EARTHQUAKE HAZARDS PROGRAM

WASATCH FRONT FORUM

VOL.I, No.2 PUBLISHED BY THE UTAH GEOLOGICAL AND MINERAL SURVEY SEPTEMBER 1984

FROM THE EDITOR

As you can see, we have already made some changes - the new name ... WASATCH FRONT FORUM ... was thought to better reflect the wide range of interests. If you have any further changes to recommend, please let us know. A comment card has been included on the final page of this issue. We appreciate your comments and suggestions. My thanks to everyone who has contributed to this issue - as you will see, we have received information from some of the participants in the recent Workshop held in Salt Lake City - BUT, we always need more. The next issues and deadlines are:

DECEMBER ISSUE....Deadline: December 31
MARCH 1985 ISSUE..Deadline: March 29
JUNE 1985 ISSUE...Deadline: June 28

Information can be sent to any of the following:

WENDY R. HASSIBE,Editor
USGS,NMD,Public Inquiries Office, 8105 Federal Building, SLC,Utah 84138 (801)524-5652 or FTS 588-5652

BILL BROWN, CO-EDITOR
USGS,MS 998,345 Middlefield Road, Menlo Park, California 94025 (415) 856-7112 or FTS 467-7112

PAULA GORI, CO-EDITOR
USGS,MS 905, National Center, Reston, Virginia 22092 (703) 860-6471 or FTS 928-6471

DON R.MABEY,CO-EDITOR
Utah Geological and Mineral Survey, 606 Blackhawk Way, SLC, Utah 84108 (801)581-6831

ART TARR,CO-EDITOR
USGS,MS 966,Denver Federal Center, Box 25046, Denver, Colorado (303) 236-1605 or FTS 776-1605

UTAH GEOLOGICAL & MINERAL SURVEY EARTHQUAKE HAZARDS PROGRAM

The earthquake hazards program in the Utah Geological and Mineral Survey (UGMS) received a major boost with signing of a cooperative agreement with the U.S. Geological Survey. Under the cooperative agreement the UGMS will participate in each of the five elements of the Regional and Urban Earthquake Hazards Investigations of the Wasatch Front. Most of the UGMS effort will be in the hazards evaluation and synthesis, information systems and implementation elements with minor activities in the ground motion modeling and loss estimation models elements.

In the hazard evaluation and synthesis program, Don Mabey and William Case are making an integrated interpretation of all geophysical and subsurface data in the valley area west of the Wasatch Range from Santaquin to Ogden. This study will investigate the structure of the valleys, the thickness and lithology of the Cenozoic fill underlying the valleys, the structure and lithology of the basement rock and the shallow hydrology. Products will be a series of 1:100,000 scale maps on the same topographic base as the Wasatch Front geologic map. William Lund is directing a program to document evidence of past earthquakes in areas where this evidence is in danger of being destroyed by developments and where the evidence is exposed in excavations.

Don Mabey and Janine Jarva are working on the information element. The first effort in this project is the compilation of a bibliography of Utah earthquake publications. The long-term objective of the project is to make information and data related to earthquake hazards along the Wasatch Front readily available to decision makers, the public and researchers.

Considerable interest has developed in Utah in the implementation element of the program. The UGMS is working with the USGS, FEMA and local groups to develop this critical part of the program. The UGMS role will be primarily in providing technical support to local organizations seeking funding support from the Federal agencies.

The UGMS is working with State and local agencies to assemble information that will be useful in loss estimation models and in developing mitigation plans. The first effort in this project is an inventory of health care facilities in Davis County being made in cooperation with the Utah Department of Health.

Bruce Kaliser is participating with the USGS team working on the ground motion modeling. The UGMS effort in this element will be to provide advice on local geology and aid in the selection of instrument sites.

The Wasatch Front earthquake hazards program is being coordinated with the regular UGMS program of state-wide multi-hazards studies and site investigations that make up the UGMS Applied Geology program. The earthquake activities in the UGMS are coordinated with earthquake research by the Department of Geology and Geophysics at the University of Utah and the University of Utah Seismograph Stations.

1984 WORKSHOP

FROM WALT HAYS, USGS

Scientists, engineers, and land-use and response planners finalized the planning of the second year (FY 1985) for the U.S. Geological Survey "Regional and Urban Earthquake Hazards Evaluation Program" in the Wasatch front, Utah at a workshop on the "Evaluation of Regional and Urban Earthquake Hazards and Risk in Utah" at the State Capitol in Salt Lake City, August 14-16, 1984. The meeting was attended by 125 individuals from local universities, State and local government, Federal agencies, and voluntary agencies.

Governor Scott M. Matheson opened the workshop by endorsing the goals of identifying geologic hazards, such as earthquakes and active landslides, and taking the necessary steps to prepare for devastating natural disasters. The Governor suggested that it will not be an easy task to convince State legislators of the necessity to prepare for an earthquake.

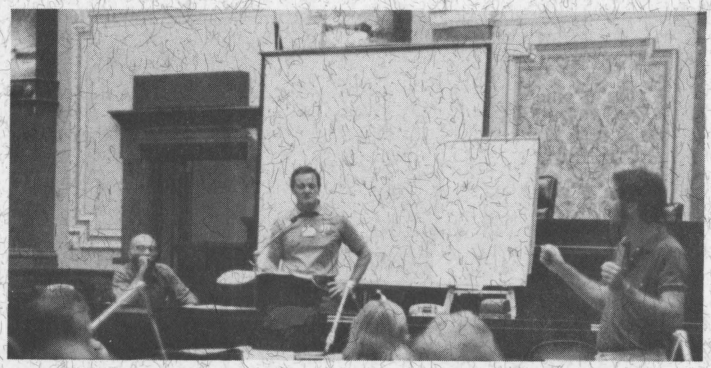
With this fact in mind, the second day's plenary session addressed 15 State legislators. The legislators, along with the workshop participants, learned what losses could be expected from a hypothetical magnitude 7.5 earthquake in Utah. The workshop participants and legislators were then informed of the possible actions which could be taken within the next 2 years to reduce future losses from earthquakes and other natural hazards. These actions included improving earthquake response capabilities, improving earthquake-resistant design of buildings and lifelines, and improving land use to accomodate known geologic hazards. At the close of this special session before a committee of State legislators, Genevieve Atwood, Utah State Geologist, was invited to submit legislative proposals in October.

