were reopened; the city manager noted that this was a major step towards normalcy because people had their streets back.

The annual *Wells Fun Run*, an event that features exhibiting classic cars, music, and a main street dance, went on as scheduled in late July. This offered people a major activity that was unrelated to the earthquake to enjoy; again this is evidence of, and support for, returning to normalcy.

On the first anniversary of the earthquake, Wells held a safety fair in the newly reconstructed Wells High School gymnasium. This gave people a chance to see the recovery of Wells via the reconstructed gym and to get preparedness information for natural hazards. Several local organizations and the University of Nevada, Reno participated in this event. Unused recovery supplies were sold to add money to the recovery fund.

Aftershocks were an impediment to recovery, both because of the continuing fear they caused and because of the possibility of further damage. Aftershocks occurred fairly frequently for about a year and a half, and tapered off after that. The larger aftershocks, swarms of aftershocks, and nighttime aftershocks that interrupt sleep had the greatest effects on making people anxious about earthquakes and fearful of having another damaging one. About six families moved away from Wells because of the effects of the damaging earthquake and the stress from aftershocks.



Figures 5, 6, 7, 8. Views from the Wells Recovery Rally. \$110,000 in relief money was raised by this event. Classic car clubs that participate in the annual Wells Fun Run event came to show their support.

Rumors

Rumors were a persistent problem throughout both response and recovery activities. Widespread rumors that cause undue anxiety in people should be corrected quickly and effectively.

One major rumor that surfaced early in the Wells earthquake was the prediction of an imminent larger earthquake that was going to strike Wells soon. This rumor began on the second day and was basically an embellishment of the expression of the probability of a larger earthquake occurring following an event, which was then propagated by the media. The problem was that the imminent earthquake rumor caused undue anxiety in the public and made emergency response personnel nervous and uncertain if they should make contingency plans in the middle of an emergency response. This rumor was countered by an on-site state scientist reporting to emergency commanders that the “imminent” prediction was unfounded and parallel statements to the media by Nevada Seismological Laboratory personnel.

There was also a rumor that the federal government did not care about the Wells disaster, in a similar or even lesser manner as the federal under-response to the recent Hurricane Katrina disaster. This criticism, principally of the Federal Emergency Management Agency (FEMA) was unfair. This was reinforced by the fact that the State of Nevada did not request a Federal Disaster Declaration from the federal government. Without a request from the state, the federal government cannot get involved in the situation directly; it is basically “not invited to help.” Yet there were a lot of local misunderstandings and feelings that FEMA didn’t care about helping Wells. “No Feds, No Problem” was a commonly heard comment made by several local citizens. In fact, FEMA did quickly respond to the State’s request to conduct a “Joint Preliminary Damage Assessment,” and ultimately the federal government helped Wells with about \$1 million of emergency response assistance by federal employees and relief funding in the 2009 Federal Omnibus Bill. But the rumor persisted. It is rare not to see ways that responses could have been better in hindsight, but we have to clearly acknowledge the truth if we are going to make the most effective enhancements to response and handle disasters well. There are times, such as major disasters, when we will need our federal partners and false rumors like this can make this partnership, and the trust involved, harder to obtain.

The “triangle-of-life” statement began to be distributed by clergy in the week following the earthquake. This statement advocates that people find safety triangles that will become uncollapsed pockets in which to survive after a building collapses from an earthquake. Nevada instead advocates a “Drop, Cover, and Hold on” response, where an individual ducks under sturdy furniture, or the like, to protect themselves from falling nonstructural items, trusting that the entire building is not going to collapse; the United States generally uses modern building codes and construction techniques that help prevent earthquake collapse. No specific attempt was made to counter the triangle-of-life rumor in this case, mostly because aftershocks were dying down and it wasn’t perceived to be a widespread issue.

Community Assessment

A community assessment for planning purposes had been scheduled for Wells prior to the earthquake. This was sponsored by the Nevada Commission on Economic Development. Rather than cancel the assessment because of the large workload of the earthquake recovery, the city continued forward with it. The community assessment gave Wells “an opportunity to come back together and look into the future,” as the Wells City Manager put it. For example, the citizens and leaders had a forum to discuss the future of the damaged historical district, and how this was impacted, or shaped, by the earthquake. Wells personnel recommend a similar activity for other communities that have had a lot of damage because it not only puts recovery into a strategy and format that makes it easier to find additional sources of funding, but it also helps the community think about reconstructing for future needs as well.

Recovery Status

Wells is a stronger community today because of the earthquake. This is evidence that they seized the “opportunity side” of the disaster. Some of their most important public gathering buildings have significantly more seismic resistance now than they did before the earthquake. The city facilities will be seismically safer when they are completed. Wells has an experienced awareness of how to execute an emergency response to a disaster, and is better prepared because of investments in an emergency radio system and more detailed response plans that include earthquake disasters. It is reported that there is a stronger sense of community now in Wells, partly evidenced by increased participation in the city’s committees, such as the beautification committee and the economic development committee. It is perhaps not surprising that Wells is keenly aware of the importance of making buildings and infrastructure safer from earthquakes since the 2008 event, but it still took leadership and commitment by the mayor and other local community leaders to take earthquake safety to heart and spend the resources to accomplish it.

