

CHAPTER 3  
EMERGENCY RESCUE CAPABILITIES

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Introduction

Advanced planning for search and rescue procedures in the event of a large earthquake is of major importance in Berkeley. Rescue plans will do nothing for the people that are killed directly by an earthquake; however, such plans can save the lives of many of the people who are seriously injured or trapped. The City of Berkeley has put together an extensive Emergency Operations Plan that contains specific plans for rescue operations in the event of an earthquake. Even if the rescue operations go smoothly the large number of people needing to be hospitalized in the event of a large earthquake may be too many for the city to handle. If this is the case, the City of Berkeley will have to rely on mutual aid. Problems could arise due to the fact that other local areas would also be looking for mutual aid from Alameda County. As a result, higher branches of mutual aid might be needed, which could take a long time to arrive.

Experience from the San Fernando Earthquake

The San Fernando earthquake of February 9, 1971 left fifty-eight people dead and 2,328 people injured, of which 215 were admitted to hospitals. Two fire stations were left inoperative, and the Emergency Communications Center was overloaded. Fire and rescue services had difficulty responding to calls due to communication problems and road obstructions.<sup>7, 2</sup>

The major rescue operations took place at Olive View and Veterans Administration Hospitals, where structural collapses occurred. At Veterans Administration Hospital, where forty-seven people died, 430 fire service personnel were involved in the five day rescue operation.<sup>7</sup> The results could have been much worse if the earthquake had not occurred at 6:01 a.m., when most people were in the relative safety of their homes. The timing was also good for the rescue services, as many personnel were on their way to assigned duty stations. Despite the problems encountered, the overall rescue response was effective in the San Fernando earthquake.

### Expected Injuries in Berkeley

An assessment of the amount of rescue services needed after a large earthquake can be made by estimating the number of people that might be seriously injured. Deaths and injuries in an earthquake are not usually a result of the actual ground movement, but come from the subsequent collapse of structures. There are large variations in the way structures hold up to earthquakes.<sup>1</sup> For example, tall buildings built before stringent building codes were enforced are the most likely to collapse in an earthquake. Small single story modern wood frame structures tend to hold up best. In addition, the type of substrate a structure sits on is important. Deep alluvium is one of the worst substrates; solid bedrock is usually the best. The distance from the fault and the magnitude of the earthquake are also factors in the structure's ability to withstand an earthquake.

A 1972 federal study of the San Francisco Bay Area by the U.S. Office of Emergency Preparedness (Algermissen Report)<sup>8</sup> predicts the effects of a magnitude 6.0, 7.0 and 8.3 intensity earthquake at three different times on the Hayward and San Andreas Faults. However, that report assesses damages for the whole Bay Area, not Berkeley. Using the techniques in the report, I calculated the possible injuries and deaths in Berkeley as a result of a 7.0 earthquake on the Hayward Fault with an epicenter near Berkeley (TABLE 1).

In the Algermissen Report injury and death estimates for schools have been made for three times of the day--2:30 a.m., 2:00 p.m., and 4:30 p.m. The deaths and injuries in schools at 2:30 a.m. were estimated to be zero, while at 2:00 p.m. and 4:30 p.m., when schools are in session, the estimates of death were high for an earthquake on the Hayward Fault. This is due to the large number of schools near the fault. However, the Algermissen estimates are too high for

<u>TIME OF DAY</u>	<u>DEATHS</u>				<u>HOSPITALIZED INJURIES</u>			
	<u>SCHOOLS</u>	<u>HOSPITALS</u>	<u>OTHER</u>	<u>TOTAL</u>	<u>SCHOOLS</u>	<u>HOSPITALS</u>	<u>OTHER</u>	<u>TOTAL</u>
2:30 a.m.	0	51	92	143	0	153	368	521
2:00 p.m.	37	140	300	477	103	710	1200	2013
4:30 p.m.	15	140	454	609	48	710	1800	2558

TABLE 1. Estimated Deaths and Injuries in Berkeley as a Result of a 7.0 Magnitude Earthquake on the Hayward Fault.

SOURCE: U.S. Office of Emergency Preparedness.<sup>8</sup>

today's schools because since the report was published, all public schools have been brought up to new standards. The California School for the Deaf and Blind and the University of California campus buildings have not been brought up to these standards. Instead of using these out-of-date estimates, I made estimates based on the types of buildings in Berkeley schools (TABLE 1).

Using the Algermissen Report, Robert Obana (see Medical section) made estimates on the number of injuries and deaths in hospitals in Berkeley at 2:00 p.m. I calculated the probable deaths and injuries for earthquakes at 2:30 a.m. and 4:30 p.m. using his techniques (TABLE 1).

Obtaining estimates on the number of probable deaths from areas other than schools and hospitals is more complicated. To obtain such estimates, data pertaining to the type of buildings that people might be in during an earthquake are needed. I used data for the Berkeley/Albany area which will give a death estimate slightly higher than for Berkeley alone. With some simple calculations the number of people in each dwelling type at 2:30 a.m. can be estimated. Then, by multiplying the number of people in each dwelling type by the number of deaths per 100,000 in similar dwellings in similar earthquakes, the probable deaths in Berkeley at 2:30 a.m. can be calculated.<sup>8</sup>

Life hazard estimates are even more complicated at 2:00 p.m. and 4:30 p.m. because there have been no major earthquakes at such times in the United States in recent history. To calculate the number of likely deaths at 2:00 p.m. and 4:30 p.m., I followed the same methods used in the Algermissen Report,<sup>8</sup> but using data from the Berkeley/Albany area rather than the entire Bay Area. At 2:00 p.m. and 4:30 p.m. death estimates are high because many people are out of their relatively safe homes, traffic is heavy, and students are in school. These estimates are very rough, as the collapse of one more or one less large building than expected would throw off estimates a great deal. Based on past earthquakes,<sup>8</sup> injury rates are roughly thirty times the death rates, while serious injuries are three to five times the death rates (TABLE 1). This leads to some 2,500 Berkeley people that might need to be rescued and hospitalized in the event of a 7.0 magnitude earthquake.

From these injury estimates for Berkeley, at 2:30 a.m., 2:00 p.m., and 4:30 p.m., estimates can be made for earthquakes at other times. The 2:30 a.m. example would resemble a late night or early morning earthquake. The 2:00 p.m. earthquake would resemble an earthquake during the working hours, while the 4:30 p.m. earthquake would be similar to any commute time earthquake of the same magnitude. Serious injuries in a weekend earthquake would tend to be lower than those of a weekday earthquake, due to more people being off work. During the summer, life hazard would be less because of the lowered city population due to decreased university enrollment. The potential hazard would be highest in an earthquake in the rainy season since the possibilities of landslides and subsidence are greater.

Locations of Injuries

Also important in search and rescue planning is the assessment of where these seriously injured and trapped people would most likely be located. In Berkeley, the structures in the downtown area near the corner of Shattuck and University will cause a large concentration of injuries and deaths due to the number of people in the area, size, age of the buildings, the number of parapets, and the close proximity to the fault.<sup>4</sup> There will probably be other concentrations of

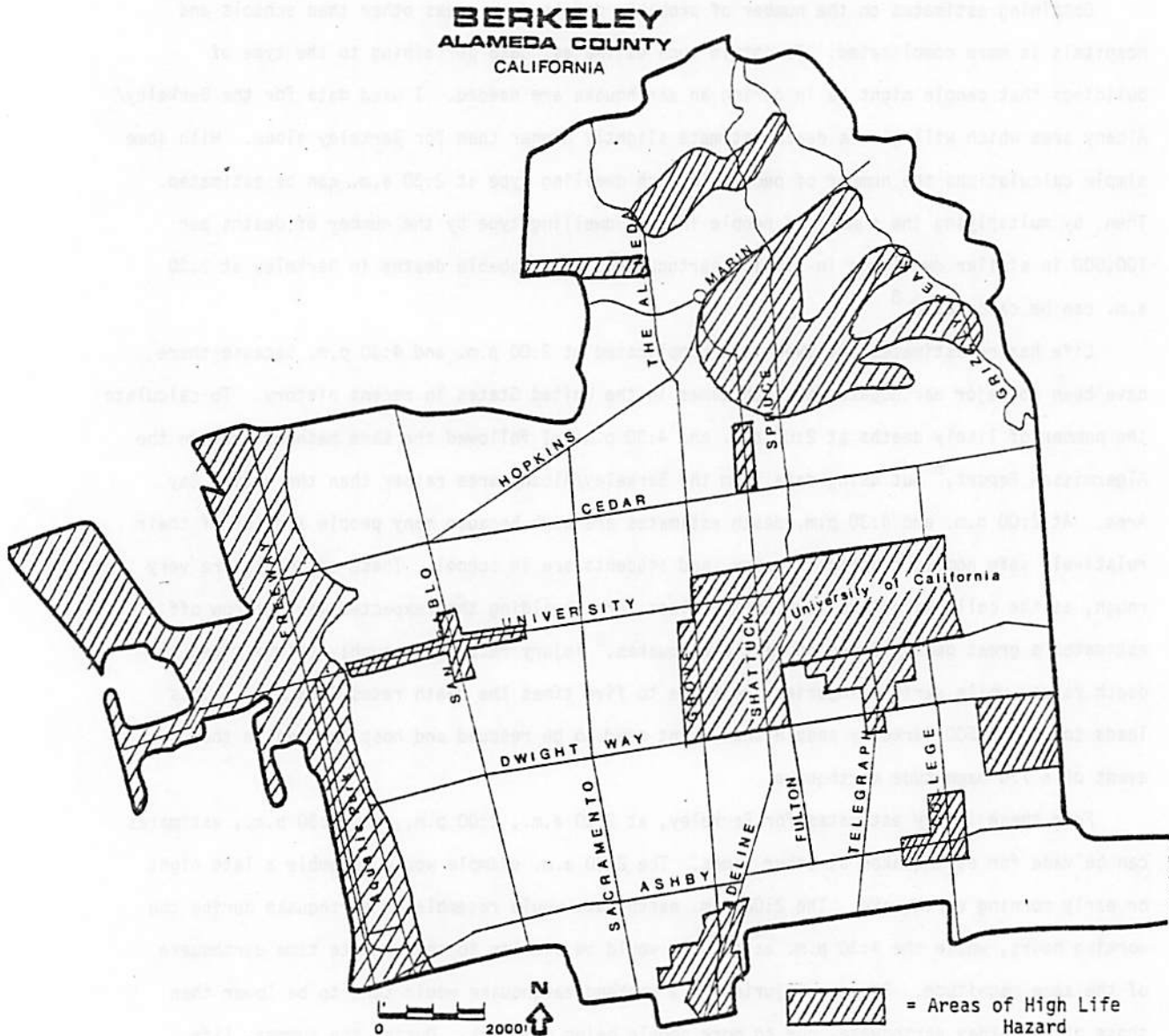


FIGURE 1. Probable Areas of High Life Hazard in the Event of a Large Earthquake on the Hayward Fault.

SOURCE: Berkeley Seismic Safety/Safety Element.<sup>4</sup>

injuries at the University, in other business districts, hospitals, in other large buildings, and houses in the North Berkeley hills (FIGURE 1). In a large earthquake, these injuries may be more widely dispersed, and there may be a greater incidence of major collapse in Berkeley than there was in San Fernando since the area adjacent to the fault is more densely populated in Berkeley.

#### Rescue Operations

The City of Berkeley has done much work on preparing for various kinds of disasters. The "Emergency Operations Plan" (EOP) for Berkeley contains detailed plans for coping with any type of disaster.<sup>3</sup> In the event of a major disaster such as an earthquake, the Fire Chief would be in charge of fire and rescue operations. Several other Berkeley agencies would support the Fire/Rescue Service.

Immediately after a major earthquake the Fire Chief will report to the Emergency Operations Center (EOC) at the Hall of Justice as required in the EOP. Acting as the Fire/Rescue Service Chief, the Fire Chief will be involved in decision-making processes with the City Manager and the other Service Chiefs. In case the chief is unavailable, there is a six-man line of succession listed in the EOP. The Deputy Chief, and off-duty Assistant Chief and a fire fighter will also report to the EOC to help in control. The Assistant Chief on duty will respond to the sub-EOC (Fire Alarm Headquarters).

In the field every fire department employee is initially expected to look after his or her own survival. After the shaking stops, all Company Commanders are to survey the conditions of personnel, apparatus and department structures. Then each company will make communications with the sub-EOC, if possible, and follow instructions. If communications cannot be made, the companies will operate independently. The Fire Department has priorities on what they will do if there are many tasks. First responsibility is the suppression of fire and the rescue of victims in fire-threatened areas. Second responsibility is to rescue people in collapsed buildings where there is no threat of fire.

In Berkeley there are four to five men at each of the seven fire stations. Although all off-duty officers are expected to report to their stations in such a disaster, they will probably take some time to get there as roads might be crowded, many may be impassable, and only about 10% of the fire personnel live in Berkeley.<sup>5</sup> To aid in rescue, the Public Works Department, the Police and the Red Cross have been designated to help the Fire Department, if possible.

The Public Works Department will probably be of great help in rescue operations by providing personnel and heavy equipment for clearing roads. Aside from their own equipment, the Public Works Department has a list of local private contractors that have heavy equipment available for rescue.

The Police Department should make a major contribution to the rescue operations. In the event of such an earthquake, all off-duty officers are required to report to duty as soon as possible. Although all Berkeley officers are required to live within fifteen miles of Berkeley, they might take a while to report, due to road obstructions. Police reserves and some of the East Bay Regional Park personnel will also report in if possible. The Police Chief located at the EOC will control all operations. Actual search and rescue activities are the third priority of the police department. However, the first two priorities, maintaining law and order and traffic control, will be a large aid to rescue operations as a whole.

The main task of the Red Cross is to assess the magnitude of the disaster and report to higher Red Cross divisions for help in setting up mass care centers for displaced people. It is not likely that the Red Cross will help out much with the search and rescue operations.<sup>6</sup> Private ambulance services will help with the rescue operations by bringing injured to hospitals if roads are clear. In addition, many people will undoubtedly volunteer to help out in search and rescue as was the case in Alaska and San Fernando.

It is doubtful that the City Fire/Rescue Service will be able to handle such a large disaster alone. In the San Fernando earthquake the collapse of one major building at Veterans Administration Hospital led to the involvement of 430 fire service personnel. In a 7.0 magnitude earthquake in Berkeley several major collapses are expected.<sup>8</sup> There is no way there will be enough trained personnel available. In fact, due to the primary obligation to fight fires which might be beyond their control, the Fire/Rescue Service may not get to non-fire rescue until hours after the earthquake. With any earthquake of this magnitude or greater at any time of the day, mutual aid will most likely be needed.

#### Rescue from Outside Berkeley

The City of Berkeley is part of an extensive state-wide mutual aid system. However, in such an earthquake mutual aid would move slowly. First, there would probably be little or no help from other East Bay cities since they would be having the same problems. The Alameda County Office of Emergency Services (OES), which sits in the Hayward fault zone, if not directly on a trace, might not be able to help out much. Assuming that the OES Services are not upset by the earthquake, its fifteen to twenty rescue vehicles<sup>9</sup> would be spread out quite thinly over the East Bay, primarily in unincorporated areas. The Sheriff Department's Law Enforcement Division would also be over-extended. And the California Highway Patrol would have its hands full on the freeways.

If the situation is beyond the control of the county OES, they would contact the Regional Division, which includes 16 counties from Monterey to Del Norte Counties. These counties would

most likely be able to send the men and equipment needed. However, due to likely communication and transportation problems, this help will take some time to get to Berkeley. Even our closest neighbors right across the bay will have trouble sending help, as the bridges might be blocked. Also, those counties might have earthquake problems of their own.

Help from local military organizations would probably get to Berkeley within a few hours of the earthquake. They would be assigned tasks to work out on their own. The military would probably function well in such an emergency. However, like the County EOS, their resources would be spread out very thinly over the damaged areas.

#### Conclusion

In the event of an earthquake on the Hayward Fault measuring 7.0 or greater on the Richter scale, there could be many immediate deaths and as many as 2,000 serious injuries in Berkeley alone. Despite detailed planning, the city rescue operations are likely to be inadequate due to the sheer magnitude of such a disaster. Limited help from the military will probably arrive fairly quickly, but adequate help through mutual aid will take much longer. It is hard to estimate just how long it would take to control the situation. However, it would seem reasonable to say that rescue operations would take longer than they did after the San Fernando earthquake, and therefore, the death rate among the trapped and seriously injured might be much higher.

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