A highlight of the workshop was the simulated response to a hypothetical earthquake. The workshop participants were given a chance to role play. Each participant joined an action group: either the "Ski Development Council," the "Business Round Table," or the "State Republicans." Each action group was charged with the task of formulating and making recommendations to a fictitious Governor's Commission. The testimony before the Commission was lively and very realistic. The excercise stimulated the participants to think about the problems posed by a massive earthquake in terms other than the direct damage or the immediate emergency problems of life safety.

At the conclusion of the workshop, each partner in the Regional and Urban Earthquake Hazards Program in the Wasatch front pledged support of the goals of the program. U.S. Geological Survey representatives renewed their commitment to the program through internal and external projects, publication of the workshop proceedings, and planning for next year's workshop. The Federal Emergency Management Agency representatives promised to assist in the implementation phase of the program through joint funding of some of the projects, such as training of land-use and emergency planners, and through sponsorship of a working group of the agencies and universities involved in implementation. The Utah Division of Comprehensive Emergency Management representatives pledged support through the Multi-Hazards Project and membership in the proposed working group. The Utah Geological and Mineral Survey representatives promised to continue work on projects to identify geologic hazards, revise proposals for new projects, and make policy recommendations to the State legislature in October to increase the capability of Utah to prepare for earthquake and other geologic hazards.

1

2



3

4

1. Darrel Crawford, Mountain Fuel Supply Company, addressing a small discussion group.
2. Wesley Dewsnup, Utah Division of Comprehensive Emergency Management, during simulated earthquake recovery excercise.
3. Rus Wheeler, USGS, Walter Arabasz, University of Utah, David Swartz, Woodward Clyde Consultants.
4. William Kockelman, USGS, addressing workshop participants on "Personal Preparedness".

EVALUATING SEGMENTATION OF THE WASATCH FAULT

Rus Wheeler
U.S.Geological Survey
Box 25046, DFC, MS 966
Lakewood, Colorado 80225

D.P.Schwartz and his coworkers have proposed that the Wasatch fault is segmented, that is, divided into several portions that are each several tens of kilometers long. Their idea is that each segment tends to rupture completely and independently of the other segments, in earthquakes of a size that is characteristic of that segment. If the segmentation hypothesis is valid, that would affect estimates of seismic hazards along the Wasatch Front in complicated but substantial ways. If the hypothesis of characteristic earthquakes is also valid, then damaging earthquakes might occur much more frequently than expected from standard extrapolations of the observed frequencies of small earthquakes.

This effort aims to evaluate the segmentation hypothesis; it is not clear how the hypothesis of characteristic earthquakes might be evaluated, but probably any light that can be shed on either hypothesis will illuminate the other. Two lines of attack, one short term and one long term, are based on the observation that the Wasatch fault zone occurs in a pre-existing belt of thrust sheets that runs north-south through Utah and adjacent states: the Overthrust Belt of the petroleum explorationist. Some workers consider that the thrust sheets are thick enough that most of the observed earthquakes occur within them. Thus if the thrust sheets are segmented in some way, then as the Wasatch fault formed within them, their pre-existing structure might have caused the Wasatch fault to also form with segments. Thrust sheets in other mountain belts like the Canadian Rockies and the central and southern Appalachians are known to be segmented, so the goal is to see whether any such segmentation in the thrust sheets coincides with boundaries between the suggested segments of the Wasatch fault.

Short-term work will look for evidence of north-south disruption in the structure of the thrust sheets along most or all of the Wasatch Front, by examining anomalies in at least three independent data sets: gravity, aeromagnetic, and structural data. If anomalies in different data sets coincide, and if the anomalies are few, then that coincidence is not likely to be due to chance. A statistical procedure can evaluate spatial coincidences of gravity, magnetic, and structural anomalies. The coincident anomalies might then be interpreted to infer the nature of the structures that cause the anomalies. For example, such structures might be large transverse ramps or abrupt north-south changes in crustal thickness or composition across long-active basement fault zones, as suggested by R.L. Bruhn.

Long-term work will concentrate on about 2000 square kilometers in the Wasatch Range between Spanish Fork and Nephi, spanning a proposed segment boundary in the Wasatch fault near Payson. The idea is to apply structural methods there that have been successful in identifying and characterizing segmentation in thrust sheets of the central Appalachians: compiling existing geologic maps and structural data, working out the relative ages of different orientations of systematic joints and of folds related to the thrusting, and mapping the intensity of those joints. If a structural expression of a segment boundary in the Wasatch fault can be recognized near Payson, where structure and stratigraphy are simpler than at other proposed boundaries, then some of those other boundaries can be examined later using methods that have worked near Payson.

Other independent efforts will also help to evaluate segmentation. Among them is the mapping of M.N.Machette and coworkers, who are unravelling the late Cenozoic evolution of young fault scarps, colluvial deposits, and other features along the Wasatch Front. D.P.Schwartz and coworkers hope to expand the trenching activities whose original results led to the segmentation and characteristic earthquake hypotheses. Those two hypotheses pose important and challenging problems whose solutions are likely to apply both to hazard evaluation in Utah and to extensional terranes generally.

UTAH MULTI HAZARDS PROJECT

Wes Dewsnup
State of Utah
Division of Comprehensive Emergency Management

The Utah Multi Hazards Project is a pilot project, funded by the Federal Emergency Management Agency, designed to develop a multi hazards mitigation process to reduce the potential for life loss and property damage due to earthquakes, floods, landslides, dam failures or any combination of these events. The project is being managed by the Utah Division of Comprehensive Emergency Management.