THE COST OF THE WELLS EARTHQUAKE

There is not a perfect and definitive way to estimate the total cost of the Wells earthquake because not all earthquake losses were reported, not all costs are tracked, some costs are being kept private (they are considered personal information or people are embarrassed by them), and some costs have not yet been discovered. In order to estimate the total cost of the earthquake, known costs were combined with indirect cost estimates, such as relief fund amounts, and some approximations, such as personal content losses, the costs of building damage that hasn't been repaired, and the replacement value of buildings that have not been demolished yet. This section will review the costs of the Wells earthquake in categories of emergency response, building damage, nonstructural damage, content losses, revenue losses and recovery costs, and other indirect costs.

Emergency Response Costs

The first direct cost of the earthquake was the emergency response. The City of Wells tabulated up the cost of the activities related to the emergency response to be approximately \$252,000. There was additional response by Elko County agencies, the Nevada Department of Transportation, the Nevada Division of Emergency Management, the Bureau of Land Management and other agencies that additionally contributed an estimated \$50,000. This makes the total estimated cost of the response approximately \$300,000.

The emergency response costs included incident command personnel, meals for volunteers, communication equipment, emergency supplies, landfill fees, and repair of water main breaks. Many of the individual activity costs are not large, but collectively it is a bill that could easily cause a small community a great deal of financial stress. Of the \$252,000 documented costs for the City's emergency response, the State of Nevada Emergency Assistance Account reimbursed \$145,000 (approximately 58% of the non-federal cost). Some other costs, such as some of the engineering inspections of insured buildings, were covered by the Nevada Public Insurance Pool.

Building Damage Costs

Most of the direct cost was from damage to buildings and houses (table 1). This estimate includes the repair of structural damage, nonstructural damage, and reconstruction support costs. The cost to fix and partially rehabilitate two connected high school buildings (gymnasium and auditorium) was \$2.478 million dollars (Nevada Public Agency Insurance Pool, 2010, pers. comm.). There was a similar large investment of almost a million dollars in the Church of Jesus Christ of Latter Day Saints, which was damaged by the earthquake, repaired, and seismically rehabilitated during reconstruction. Because there was additional rehabilitation work done to the building, the cost to just "fix" the earthquake damage is estimated to be at least a third of the total, or about \$300,000.

The two largest, partially damaged buildings that are left to fix are the El Rancho and the Nevada Hotels. It is uncertain what will happen to these buildings; they are fenced off for the time being and the El Rancho is covered with plastic to protect it from the weather. If the earthquake damage to these partially collapsed buildings were fixed it would likely cost at least \$800,000 in the El Rancho and at least \$500,000 for the Nevada Hotel. Repair of extensive damage to the Bullshead Bar and the Wells Chalet will cost at least \$250,000 each, if they are rebuilt. There are seven additional buildings in the historical district with moderate damage that will require at least \$80,000 each to repair. The repair of earthquake damage to insured public buildings and water facilities owned by the City of Wells and related costs are reported by the Nevada Public Agency Insurance Pool to be \$2.24 million.

Additional damage costs were indirectly estimated using disaster assistance and loan amounts. The Nevada Homeowners Disaster Assistance program paid out \$123,000 for home damage, including helping with the replacement of three totally destroyed homes. Smaller types of damage, such as parapet damage requiring a new roof for the local bar, were supported by loans from the Small Business Administration (SBA). The SBA awarded \$388,000 in home and small business loans for damaged facilities in Wells and this was another indirect cost estimate.

The total direct and indirect building damage costs were >\$7,889,000. Part of this cost includes nonstructural repairs to buildings in addition to the structural reconstruction. This was impossible to separate out with the data at hand. Many of the projected estimates are likely low and other building damage likely exists that was not found by this study.

Nonstructural Damage Costs

Nonstructural damage costs could only be partially estimated and were far more extensive than tabulated – so the cost estimate is a bare minimum. But the individual nonstructural costs that occurred are illustrative of what can happen from a strong earthquake. These costs are from damage to chimneys, ceiling systems, electrical systems, nonstructural building elements like infill walls, and shifted tanks that needed to be reset. The specific nonstructural damage costs are reported in table 1.

Significant nonstructural damage from the Wells earthquake ranges from about \$22,000 to \$50,000 for most individual businesses and buildings. The largest costs were to buildings with multiple functions, large amounts of equipment, or large contents, such as slot machines; the costs for repair were in the \$100,000 to \$200,000 range, but in these cases the content loss was included in overall loss estimates; content loss for these was likely on the order of tens of thousands of dollars. An indirect cost of \$17,000 for Elko County buildings was reported by the Nevada Public Agency Insurance Pool and gives a perspective of the lower levels of nonstructural damage. Elko County's buildings, such as the maintenance building, had cracks in external walls which were cleaned out, new grout was put in, and the buildings were repainted. An estimate of \$20,000 damage for four additional buildings was added to cover other damaged buildings with unknown repair costs.

The nonstructural damage estimate that could be tabulated was \$469,000; this estimate significantly underestimates the total value because nonstructural damage was more widespread than tabulated, and there was a large amount of nonstructural repair included in the building damage costs (above) that could not be separated out.

Content Losses

Content losses were more numerous and were wider spread than nonstructural damage. Thus, the content loss costs tabulated in table 1 are likely also underestimated. They give an important perspective on what content losses to a major earthquake could be, however. Content losses available for three businesses ranged from \$10,000 to \$50,000 each. These were the largest content losses in Wells. The rest of the houses and businesses had between virtually no content loss (contents may have been displaced but they were not broken) and several thousands of dollars of loss, commonly because valuable objects were broken. A general estimate of \$500 per house or business for 350 estimated locations was made to try to cover unaccounted for content losses or a total estimate would not have been possible. Making these assumptions, a total content-loss estimate of >\$275,000 was made.

Revenue Losses and Recovery Costs

Revenue losses and recovery costs were combined and totaled. Revenue losses were estimated in consultation with the Wells city manager. A couple of businesses were able to resume business on the day after the earthquake in a limited capacity, but most businesses were closed at least three business days. A few businesses in buildings with nonstructural damage, took as much as two weeks to resume business operations. Most businesses lost at least several thousand dollars to tens of thousands of dollars in revenues. A total estimate of business revenue loss from the Wells earthquake is \$175,000. Wells Propane estimated that they had \$70,000 of minor nonstructural damage, inspections of propane units, and repair of two broken gas pipe lines in manufactured homes; this was imperfectly placed in this category as a recovery cost. One of the largest non-construction recovery activity costs was the public adjuster hired by the city, which cost \$131,000. The total cost of estimated revenue losses and recovery costs is \$376,000.

Other Indirect Cost Estimates

Other costs were covered by donations, federal appropriations, and private insurance. These serve as other indirect cost estimates from the earthquake. Donations to the Wells Earthquake Relief Fund and to the Wells Recovery Rally totaled about \$258,000; these funds were used to help people repair or replace damaged chimneys, windows, and houses. \$940,000 of additional reconstruction and recovery funds for the city were appropriated to the 2009 Federal Omnibus Bill by a Nevada U.S. Senator and a Nevada U.S. Congressman. A private insurance payment of \$37,000 is also added to this group because it indirectly covers a portion of the loss of a house. The total for these indirect cost estimates was \$1,235,000.

Table 1. Costs of the 2008 Wells Earthquake

Emergency Response about **\$300,000**

Building Damage Costs

Direct Cost Estimates

High School gymnasium/auditorium	\$2,478,000
LDS Church	>\$300,000
El Rancho	\$800,000
Nevada Hotel	\$500,000
Bullshead Bar	\$250,000
Wells Chalet	\$250,000
Seven other buildings (\$80,000 ea.)	\$560,000
City of Wells buildings and water	\$2,240,000

Indirect Cost Estimates

Nevada Homeowners Disaster Assist.	\$123,000
Small Business Administration Loans	\$388,000

Total **>\$7,889,000**

(Italicized numbers were projected, not borne)

Nonstructural Damage Costs

4-Way Casino (damage + contents)	\$100,000	
Flying J (damage + contents)	\$197,000	
Stuart Grocery	\$50,000	
Wells Rural Electric	\$30,000	
Bonneville Transloader	\$22,000	(plus renter loss of \$1,500/mo.)
Four buildings \$20,000 damage ea.	\$80,000	
Elko County insurance claims	\$17,000	(\$60,000 regionally)

Total **>\$496,000***

(Italicized numbers were estimated)

* This is an underestimate because there was some nonstructural damage repair that occurred with the structural repairs and nonstructural damage occurred in other buildings for which information was not available.

Content Losses from the Earthquake

350 homes and businesses w/ \$500 ea.	\$175,000
Stuart Grocery	\$50,000
Hardware Store	\$30,000
Great Basin Beverage Dist.	\$10,000
Two cars @ \$5,000 ea	\$10,000
<hr/>	
Total	\$275,000

(Italicized numbers were estimated)

Revenue Losses and Recovery Costs

Loss of business revenues estimate	\$175,000
Wells Propane (inspection costs +?)	\$70,000
Public adjuster cost (City of Wells)	\$131,000
<hr/>	
Total	\$376,000

(Italicized numbers were estimated)

Other Indirect Cost Estimates

Donations (relief fund, recovery rally)	\$258,000
2009 Federal Omnibus Bill	\$940,000
Private earthquake insurance	\$37,000
<hr/>	
Total	\$1,235,000

Total Cost of the 2008 Wells Earthquake

Emergency response	\$300,000
Building damage costs	>\$7,889,000
Nonstructural damage costs	>\$496,000
Content loss costs	\$275,000
Revenue losses and recovery costs	\$376,000
Other indirect cost estimates	\$1,235,000
<hr/>	

Total Cost >\$10,571,000

The total cost of the Wells earthquake, >\$10,571,000 is likely within 5% of the actual cost. The cost estimate is considered a minimum estimate because of unaccounted for damage and costs that are still being incurred. Nevertheless, the largest costs are captured and the total cost is likely not over \$11 million. By far the largest costs were for the building damage and associated costs, which were >\$7,889,000, or 75% of the total cost. When nonstructural damage costs are added to this, it accounts for 80% of the total cost. Buildings and nonstructural elements can be made to be more seismically resistant by building in accordance with the seismic provisions of modern building codes. Thus, adoption of building codes by communities is a major strategy for lowering the cost from earthquakes.

Cost of the Damage to Utility Systems

The cost of the earthquake damage to the utility systems was approximated independently. These estimates should be considered as minimum values, however, because not all costs were kept or reported. For example, the damage to the grocery store’s electrical system which shorted and smoked during the earthquake is lumped into a general loss estimate for the store, and could not be broken out.

The water system had the most severe impacts from the mainshock and a major aftershock. Damage included a broken water main that needed to be repaired immediately and a small “elephants foot” formed in one large water tank (this is a small bulge in side of the tank on the bottom caused when the weight of the tank was shifted onto that side by the shaking). It was also noted that there were many more water breaks during 2008 in town than usual and that many of these were likely damage from the earthquake, but could not be directly attributed to it. The cost of the damage to the water system, \$111,000, is estimated from the costs covered by the insurance pool for the system. The gas system (propane tanks) was mostly unaffected, but there were costs associated with emergency response; inspecting the entire system, fixing broken gas lines inside two manufactured homes, and nonstructural damage to the headquarters office. The electrical system also was largely unaffected by the earthquake and electricity stayed on, but a large transformer shifted and had to be reset, and there was significant nonstructural damage at the headquarters office; nonstructural damage to the tile ceiling systems accounted for most of the \$30,000 cost. The loss of revenue from the power shut-down while the transformer was reset was not available.

The minimum cost estimate for utilities from the earthquake was >\$211,000 (see table 2).

Table 2. Utility System Damage Costs

Water system	>\$111,000
Gas system	\$70,000
Electrical system	>\$30,000
Sewer system	?
Total	>\$211,000

RECOVERY AND RELIEF FUNDING FOR THE EARTHQUAKE

With a disaster, there is a loss to a community and part of the recovery can be thought of as the replacement of that loss. Without a Federal Disaster Declaration the community had to seek several lines of relief to help with the response and recovery costs. The costs of the Wells earthquake are greater than \$10 million. Earthquake insurance, relief funds, disaster grants, and disaster loans total almost \$6.7 million, or 65% of the total estimated cost, to date. Several of the sources of relief funding are listed in table 3 and are further described below.

Table 3. Relief Funds/ Disaster Assistance Grants and Loans/ Earthquake Insurance Payments

Nevada Emergency Assistance Account	\$145,000
Nevada Homeowners Disaster Assist.	\$123,000
Small Business Administration Loans	\$388,000
Donations (relief fund, recovery rally)	\$258,000
2009 Federal Omnibus Bill (approp.)	\$940,000
Nevada Public Agency Insurance Pool	\$4,798,000
Private Earthquake Insurance	\$37,000
Total	\$6,689,000

The Wells Earthquake Relief Fund

The Wells earthquake and its effects were seen and felt by all Nevadans and the adjoining states of Utah and Idaho. Many wanted to help, but only could do so monetarily (which is a lot of help it turns out). In response the Wells Earthquake Relief Fund was set up by the Nevada State Bank (the local bank in town). Over \$100,000 was donated to the Wells Earthquake Relief Fund within the first two months and a total of \$148,000 was ultimately donated to this fund.

These funds and other relief funds were administered by the interfaith committee set up for this purpose. The committee took in requests for help from Wells residents and businesses and parceled the funds out to the most needed projects. Nearly all of these funds were allocated within the first year.

Wells Recovery Rally

The Wells Recovery Rally, described in an earlier section, was an all volunteer event that took donations from individuals and businesses from Wells and the surrounding region and parlayed these into a group of fund-raising events, including an auction and meal. The rally brought in about \$110,000 of relief money.

Nevada Public Agency Insurance Pool

Wells lies in one of the “nominally” lowest earthquake hazard parts of Nevada (c.f., Anderson, this volume; Petersen and others, this volume), but nevertheless the City of Wells, the Elko County School District, and Elko County all had earthquake insurance for their buildings. This is partly because there is a strong advocate at the Nevada Public Agency Insurance Pool who has promoted earthquake insurance for public governments and agencies throughout the state.

A total of \$4.798 million was paid out for 30 insured structures that were damaged from the earthquake by the Nevada Public Agency Insurance Pool (2010, pers. comm.). This included the high school gymnasium and auditorium; City Hall (an unreinforced masonry building – URM); the Public Works building (URM); the pool facility; and a water tank. The cost of repair covered by the insurance pool for the Elko County School District was \$2,478,000; cost for the City of Wells was \$2,240,000 (five locations with major damage and 27 locations with minor damage); cost for Elko County facilities in Wells was \$17,000; and cost for a McDermitt school (cosmetic damage) was \$56,000. A school in Jackpot also had \$3,800 of insured damage that was cosmetic.

The earthquake insurance helped Wells get their high school back in good working order by the next school year so it could be fully used. The insurance helped the City of Wells weather the financial impacts of the earthquake and to reconstruct in a manner that was more resilient to future earthquakes by combining the insurance monies with other monies for new facilities and getting out of URM buildings.

A public adjuster was hired by the City of Wells to help provide an independent assessment of damage for developing the insurance claim. The adjuster lobbied the city council for the job promising to get more money out of the insurance pool. The adjuster’s fee was 8% of insurance monies paid to the city. The financial incentive of the fee setting combined with the inexperience of working with earthquakes by most of the parties involved, initial underestimates of damage costs by the insurance pool, and significant amounts of hidden damage caused the relationship between the adjuster and the insurance pool to become contentious and negotiations became protracted causing delays of resolution; it took two years for the final negotiations on the city buildings and facilities. The situation was also complicated because the city wanted to combine monies and build new buildings rather than continue to operate in reconstructed, but seismically vulnerable, URM buildings. Nevertheless, a good resolution appears to have been reached and the city is moving forward with new facilities. The final adjustment was substantially larger than the initial estimates by the insurance pool (almost twice as much), but this could have been resolved in a faster and less contentious manner. A flat rate for work performed by the adjuster rather than percentage of monies paid out might help shorten this delay. Some time is required for these negotiations, however, because the assessment is an evolving situation when things like hidden damage are found.

Private Earthquake Insurance

As of this writing, only one home in Wells is known to have had earthquake insurance coverage; it was one of the three homes that were destroyed. In this case, the insurance company paid off the existing mortgage for the home, \$37,000. No businesses in Wells had earthquake insurance, although some are now contemplating getting it. In at least one case, obtaining earthquake insurance to cover a company was talked about post-event, but the damage sustained from the 2008 earthquake versus the insurance cost was not enough to be worth it (they could afford to take those same losses again rather than having an insurance policy; of course there is no guarantee that the next earthquake won’t be more severe). Some businesses are contemplating buying earthquake insurance but they are fearful that the recent Wells earthquake will cause the cost of local insurance to become too expensive. There were some successful rental insurance claims for damage contents, but these were apparently limited in number.

Nevada Homeowners Disaster Assistance

The Nevada State Homeowners Disaster Assistance is a state program that was created to help homeowners in times of disaster and property loss. The program supplies individual grants to homeowners based on the Federal Individual and Household Program rates, which changes annually with the Consumer Price Index. In 2008, there was up to \$28,000 available per homeowner to help rebuild damaged homes. The application period for homeowners from the Wells earthquake was from March to May 12, 2008. There were 10 original applications, of which 5 were approved for a total of \$127,122. Four of these applications were for the full \$28,000. Applicants returned \$3,807 because their repairs were less than their original estimate; thus, the final amount the State paid out from this program was \$123,315. The applicants that did not receive funding either stopped pursuing funding, or were denied because insurance was paying for the expenses requested.

Nevada Emergency Assistance Account

The State of Nevada was able to reimburse the City of Wells for \$145,000 of documented costs for the emergency response associated with the earthquake. This was nearly half of the cost of the response. This emergency assistance account significantly helps smaller communities with the relatively high costs of an emergency response to a disaster. Similar state accounts or financial help from FEMA for emergency response are important so the cost of the earthquake disaster response doesn't impede a community's efforts to recover.

Small Business Administration

The Small Business Administration (SBA) provided loans for residential and business reconstruction from the earthquake. The SBA set up a temporary office in Wells for a little over a month following the earthquake and designated the incident "Disaster Declaration #11180." Disaster loans were being offered at interest rates of 2.75% for home damage and 4% for business damage. Twenty-five applications were submitted. The SBA awarded eight loans for a total of \$388,100; \$143,200 in residential loans and \$244,900 in commercial loans. Applications that were not awarded did not fully qualify or applicants found other financial aid during the review period.

No Federal Disaster Declaration Request

The State of Nevada declared a State Disaster for the Wells earthquake, but decided not to forward a request for a disaster declaration from the Federal Government. The decision was made after reviewing preliminary damage assessments, reviewing local, county, and state assets, and consultation with the Federal Emergency Management Agency. There were several factors considered in this decision, including the estimated damage costs, the ability for the local government and the state to conduct appropriate response, recovery, and mitigation programs needed to handle the disaster, and the resiliency of the communities affected.

Damage costs from the earthquake were rapidly assessed by a state assessment team on the second and third days following the event to determine whether the disaster could qualify for a Presidential Disaster Declaration and federal disaster assistance. The initial assessment showed there was not enough allowable damage to qualify. The damage dollar threshold for Federal disaster assistance to Nevada in 2008 took the 2000 census number for the state of 1,998,257 people and multiplied it by the "Statewide Per Capita Impact" of \$1.24 (Nevada state threshold) to get a damage-cost threshold for assistance of \$2,477,839. The damage-cost estimate is limited to public and government facilities and does not include insured damage. The number of homes damaged and the severity of their damage was considered. The largest costs in Wells were insured losses. The non-insured public and private damage assessment cost estimate for the earthquake was \$778,600, far below the approximately \$2.5 million Federal assistance threshold for Nevada. Current damage estimates change these numbers, but not the conclusion that the non-insured damage value is below the threshold; the largest increases in cost estimates with time have been to the insured properties.

After considering all factors, Nevada decided the disaster could be handled "in-state" and did not forward a request to the federal government for assistance. Given that the emergency response was successful, the recovery of Wells is going to be similarly successful, and 64% of the earthquake costs are being covered by relief funds and loans, it appears this was a reasonable assessment by Nevada. What might be considered in the future is that a sub-threshold request might not get a Presidential declaration, but may be enough to allow FEMA to assist with some resources for the disaster anyway; this is partly because some of the resources used for the Wells recovery are no longer available because of the recent downturn in the economy.

2009 Federal Omnibus Bill

Nevada's federal legislators helped Wells in the recovery effort by adding a total appropriation of \$940,000 to the 2009 Federal Omnibus Bill. After consulting with the town about how much relief aid they needed for recovery from the earthquake, Nevada U.S. Senator Reid and Nevada U.S. Representative Heller each added a relief appropriation to their respective bills.

Private Funding

Many of the minor repairs needed for buildings were covered by owners as out-of-pocket expenses. In the case of the Wells Ward Church of Jesus Christ of the Latter Day Saints (LDS), not only were earthquake damage repairs made, but the LDS Church decided to rehabilitate the building to give it more earthquake resistance as well. Buildings such as churches can house large numbers of people at times making them high-risk structures and this rehabilitation should help protect these people should another earthquake occur. This is an example of a privately funded seismic rehabilitation during the recovery effort and was completed within a year of the earthquake.

Summation

The overall recovery of Wells has gone reasonably well aided by several sources of relief funding that helped Wells despite not having a Presidential Disaster Declaration. To date, the community of Wells has received a total of 64% relief funding for the currently known and estimated costs of the earthquake, leaving about a \$3.8 million funding gap, or permanent loss, to the community (table 4). Over a million dollars of this gap to date has been borne by the City of Wells, businesses, and individuals, but the rest awaits resolution. Other funding opportunities, such as historical preservation funds, may still be possible.

Table 4. Cost and Relief Fund Totals for the 2008 Wells Earthquake

Total Cost of the Wells Earthquake	>\$10,571,000
Insurance and Relief Funds (64%)	\$6,689,000
Earthquake Costs Not Covered (36%) (borne by the community)	>\$3,775,000

Similar losses to other Nevada communities are anticipated from future earthquakes. Ways to reduce this large financial loss are to have earthquake-resistant communities with mitigated potential hazards to limit damage and by increasing the amount of earthquake insurance coverage in a community; earthquake insurance covered 46% of the total estimated losses of the Wells earthquake.

STABILIZATION AND RECONSTRUCTION OF EARTHQUAKE DAMAGE

Wells has been doing post-earthquake reconstruction in phases. Phase one focused on the schools and businesses. The emphasis of the second phase was on people's houses and stabilizing living arrangements, such as moving displaced people out of hotels and into rental homes. The third phase focused on government buildings with an emphasis on upgrading city buildings and getting city workers out of unreinforced masonry buildings; this effort is ongoing. Lastly, some of the damaged private buildings in the historical district are being targeted for demolition, rehabilitation, or reconstruction, some of which has already taken place. Two of the historical buildings have been temporarily covered with plastic to prevent further weather damage through breaks and holes.

Several buildings damaged from the earthquake have undergone, or are undergoing, stabilization, reconstruction, and seismic rehabilitation (figures 9–28). The largest project thus far has been the reconstruction and rehabilitation of the Wells High School gymnasium and auditorium building which had significant damage from the shaking (Trabert, this volume). This building required \$2.478 million worth of work that needed to be completed by the beginning of the 2008/2009 school year (about 6 months). This was mostly achieved and the building was indeed ready for use by the beginning of the school year, despite surprise findings of hidden damage (figures 13–15). Earthquake damage was repaired in an up-to-code fashion, but only those elements that were damaged were repaired. Thus, the building has been partially seismically strengthened.

The Church of Jesus Christ of the Latter Day Saints not only repaired the earthquake damage to the Wells Ward Church, but seismically rehabilitated the building as well as part of a program it has to seismically rehabilitate churches throughout the west (figures 16–18). The Wells Ward Church includes a gymnasium and chapel that at times have significant numbers of people inside; the increased seismic resistance in the buildings decreases the overall risk of earthquake harm to these people. This building did have some substandard construction that was exposed by the earthquake damage and was subsequently upgraded, so this was a particularly wise decision.

One roof was replaced on a building along main street (Luther’s Bar); the roof was not connected to the building, shifted during the earthquake, and had to be rebuilt; the parapet of this structure also had cracking damage. In other buildings, broken walls were removed and/or rebuilt. One building’s brick veneer that had partially fallen was fully taken down, and the wall was refinished and painted (figures 19–21). At least one parapet/ brick main street store-fronting had tilted outwards a little from the earthquake; this fronting was subsequently anchored to the structure.

All three of the damaged homes have been replaced at the time of this writing using donated relief monies and the Nevada’s Homeowners Disaster Assistance program (figures 26–28). The homes were demolished and taken away; new foundations were poured, and the original structures were replaced by manufactured homes.

Several unrepaired buildings have been protected from further weather damage with the use of large tarps (figures 29–30). This was done mostly the day of the earthquake and/or prior to the 2008/2009 winter. Holes and cracks in roofs and walls have caused many leaks from precipitation, further damaging the interior of the buildings.

Stabilization of nonstructural elements began immediately once the response phase was over (figure 22) and continued until all threatening damaged objects were brought down, stabilized, or were fenced off (e.g., figures 31 and 32).



Figure 9. The earthquake-damaged chimney of the Wells High School auditorium.



Figure 10. Careful demolition of the chimney that began the day after the earthquake.



Figure 11. More of the careful demolition work on the chimney the day after the earthquake).



Figure 12. The chimney nearly entirely taken down to its damaged level.



Figure 13. Reconstruction of the rear wall of the high school gymnasium.



Figure 14. Close-up of the reconstruction of the rear wall of the high school gymnasium.



Figure 15. Completed reconstruction of the rear wall of the Wells High School gymnasium.



Figure 16. Reconstruction of the LDS Church which had severe cracking and some column damage. The building was only partially reinforced, so during reconstruction the building was rehabilitated to be seismically resistant. This photograph shows the removal of sections of the front of hollow concrete blocks to place rebar and concrete in these and create reinforced columns and reinforced beams in the LDS Church reconstruction.



Figure 17. The above photograph shows a detail of the rebar in the slots prior to being tied together.



Figure 18. The finished chapel after the LDS Church reconstruction.



Figure 19. The earthquake-damaged Overland Hotel where bricks and window glass rained down over the entrance and bench in a potentially deadly fashion.



Figure 20. The Overland Hotel after the bricks were peeled off the front and sides of the building and it received a stucco treatment.



Figure 21. The finished building is shown with its seismically vulnerable brick cladding removed. This same procedure can be used for pre-earthquake mitigation for other buildings with unreinforced brick cladding in earthquake country; although the glass is still vulnerable, this is a much safer, earthquake-resistant building.



Figure 22. Recovery began immediately following the emergency response. Here some available response personnel are helping take down a damaged chimney and cover the hole for a single mother. Caution was used because large aftershocks were still occurring.



Figure 23. Earthquake-damaged chimneys.



Figure 24. Volunteers tore the rest of the chimney down, stacked the bricks (since removed in photo), and boarded up the hole left by the fireplace.



Figure 25. This part of the house was later remodeled to have a new set of French doors.



Figure 26. Rock house that was damaged beyond repair from the earthquake with a failed rubble-wall foundation, failed lower part of a wall, and failed wall-roof connection. *Photo by Wells resident.*



Figure 27. The removal of the badly damaged rock house and the new foundation were funded by the relief fund from donations and recovery rally.



Figure 28. The new home that replaced the badly damaged one was partly funded by the Nevada Homeowners Disaster Assistance Fund.



Figure 29. Temporary protection of buildings from weather; a large plastic tarp covers the top of the El Rancho Hotel where collapsed walls allowed the rain and snow into the building.



Figure 30. Quilici Market was also covered with black plastic used as weather-proofing until it could be reconstructed.



Figure 31. Close-up of the careful work required in the removal of the Bullshead Bar sign. *Photograph by Wells resident.*



Figure 32. Removing the unstable Bullshead Bar sign that was leaning against a lamppost, in danger of falling from aftershocks. *Photograph by Wells resident.*

DISCUSSION: RECOVERY OF A COMMUNITY FROM AN EARTHQUAKE DISASTER

The recovery of a community from a disaster means that the community has been restored to its pre-disaster condition, or to an enhanced, better condition. There is an opportunity following a disaster to make things stronger than they were, so that the next disaster, and in particular the next earthquake, isn't as hurtful, doesn't do as much damage, and doesn't disrupt the community as much. A successful recovery comes from knowing the right things to do, making them happen, and doing them quickly. It also comes from the heartfelt "we-are-all-in-this-together" attitude of neighbors, near and far, helping neighbors.

Recovery must occur as fast as is reasonably possible. The preparation of an *Earthquake Disaster Recovery Plan* by a community can help accelerate the recovery process. Many communities are unfamiliar with the effects of earthquakes and how to recover from them. Coupled with the instantaneous and widespread nature of earthquake damage, a rapid, effective, and successful recovery is a difficult thing to devise rapidly in the aftermath of an event. Planning determines the most important recovery aspects to consider and reduces execution times. All Nevada communities should develop Earthquake Disaster Recovery Plans.

Community governments with limited staffing suddenly have unexpected responsibilities, challenges, increased workloads, and increased costs due to an earthquake disaster. Commitment and a positive effort forward are needed at this critical time. Volunteers should be sought out for the large workloads. Face-to-face communication with people from other agencies can help make some processes go faster and can help limit misunderstandings, making things more efficient.

Volunteers provided a majority of the early recovery work and were a key to the successful recovery of Wells. They can get a community back on its feet faster than any local, state, or federal agency or program. Meeting with potential volunteer groups pre-event and including them in the planning, training, and exercises can build even stronger relationships and make them even more effective in recovery activities. Although this may be a little counterintuitive, tracking volunteers' time during a disaster is important and can be used for cost-share for some disaster funding. In certain instances, volunteers can be reimbursed for documented services if a disaster is declared.

People need to stay as positive through recovery as possible. Local leadership plays an important role here and in the case of the Wells earthquake, Mayor Tybo was the inspirational motivator for the people; in the days following the earthquake he dismissed negative thoughts as useless and articulated that better days were ahead. In Japan, which has experienced many devastating earthquakes and other disasters, there is an attitude called *Gaman* that helps people recover from disasters, such as the 1995 Kobe earthquake (Reid, 1995). It is one of the virtues of a samurai to be able to "bear the unbearable" and work through a hardship without complaint. This intense focus on working to make things better helps "dull the pain and gives victims something other than their losses to think about" (Reid, 1995). In Wells, it was a "can-do pioneering spirit" that got people through. Pioneers had to deal with hardships quickly and effectively or their existence was threatened. People didn't unduly fret about their losses; they worked hard to get things right again and continued on. In Wells, people didn't hesitate but went out of their way to help each other. Consequently, clean-up and restoration were relatively rapid.

Distinct losses and a funding gap exist with earthquake disasters. Not everything is reimbursed, replaced, and recovered. Some building owners lost over a million dollars in damage from the Wells earthquake. The only way to help stem such losses is through pre-event mitigation. The use of building codes and good construction adds seismic resistance to structures so they can survive earthquakes. Securing and relocating dangerous building contents can help prevent injuries and reduce losses from earthquakes. Pre-earthquake mitigation is one of the few ways to reduce the gap between costs and relief funding. Mitigation also empowers people and helps make them feel safer, which can be important when aftershocks are continuing and keep anxiety high.

The community of Wells acknowledged problems that arose with the 2008 earthquake and have mitigated many of these. For example, cell phones were difficult for emergency personnel to use during the disaster so new two-way radios were acquired for emergencies. The City of Wells recognized that having earthquake-vulnerable unreinforced masonry buildings for the city hall and public works was not a good situation and is moving into new, seismically resistant buildings in the near future. Water heaters were recognized by the gas company as being the most likely problem with the gas system in future earthquakes, and heaters are now being strapped when serviced or installed. Community Emergency Response Teams (CERT) are being formed and training is taking place in Wells. The ultimate hope is that through greatpreparedness and mitigation, the need for an extensive recovery from a disaster will be reduced, or ultimately eliminated.

SUMMARY

The recovery of Wells from the 2008 earthquake disaster was assisted by numerous volunteers, several monetary relief resources, and a helpful media.

The community engaged in a rapid and thoughtful recovery, and although activities are continuing, many buildings, chimneys, and other damage have been reconstructed or replaced. People at every level were dedicated, motivated, and relentless in their conviction to make the recovery effective.

The Wells earthquake cost over \$10,571,000, the majority of which was related to building damage. The emergency response and content losses for comparison were 3% of the cost each, or \$300,000 and \$275,000, respectively. The large percentage of cost related to building damage in Wells underscores the importance of adopting and implementing modern building codes that incorporate seismic resistance into buildings, in order to lower the overall cost due to earthquake damage.

There were several monetary resources that were available to Wells and its residents. These resources are important for rural communities, which can struggle greatly under losses associated with earthquake disasters. The monetary relief resources used for the Wells earthquake disaster included the following:

- Nevada Public Agency Insurance Pool,
- Small Business Administration,
- State Emergency Assistance Account,
- Homeowners Disaster Assistance program.

There were also relief monies appropriated by Nevada's Federal legislators and Nevada, Utah, and Idaho citizens donated to a relief fund. The total amount of insurance, grants, loans, and relief monies recovered to date is almost \$6.69 million, or about 64% of the total loss, but millions of dollars remain uncovered and are being borne by citizens and the city. Building seismically-resistant buildings and implementing earthquake hazard mitigation plans are the primary ways to reduce these levels of losses to Nevada communities from future earthquakes. Earthquake insurance of public buildings accounted for 72% of the relief monies for the Wells earthquake and was a major contributor towards a successful recovery; as such, it should be considered by other communities located in earthquake-prone country.

Public communication is essential in motivating people, getting and keeping information in the public eye, and in helping to maintain public interest to foster and facilitate recovery activities. The media kept the Wells earthquake disaster in front of a regional audience for over a year, which helped keep a high general awareness of the status of the recovery of Wells, which in turn kept people involved. Developing a working relationship with interested news reporters and news agencies is an important communication resource for the local towns.

The so-far-successful recovery of Wells from the 2008 earthquake provides a model for other rural communities that are struck by a similar disaster and level of loss. Moving as fast and aggressively as possible and making the recovery a community goal helped the recovery process. Recovery funding should be sought out far and wide and diligent follow-through is needed to secure it. Community assessment and planning helped lay the path of recovery for Wells and gave citizens a vision of a future, recovered community. An Earthquake Disaster Recovery Plan for a community can pre-identify many of these sources of funding and give some valuable insight into early recovery activities, so that an effective, post-disaster recovery can be launched immediately.

ACKNOWLEDGMENTS

Several people reviewed and made numerous helpful comments that improved this paper. Johanna Fenton from FEMA Region IX, Rick Martin and Ron Hood from the Nevada Division of Emergency Management all made some great comments and edits which I appreciate very much. Special thanks to Jolene Supp, the City Manager of Wells, who responded to numerous questions that added important information to this paper. Thanks also to Donna Squires from ASC Company representing the Nevada Public Agency Insurance Pool, who detailed the insurance pay-outs and status of negotiations several times for this paper. Special thanks to D.D. LaPointe from the Nevada Bureau of Mines and Geology for significantly improving the manuscript as well.

REFERENCES

- Anderson, J.G., *this volume*, Seismicity and Seismic Hazard of Northeastern Nevada.
- Petersen, M., Pankow, K., Biasi, G., Meremonte, M., Harmsen, S., Mueller, C., Zeng, Y., *this volume*, Ground motions from the 2008 Wells, Nevada Earthquake Sequence and Implications for Seismic Hazard.
- Reid, T.R., 1995, Kobe Wakes to a Nightmare: National Geographic, July 1995, p. 112–136.
- Trabert, T.E., *this volume*, Wells High School Analysis and Reconstruction Following February 21, 2008 Earthquake.