The whole San Jacinto fault should be considered a seismic source Type A. The UBC source zone classification of the San Jacinto Valley segment of the San Jacinto fault as a type B fault is based on its maximum magnitude of 6.9. The UBC has a minimum M_w 7.0 for Type A. However, of any southern California fault, this fault segment has the highest probability of generating a large earthquake in the next 30 years (43%; WGCEP, 1995). It also has a high slip rate (±12 mm/year). Further, there are always uncertainties in identifying fault segments boundaries (and thus maximum magnitudes). For all these reasons, we recommend reclassifying the San Jacinto fault as a Type A. This reclassification would extend the near source zone an additional 5 kilometers as shown on Figure 1-29, and affect the near source factors for the area (Tables 16-S and 16-T; UBC, 1997). Reclassification would mitigate the potential for building damage in portions of the cities of Riverside, Moreno Valley and Perris.

To establish near-source factors for any proposed project in the County of Riverside, the first step is to identify and locate known active faults in the region. The International Conference of Building Officials (ICBO) has provided an Atlas of the location of known faults for California to accompany the 1997 UBC.

The rules for measuring distance from a fault are provided by the 1997 UBC. The criteria for determining distance to vertical faults, such as the San Andreas, are relatively straightforward. The distance to thrust faults (which meet the surface at a low angle) and blind thrust faults (which are shallow dipping but buried) is assumed as 0 for anywhere above the dipping fault plane to a depth of 10 kilometers. This greatly increases the areal extent of high ground shaking parameters, but is warranted based on observations of ground shaking at Northridge.

Summary: Seismic building codes are now undergoing their most significant changes since their inception. These improvements are a result of experience in recent earthquakes, as well as extensive research under the National Earthquake Hazard Reduction Program (NEHRP). Inclusion of soil and near-field effects in the 1997 UBC represents meaningful and important change. Seismic codes will continue to improve under the International Building Code, which is to replace the UBC beginning in the year 2000.

1.9.2 Retrofit and Strengthening of Existing Structures

The new building codes mitigate hazard in new construction. The retrofit and strengthening of existing structures requires the adoption of ordinances. The County of Riverside is required by state law to adopt an ordinance aimed at retrofitting unreinforced masonry buildings (URMs). Although retrofit buildings may

still incur severe damage during an earthquake, the mitigation results in a substantial reduction of casualties by preventing collapse.

Past earthquakes have shown that many other types of structures other than URMs are potentially hazardous. Structures built before the code incorporated lessons from the 1971 Sylmar earthquake are particularly susceptible to damage. These include pre-cast tilt-up concrete buildings, soft-story structures, unreinforced concrete buildings, as well as pre-1940 single-family structures. Other potentially hazardous buildings include irregular-shaped structures and mobile homes.

The County should consider a program to inventory its building stock. Buildings can be identified and inventoried following the recommendations set forth in publications such as "Rapid Visual Screening of Buildings for Potential Seismic Hazards: Handbook and Supporting Documentation" and " A Handbook for Seismic Evaluation of Existing Buildings and Supporting Documentation", both prepared by the Applied Technology Council in Redwood County, California, and supplied by the Federal Emergency Management Agency (FEMA publications 154 and 155, and 175 and 178, respectively).

Often, and understandably, communities seek to cut inventory costs by looking only for hazardous structures. However, it quickly becomes more cost-effective to perform a complete inventory than to return to the same databases and neighborhoods for new partial inventories, as additional hazardous building features are recognized by the engineering community. Knowing the total building stock allows more accurate loss estimations and more able prioritizing of limited resources.

The societal and economic implications of rehabilitating existing buildings are discussed in many publications, including "Establishing Programs and Priorities for the Seismic Rehabilitation of Buildings - A Handbook and Supporting Report", "Typical Costs for Seismic Rehabilitation of Existing Buildings: Summary and Supporting Documentation," (FEMA Publications 174 and 173, and 156 and 157, respectively). Another appropriate source is the publication prepared by Building Technology, Inc. entitled "Financial Incentives for Seismic Rehabilitation of Hazardous Buildings - An Agenda for Action (Report and Appendices).

The building inventory phase of a seismic hazard mitigation program should incorporate GIS technology. The data base should include information such as the location, the date and type of construction, construction materials and type of structural framing system, structural conditions, number of floors, floor area, occupancy and relevant characteristics of the occupants (such as whether the building houses predominantly senior citizens, dependent care or handicapped residents), and information on other building characteristics that may pose a threat to life. In proper format, this information may be input into the HAZUS database

and mitigation improvements could be tracked by running updated loss estimation calculations.

Once buildings are identified as potentially hazardous, a second, more thorough analysis may be conducted. This may be carried out by local officials, such as the County's building department, or building owners may be required to submit a review by a certified structural engineer. The review would assess the structural and non-structural elements and general condition of the building, and the building's construction documents (if available). Nonstructural elements should include the architectural, electrical and mechanical systems of the structure. Cornices, parapets, chimneys and other overhanging projections should be considered, as these may pose a significant threat to passers by, and to individuals who, in fear, may leave the building during shaking. State of repair of buildings should also be noted, including cracks, rot, corrosion, and lack of maintenance, as these conditions may decrease the seismic strength of a structure. Occupancy should be noted as this factor is very useful in prioritizing the buildings to be abated for seismic hazards.

For multi-story buildings, high occupancy structures, and critical facilities, the analysis should include an evaluation of the site-specific seismic environment (e.g., response spectra, estimates of strong ground motion duration, etc.), and an assessment of the building's loads and anticipated deformation levels. The resulting data should be weighted against acceptable levels of damage and risk chosen by the County for that particular structure. Once these guidelines are established, available mitigation techniques (including demolition, strengthening and retrofitting, etc.) can be evaluated, weighted, and implemented.

The County of Riverside should set a list of priorities to establish and conduct strengthening of hazardous buildings, once identified. Currently, there are no Federal or State mandated criteria established to determined the required structural seismic resistance capacity of structures. Retrofitting to meet the most current UBC standards may be cost-prohibitive, and therefore, not feasible. The County may develop its own criteria, following a comprehensive development and review process that involves experienced structural engineers, building officials, insurance representatives, and legal authorities. Selection of the criteria may follow review of the seismic performance of similar buildings that had been retrofit prior to an earthquake. For example, upgrading potentially hazardous buildings to 1973 standards may prove inefficient if past examples show that similar buildings retrofit to 1973 construction codes performed poorly and had to be demolished anyway. Many issues must be addressed, including justification for strengthening a building to a performance level less than the current code requirements, the potential liabilities and limitations on liability, and the acceptable damage to the structure after strengthening (FEMA, 1985).

Programs to encourage mitigation of potentially hazardous buildings can be

voluntary or mandatory. Voluntary programs have been implemented with various degrees of success in California. Incentives to engender support among building owners include tax waivers, tax credits, and waivers from certain zoning restrictions. Other cities have mandated review by a structural engineer when a building is undergoing substantial improvements.