The Project, now in its second year, has developed a model process by which hazard mitigation can be effectively accomplished, and is currently testing that process in the Ogden/Pineview area of Weber County, Utah. The Project is being assisted by a Steering Committee, comprised of various state and federal agency leaders; a Technical Review Committee, comprised of technical experts in earthquake, flood, landslide and dam safety; a Public Awareness and Education Resource Committee, comprised of community leaders and education and media representatives; and an Administrative Review Committee, comprised of local elected officials and their department heads.

The model process, developed by the Project, identifies steps necessary for multi hazard mitigation and includes the development of a good data base for the community; development of composite hazard scenarios with occurrence probabilities; elected official, professional and public education and awareness programs; selection of technically, politically, economically and socially feasible mitigation alternatives; and development of an effective implementation strategy.

The Project has developed hazard maps, risk assessments, a list of mitigation alternatives, demographic information and training and educational materials to assist the local governments in defining their needs and developing and implementing mitigation programs for their community.

Results and analysis of the Project will be forthcoming in the fall of 1985. If you have any questions or would like further information, please contact Wes Dewsnup, Project Manager at (801) 533-5271, or write to the Division of Comprehensive Emergency Management, P.O. Box 8100, 1543 Sunnyside Avenue, Salt Lake City, Utah 84108-0100.

CALL FOR PAPERS
EVALUATION OF REGIONAL AND URBAN EARTHQUAKE HAZARDS
WASATCH FRONT, UTAH

U.S. GEOLOGICAL SURVEY PROFESSIONAL PAPER

Participants in the Regional and Urban Earthquake Hazards Evaluation Program are requested to prepare a manuscript for the professional paper on "Evaluation of Urban and Regional Earthquake Hazards and Risk in Utah" which will be published in the 3rd year of the program (FY 86).

Deadline for transmittal of the manuscript is JULY 14,1985. The manuscript should represent a synthesis of several research studies or present the findings of a topical study. The manuscripts must receive peer review according to standard USGS procedures. The format for the manuscript may be obtained by contacting Walter Hays or Paula Gori at (703) 860-6471 or (FTS) 928-6471 or writing to them at U.S. Geological Survey, 905 National Center, Reston, Virginia 22092.

Plans for next year's meetings are still being formulated. Participants in the program will be advised in the near future of the dates and topics of the meetings.

FROM JEFF KEATON, DAMES & MOORE :

Copies of the Proceedings of the Specialty Conference on "Delineation of Landslide, Flash Flood, and Debris Flow Hazards in Utah" can now be ordered. This very successful, two-day conference was held at Utah State University in June 1984. It included over 50 technical presentations plus four keynote speakers and an opening address on themes which covered geological hazards, flood hazards, mitigative measures, emergency preparedness/response and a special session on the Thistle Landslide. The conference was co-sponsored by eleven federal and state government agencies and professional societies. It attracted 226 professionals from all parts of the U.S. including leading experts in flooding, landslides, stream hydraulics, protective watershed management and the social, legal, and political aspects of emergency and remedial programs. A copy of the proceedings may be ordered by writing to Ms. Dawn Herzog, Utah Water Research Laboratory, UMC 82, Utah State University, Logan, Utah 84322. Please enclose a check for $30 payable to "Utah Water Research Laboratory" or provide invoicing instructions.

FROM UGMS

The increased interest at this time in the Great Salt Lake and its rising lake level has inspired the publication of a new map to show the area covered by Great Salt Lake and its predecessor, Lake Bonneville, at various key elevations. The new map, MAJOR LEVELS OF GREAT SALT LAKE AND LAKE BONNEVILLE, is by Donald R. Currey, Professor of Geography at the University of Utah; Genevieve Atwood, Director of the Utah Geological and Mineral Survey and State Geologist, and Don R. Mabey, Senior Geologist at the UGMS.
The map is in full color, at a scale of 1:750,000. The cost is $4.50 or $6.50 by mail prepaid. Add $0.26 for sales tax if purchased in Utah.

More information about the Great Salt Lake is found in GREAT SALT LAKE, A SCIENTIFIC HISTORICAL AND ECONOMIC OVERVIEW, 1980, edited by J.W.Gwynn. This 400-page book is a compilation of 36 articles on all aspects of the lake. It is available from UGMS for $10.00 or $14.00 by mail. Add $1.58 sales tax if purchased in Utah. The new map MAJOR LEVELS OF THE GREAT SALT LAKE AND LAKE BONNEVILLE may be purchased with this volume for a total cost of $12.50, $16.50 by mail, with $1.72 sales tax if purchased in Utah.

INFORMATION RESOURCE

The Public Inquiries Offices of the U.S. Geological Survey are an information resource that can provide earth science information covering a broad spectrum of concerns and interests. The ten offices maintain this information for wide geographic areas, in addition to special focus on states surrounding the location of each PIO. Some of the PIO's have national coverage in maps and publications. In addition, all offices have access to library copies of all USGS publications. Information about topographic mapping, special mapping products, digital information, aerial photography, thematic mapping, open-file reports and projects within the agency are accessible through several data bases which are part of ESIN (Earth Science Information Network) as well as through information maintained by each of the PIO's.

Each PIO sells USGS book reports and maps of geographic areas adjacent to their location. Price and ordering information, along with indexes, lists of publications and yearly supplements are available from any of the PIO's listed. The names of the Information Specialists in charge, along with addresses and telephone numbers are:

Elizabeth Behrendt
108 Skyline Bldg, 508 Second Avenue
Anchorage, ALASKA 99501
907-277-0577

Lucy Birdsall
7638 Federal Bldg,300 N.Los Angeles St.
Los Angeles, California 90012
213-688-2850

Bruce Deam
Rm.122,Bldg.3,345 Middlefield Road
Menlo Park, California 94025
415-323-8111, ext. 2817

Pat Shiffer
504 Custom House, 555 Battery St.
San Francisco, California 94111
415-556-5627

Irene Shy
169 Federal Bldg,1961 Stout Street
Denver, Colorado 80294
303-837-4169

Bruce Hubbard
1028 General Services Bldg.
19th and F Streets NW
Washington D.C. 20244
202-343-8073

John P. Donnelly
1C45 Federal Building
1100 Commerce Street
Dallas, Texas 75242
214-767-0198

Wendy R. Hassibe
8105 Federal Building
125 South State St.
Salt Lake City, Utah 84138
801-524-5652

Margaret Counce
302 National Center, Rm. 1C402
Reston, Virginia 22092
703-860-6167

Jean Flechel
678 U.S. Courthouse
West 920 Riverside Avenue
Spokane, Washington 99201
509-456-2524

UTAH EARTHQUAKE ACTIVITY
April to September 1984

William D. Richins

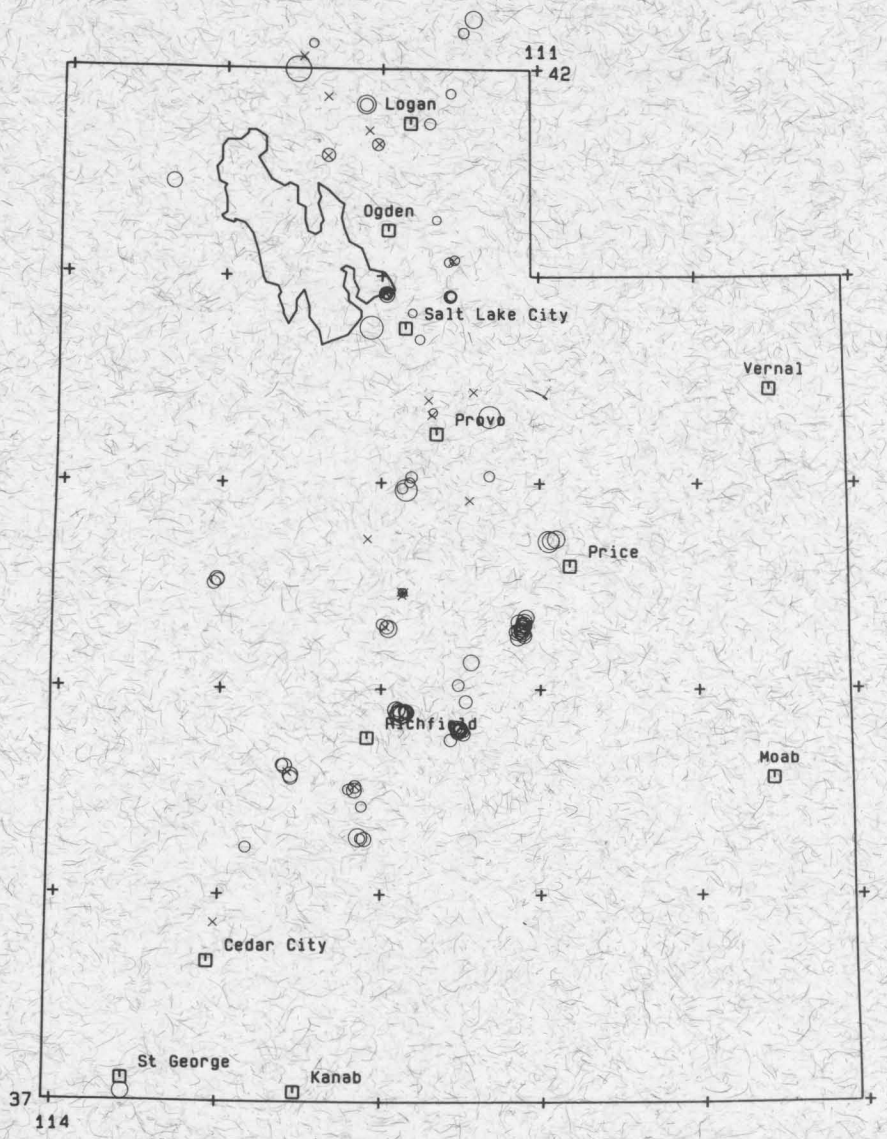
University of Utah Seismograph Stations
Department of Geology and Geophysics

The University of Utah Seismograph Stations records an 80-station seismic network designed for local earthquakes monitoring within Utah, southeast Idaho and western Wyoming. During April 1 to September 30, 1984, 258 earthquakes were located within the Utah region (see figures 1 and 2).

The largest earthquake during this time period occurred on August 16, 1984 12 miles south of Levan near the Wasatch Fault. This earthquake had a magnitude of 3.7 and was felt in Levan, Gunnison, Ephraim, Manti and other nearby communities. A total of 5 earthquakes were reported felt in the Utah region during this time period. Other significant aspects of earthquake activity shown in Figures 1 and 2 include (from north to south):

1) a magnitude 3.0 earthquake within Pocatello Valley on the Idaho-Utah border near Snowville, Utah on May 12,
2) a magnitude 3.0 earthquake northwest of Tremonton on August 6,
3) a magnitude 2.8 earthquake approximately 35 km west of Brigham City on September 30,
4) a magnitude 2.7 earthquake approximately 25 km west of Salt Lake City on June 10 felt in Magna,
5) a magnitude 2.6 shock in the vicinity of Wallsburg 25 km east of Provo on May 5,
6) continued small magnitude activity within Goshen Valley 40 km southwest of Provo with magnitudes less than 2.7,
7) clustered small magnitude earthquake activity in the vicinity of active coal mining northwest and southwest of Price in central Utah, and
8) on-going activity scattered throughout a northeast-southwest trending belt between Richfield and Cedar City in southwest Utah.

A new earthquake bulletin titled "Earthquake Data for the Utah Region, January 1,1981 to December 31, 1983" was published in August 1984 by the University of Utah Seismograph Stations. A limited number of these volumes are now available at the Utah Geological and Mineral Survey. Additional information on earthquake data within Utah is available by contacting the University of Utah Seismograph Stations, Salt Lake City, Utah 84112 (telephone 801-581-6274).



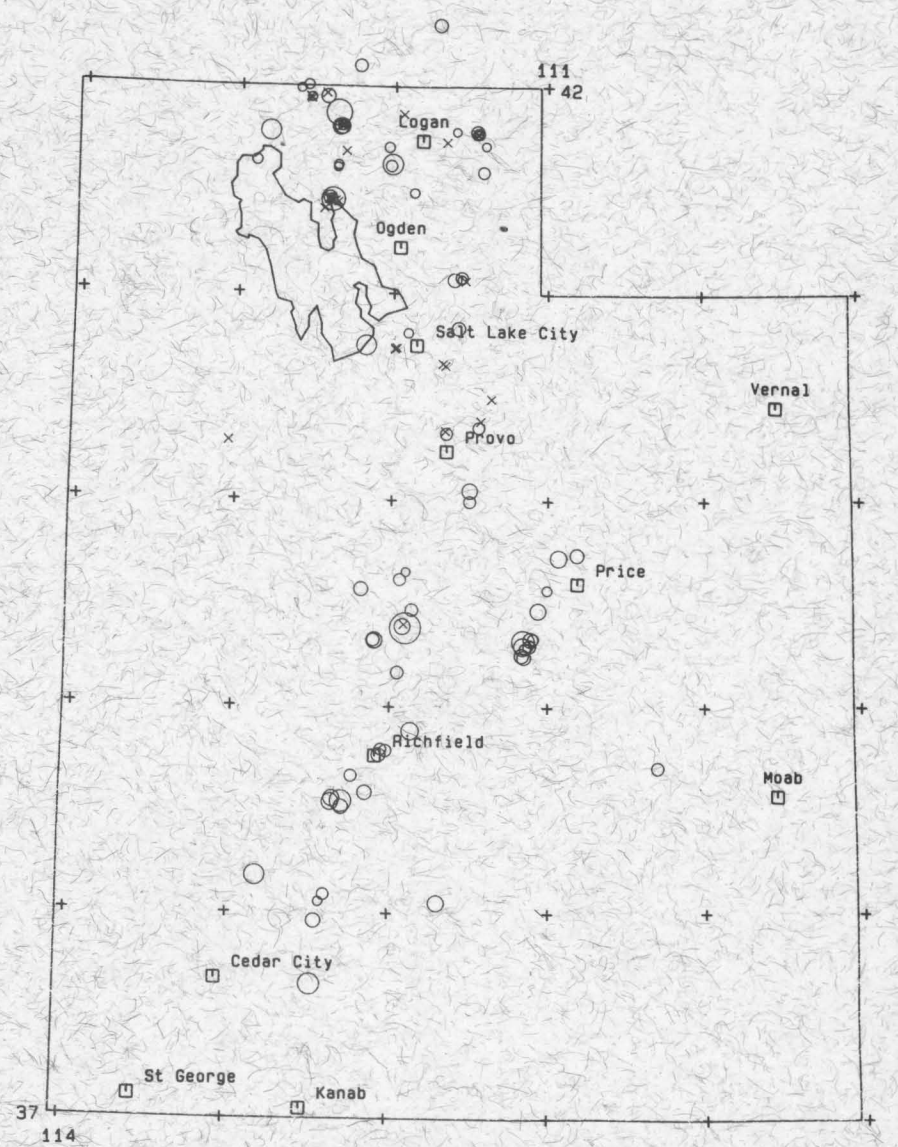
Utah Earthquakes: Apr 1 - Jun 30, 1984

0 50 100 km

magnitude scale (ml):

6 4 2 1 <1.0

Figure 1.



Utah Earthquakes: Jul 1 - Sept 30, 1984

0 50 100 km

magnitude scale (ml):

6 4 2 1 <1.0

Figure 2.

PROJECT UPDATE

From Rich Madole, USGS, Denver, Colorado

"Landslides pose a significant geologic hazard along the Wasatch Front. The location, age, and frequency of landslides are all important factors that must be considered in estimating the landsliding hazard in a specific locality. I have been studying landslides at several localities along the Wasatch Front, and comparing them with other slides in Utah and Colorado where ages are known. I find that landslide morphology changes systematically with time in much the same way as does the constructional topography of glacial landforms. There is a reduction in relief and a general smoothing of topography with time as depressions fill, ridges broaden and flatten, and slope angles decrease. Soils developed on pressure ridges also show systematic changes with increased age. Aspects of soil development that will be useful in assigning ages to landslide deposits include soil thickness, the number and sequence of horizons developed, depth of leaching, and soil organic-matter content per cm_3. Materials suitable for radiocarbon dating and amino-acid dating were found to be relatively common in the landslide deposits of this region. These materials will provide a means for determining the times of landsliding and for calibrating relative-dating techniques.

The primary goal of this new project is to determine landslide recurrence intervals in order to improve evaluations of landslide hazards and to contribute to the broader problem of landslide prediction. For a given landslide area, this involves determining the number of slides and the dates of their occurrence, reconstructing the climatic and geomorphic histories of the area, and evaluating the relationships between landsliding, climatic change, and geomorphology.

The establishment of a good chronology for landsliding is an important base for evaluating other natural hazards, such as floods and earthquakes. If earthquake-induced landslides can be recognized, then ages obtained from them can be used to date earthquakes. Identification of earthquake-induced landslides is a secondary goal of this project.

It is difficult to evaluate the contemporary landslide hazard solely on the basis of the distribution of landslides because mapped landslides include many that occurred when conditions (chiefly wetter climate) were different than at present. Therefore, estimates of landsliding based on the gross distribution of landslides, with little consideration given to age and origin, may overestimate the landslide hazard.

DISASTER RESPONSE AND PREPAREDNESS IN UTAH, 1983-84 NEW REPORTS AND PROJECTS.....HYDROLOGIC HAZARDS
William M. Brown III

DISASTER RESPONSE AND PREPAREDNESS IN UTAH, 1983-84

The bulk of current public focus on geologic activity in Utah has arisen from recurrent debris-flow, landslide, and flood events that began in April, 1983 and persisted through the summer of 1984. These events occurred statewide, resulted in two Presidential disaster declarations for Utah, and prompted much activity and interest by federal, state, and local agencies in the general area of geologic hazards. This interest has a strong and positive carryover to the goals of the Wasatch Front Project, including active support for geologic hazards investigations in general, and formation of formal and informal associations among agencies to facilitate implementing results of scientific research. The following reports exemplify the attention given to geologic hazards, and offer insights into actions currently underway and into which earthquake preparedness is or may be integrated.

INTERAGENCY HAZARD MITIGATION REPORT FEMA-720-DR-UTAH: Federal Emergency Management Agency,1984 Region VIII,Denver, Colorado, September 14, 1984, 26p. (Prepared in response to the August 17, 1984 Presidential disaster declaration covering severe storms, flooding, mudslides, and landslides in Utah for April 1-July 1,1984).

INTERAGENCY HAZARD MITIGATION REPORT FEMA-680-DR-UTAH: Federal Emergency Management Agency, 1983-84, Region VIII,Denver, Colorado, four reports, May 14, 1983,14p.plus attachments; August 1,1983, 18p.plus attachments; November 14,1983,15p.plus attachments; and February 14,1984,19p.plus attachments. (Prepared in response to the April 30,1983 Presidential disaster declaration covering the Spanish Fork River slide-dam and Thistle flood, and subsequent flooding, debris flows,debris floods, and landslides in Utah for April 30-July 1,1983.

The contents of those reports reflect a consensus among representatives of many local,state,and federal agencies as to encouraging,funding, and monitoring hazard mitigation measures during reconstruction and recovery as a means of reducing the potential for future losses. The following report stems from the recommendations and directives of the Interagency Team, and sets forth a statewide plan to mitigate potential future damages from natural and man-caused disasters.

HAZARD MITIGATION PLAN, UTAH,1984: State of Utah Department of Public Safety, Division of Comprehensive Emergency Management, Salt Lake City, Utah, February 1984, 92p. (The report concludes: "Hazard mitigation is a management strategy in which current actions and expenditures to reduce the occurrence or severity of potential disasters are balanced with potential losses from future disasters. Utah is committed to this philosophy and presents this hazard mitigation plan as evidence of a commitment to implement this strategy.")

NEW REPORTS AND PROJECTS

THE UTAH LANDSLIDES, DEBRIS FLOWS, AND FLOODS OF MAY AND JUNE, 1983: Anderson, L.R.,Keaton, J.R., Saarinen,T.F., and Wells, W.G., II, Committee on Natural Disasters, National Research Council Post-disaster Study Report, National Academy Press, Washington D.C. 96p. (Of additional interest is a listing on pages 93-94 of postdisaster study reports on worldwide earthquakes, 1964-83).

DISASTER BELIEFS AND EMERGENCY PLANNING: Dennis Wenger, Thomas James and C.E. Faupel, Todd Publications, New York NY,260p. (This book empirically examines the nature of public and official knowledge about disaster behavior in three communities with extensive disaster experience. The level of public and official knowledge of specific protective action that can be taken in time of disaster is also examined. The study includes a detailed content-analysis of more than 70 disaster plans. A chapter examines the adequacy of plans, presents a checklist for plan analysis, considers planning in light of public knowledge and beliefs, and discusses weaknesses in the planning process). Available from Todd Publications, P.O. Box 1097, Lenox Hill Station, New York, NY 10021, for $24.50 clothbound or $12.95 paperback, plus $1.75 postage and handling.

LANDSLIDES FROM THE MAY 25-27, 1980, MAMMOTH LAKES, CALIFORNIA, EARTHQUAKE SEQUENCE: Harp, E.L.,Tanaka, Kohei, Sarmiento, John and Keefer, D.K., 1984: U.S. Geological Survey Miscellaneous Investigations Series Map I-1612, 1:62,500. (The accompanying text describes rock falls and rock slides in relation to rock type,

(continued)

(Disaster Response...continued)
and documents liquefaction and lateral spreading at 6 locations. The earthquake sequence of four earthquakes of magnitude 6.0 or greater and more than 200 aftershocks of magnitude 3.0 or greater triggered several thousand landslides throughout an area of approximately 2500 square kilometers. The failures ranged in size from toppling of a few small rocks to rock-fall avalanches of more than 200,000 cubic meters, the largest of which travelled about 1 kilometer from its source).

EARTHQUAKE VULNERABILITY OF URBAN WATER SYSTEMS, SALT LAKE COUNTY, UTAH: Barnhard, L.M., U.S. Geological Survey, Denver, Colorado, Master's Thesis for the University of Colorado, Boulder, Colorado, in progress. (This study suggests the effects of a postulated magnitude 7.5 earthquake along the Wasatch Front, Utah, on the culinary water system of Salt Lake County. The study uses recent data on earthquake recurrence, liquefaction potential, and site amplification to estimate the vulnerability of water distribution systems. The data are complemented by case studies of water system damage during historical earthquakes, and by recent field investigations in central Utah of landslide damage to water systems).

HYDROLOGIC HAZARDS

EFFECTS OF WATER AND SEDIMENT DISCHARGES ON CHANNEL MORPHOLOGY: U.S. Geological Survey, Water Resources Division, Lakewood, Colorado. Garnett P. Williams is researching effects of large sediment introductions on stream channels, and has studied the reactivation of the 3 1/2-kilometer-long Manti landslide in central Utah during 1976. The reactivation created about 63 new ponds on the landslide surface and caused aggradation of as much as 35 meters (one of the highest figures ever reported for such aggradation anywhere) in the stream channel that flows past the toe of the landslide. The landslide has also undergone significant movement in 1983-84. (Williams, G.P., Stream-channel changes and pond formation at the 1974-76 Manti Landslide, Utah, U.S. Geological Survey Professional Paper, in press).

RHEOLOGICAL PROPERTIES AND INITIATING MECHANISMS OF MUDFLOWS AND DEBRIS FLOWS: U.S. Geological Survey, Water Resources Division, Vancouver, Washington. Thomas C. Pierson is attempting to develop empirical relations among variables in natural slurry flows based on observed and measured flow behavior so that the rheology of a wide variety of mudflows and debris flows may be defined. He is also attempting to identify the source of liquid and solid components of a variety of mudflows and debris flows, and to define the mechanisms by which the components are mixed and the flows mobilized under natural conditions. He has obtained data using portable field equipment to monitor the clay-rich slurries at Rudd Canyon (Farmington, Utah) in 1983-84 , and has filmed the passage of several flows there during that period.

FLOODS OF MAY TO JUNE, 1983 ALONG THE NORTHERN WASATCH FRONT, SALT LAKE CITY TO NORTH OGDEN, UTAH: Lindskov, K.L., 1984, U.S. Geological Survey Open-File Report 84-456 (Pending publication by the Utah Geological and Mineral Survey).

WATER LEVEL AND WATER-QUALITY CHANGES IN THE GREAT SALT LAKE UTAH, 1847-1983: Arnow, Ted, 1984; U.S. Geological Survey Circular 913, 22p. (The status of the level of the Great Salt Lake will have some significant impacts as regards earthquake hazard research and preparedness. It is to the benefit of everyone associated with the Wasatch Front Project to learn what they can about this fascinating body of water).

Next issue I expect to discuss some aspects of earthquake preparedness, and present an article on the Portola Valley Ranch residential subdivision that lies near the San Andreas Fault south of San Francisco, California. This is an elegant, successful development wherein geologic hazards considerations in the design did not interfere with the overall attractiveness and salability of the housing units. If you have any ideas or comments on this subject, please contact me at the phone number or address given below. Please contact me at any time if you have information that you would like to see in the FORUM.

William M. Brown, III, Physical Scientist
U.S.Geological Survey, Branch of Engineering Geology and Tectonics
Regional Landslide Research Group
345 Middlefield Road, MS-998
Menlo Park, California 94025
415-856-7112;7119 FTS: 467-7112;7119

◁PUBLICATIONS▷

The ninth annual Natural Hazards Research Workshop was held in July, 1984 in Boulder, Colorado. A workshop packet, which includes all abstracts and summaries, a program and participant list is available for $10.00 from Natural Hazards Research and Applications Information Center, Campus Box 482, University of Colorado, Boulder, Colorado 80309. Individual abstracts or session summaries are free upon request. Some of the abstract titles are:

RIP-3 AN INVESTIGATION OF POST-EARTHQUAKE FIRE RISK...Charles Scawthorn, Dames and Moore

RIP-8 PLANNING AND ENGINEERING RESPONSE TO LANDSLIDES...Martha L.Blair, William Spangle & Associates, Inc.

RIP-11 NETWORKS OF ORGANIZED VOLUNTEERS IN PREPARING FOR NATURAL HAZARDS...David Gillespie, Michael Sherraden, Washington University

RIP-13 THE ROLE OF INFORMATION IN THE JUDGEMENT OF RISKS FROM TECHNOLOGICAL AND NATURAL HAZARDS...George Cvetkovich, Western Washington University, Timothy C.Earle, Battelle Human Affairs Research Centers

RIP-15 SIMULATION OF FLOOD HAZARDS ON ALLUVIAL FANS...L.Douglas James, Utah State University

RIP-21 THE ROLE OF THE STATES IN NATURAL HAZARDS MITIGATION DECISIONS W.Henry Lambright, Syracuse University

P/P-6 NATIONAL INFORMATION SERVICE FOR EARTHQUAKE ENGINEERING...Ruth C.Denton, Earthquake Engineering Research Center

CONCURRENT SESSIONS SUMMARIES

CS84-18 GEOGRAPHICAL INFORMATION SYSTEMS: WHAT STEPS SHOULD BE TAKEN TO IMPROVE AVAILABLE DATA FOR DECISION MAKERS?

CS84-22 RISK ANALYSIS:WHAT HAVE WE LEARNED TO IMPROVE SITING, DISPOSAL, AND DEVELOPMENT DECISIONS?

CS84-25 EARTHQUAKE ECONOMICS

CS84-26 FLOOD-PRONE COMMUNITIES, POPULATION DEVELOPMENT POTENTIAL

CS84-27 LAND USE AFTER WARNINGS, LONG VALLEY

CS84-31 SIMULATION MODELING OF FLOOD HAZARD RISK IN UTAH

CS84-32 MAPPING HIGH RISK AREAS

CS84-36 STATE-OF-THE-ART ASSESSMENT OF RESEARCH ON EMERGENCY EVACUATION

GRANTS

Training curricula..."Development of Training Curricula for the National Emergency Training Center and Instructional Material for a Public Information Campaign." Federal Emergency Management Agency, $2.7 million, 15 months, Project Director: Albert Ferri Jr, Executive Vice President TRITON Corporation, 1255 23rd Street NW, Washington D.C. 20037 (202)296-9610

M & M Protection Consultants, a technical service of Marsh and McLennan, 222 South Riverside Plaza, Chicago, Illinois 60606 (312) 648-6000, has a publication entitled "Natural Hazards Information System--Purpose and Application Bulletin," which summarizes how and why the NHIS was developed, and some of the engineering and risk management applications to which it has been put.

U.S.GEOLOGICAL SURVEY PUBLICATIONS

(Information on obtaining the following publications is available from any of the Public Inquiries Offices listed in this issue)

PP1274AB Faulting related to the 1915 earthquakes in Pleasant Valley, Nevada.

P 1291 The triangular stress diagram: a graphical representation of crustal stress measurements. H.S. Swolfs

C.896-D Earthquakes in the United States, October-December 1982

OF83-934 Linear features determined from Landsat imagery for the Richfield 1:250,000 quadrangle and adjacent areas, Utah. M.E.Cooley

OF84-166 Intensity survey of the Borah Peak earthquake of October 28,1983. G.Reagor and F.Baldwin

OF84-225 United States earthquake data file, C.W. Stover, B.G.Reagor, S.T. Algermissen

OF84-255 User's guide to SELECT, an interactive VAX computer program for building subsets of earthquake data. F.W.Klein

OF84-257 Fast evaluation of Hr and Hz field soundings near a rectangular loop source on a layered Earth (program HRZRECT). W.L. Anderson

OF84-297 Preliminary isoseismal map and intensity distribution for the Borah Peak, Idaho earthquake of 10/28/83. C.W. Stover

OF84-456 Floods of May to June 1983 along the northern Wasatch Front, Salt Lake City to North Ogden, Utah. K.L. Lindskov

General Interest Publication

THE SAN ANDREAS FAULT...S.S. Schulz and R.E. Wallace, 1984 (revision)

John Boatwright...The effect of rupture complexity on estimates of source size. JGR, Journal of Geophysical Research, B, v.89, no.2, February 10, 1984, p.1132-1146

E.E. Brabb and R.W. Fleming...Landslide emergency met. Earth Science, v. 36, no.4, 1983, p.14-15

E.R. Engdahl and S.Billington...Short-period depth phases observed from subduction-zone earthquakes (abstr.) Eos. Transactions, American Geophysical Union. v.64, no.18, May 3, 1983. p.264

W.W. Hays...Technical problems in the construction of a map to zone the earthquake ground-shaking hazards in the United States. Engineering Geology, v.20, no.1-2, March 1984, p.13-23.

D.K. Keefer...Rock avalanches caused by earthquakes; source characteristics. Science, v.223, no.4642, March 23, 1984, p.1288-1290

D.F.McTigue and R.S. Stein...Topographic amplification of tectonic displacement; implications for geodetic measurement of strain changes. JGR. Journal of Geophysical Research, B, v.89, no.2, February 10, 1984, p.1123-1131

R.S.Stein...Implications of off-fault aftershocks for preearthquake stress (abstr), Program with abstracts - Geological Association of Canada, v.8, 1983, p.A64

C.W.Stover...Intensity distribution and isoseismal map. Special Publication - California Division of Mines and Geology, v.66, 1983. p.1-4.

COMMENTS...CONTRIBUTIONS...ETC !

We appreciate any comments that you may have on the "FORUM". Everything is fair game...format, nature of material in each issue, suggestions for future issues, contributions, appearance, illustrations etc. Please mail to the address shown on the bottom of the form. Thank you.

_____

_____

_____

_____

_____

NAME_____

ADDRESS_____

CITY_____STATE_____ZIP CODE_____

PLEASE RETURN CARD TO: WENDY HASSIBE, FORUM EDITOR, 8105 FEDERAL BUILDING, SLC, UTAH 84138, OR ANY CO-EDITOR LISTED ON THE FIRST PAGE

LAST MINUTE ADDITIONS.....
TOO GOOD TO WAIT FOR THE NEXT ISSUE !.....

Following are some excerpts from U.S. Geological Survey Open File Report 84-765 which has just been published. William J. Kockelman is the author of the 20 page report. Information on obtaining copies is available from any of the Public Inquiries Offices listed in this edition of the FORUM.

REDUCING LOSSES FROM EARTHQUAKES THROUGH PERSONAL PREPAREDNESS

William J. Kockelman
USGS, Menlo Park, California

"Actions to reduce earthquake hazards can be divided into five phases: two before the event, one during the event and two after the event. These five phases are: (1) pre-event mitigation techniques which may take 1 to 20 years, (2) preparedness measures which may take 1 to 20 weeks, (3) response during the event, (4) recovery operations following the event which may take 1 to 20 weeks, and (5) post-event reconstruction activities which may take 1 to 20 years. Obviously, those times will vary depending upon the magnitude of the earthquake and the resources available to the community and metropolitan area.

Preparedness is just one phase of hazard reduction; personal preparedness is just one aspect of that phase. For example, the Council of State Governments (1976) suggests an outline for a comprehensive state emergency preparedness plan and the Western States Seismic Policy Council (1984, Appendix A) reports on the status of states' earthquake preparedness projects. The Southern California Earthquake Preparedness Project (1983), through `planning partner' arrangements with selected public jurisdictions and private entities, has developed prototypical planning guidelines for responding to, and recovering from, an earthquake. The Federal Emergency Management Agency recently funded the Central United States Earthquake Consortium -- the nation`s first effort to develop and coordinate earthquake preparedness activities in a region composed of several states. Corporate, utility, and governmental preparedness (as well as mitigation, response, recovery, and reconstruction) can be very complex; discussion of these is beyond the scope of this paper.

A prerequisite to personal preparedness is familiarity with and concern about all hazard-reduction phases. For example, strengthening the structure of the home, storing water, and showing family members how to shut off the electric-, gas-, and water-supply lines are only a part of one phase -- personal preparedness. Equally important are the other phases which might include picking up children from an evacuated school, securing heavy objects at the work place for the safety of a spouse, and retrofitting the commuter-highway overpasses needed to reunite a family.

MITIGATION TECHNIQUES

Many techniques for reducing earthquak hazards before the event are available to planners, engineers, and decisionmakers. Some of these techniques are well known to the planning profession, such as public acquisition of hazardous areas; or to the engineering profession, such as designing and constructing earthquake-resistant structures. Others are obvious, such as warning signs and regulations. