On January 17, 1995, an earthquake struck the city of Kobe, Japan. The earthquake lasted only 20 seconds, but 5000 people were killed [Begley, 1995]. This example shows how deadly earthquakes are. Earthquakes have killed 2.7 million people during the period from 1900 to 1976 [Deshpande, 1987]. In comparison 1.8 million people have been killed by all natural disasters, other than earthquakes. More people are killed by earthquakes than any other form of weather hazard. Earthquakes are deadly because they strike without warning. If better methods could be found to predict earthquakes, people could be given advance warning of an earthquake, and lives could be saved.

Earthquakes are classified by the depth at which they occur. There are two types of earthquakes: shallow and deep. Shallow earthquakes, which compose the majority of earthquakes, occur at depths down to 300 kilometers. Deep earthquakes occur at depths from 300 to 680 kilometers. Shallow earthquakes produce more damage. In addition, the mechanism that produces shallow earthquakes is known, while the mechanism that produces deep earthquakes is not fully understood. The information in this report refers only to shallow earthquakes, because they are more common, more destructive, and better understood.

The purpose of this report is to review two methods of predicting earthquakes. The two methods reviewed are the statistical analysis of earthquakes and geophysical precursors of earthquakes. In order to illustrate the statistical analysis, two case studies will be reviewed: Friuli, Italy, and Parkfield, California. There are many geophysical precursors of earthquakes; however, only five of them will be discussed in this report. The five geophysical precursors reviewed are the velocity of the P-wave changes, ground uplift and tilt, radon emissions increase, electrical resistivity of rocks decrease, and underground water level fluctuates.

An earthquake prediction states the probability of occurrence, time span, region, and magnitude range of the earthquake. The method used to calculate the probability of occurrence and magnitude range of the earthquake will not be discussed. When discussing the geophysical precursors, the method used to calculate when the earthquake will occur will not be discussed; however, the length of warning for an earthquake will be discussed briefly. In addition, there are other methods of predicting earthquakes that will not be reviewed.

This report is divided into three main sections. The first section of this report will

describe the five stages of an earthquake. An understanding of these stages will help to understand how geophysical precursors arise and how they could be used to predict an earthquake. The second section describes the statistical analysis of earthquakes. The statistical analysis is used to give a long-term prediction of an earthquake. The third section discusses five geophysical precursors of earthquakes. Monitoring of geophysical precursors enables scientists to give medium- and short-term predictions of earthquakes. The report concludes with a discussion of the advantages and disadvantages of the two reviewed methods of earthquake prediction. In addition, the three stages of earthquake prediction will be discussed. The three stages of earthquake prediction are based on combining the two reviewed methods of predicting earthquakes and incorporating them into the stages of an earthquake.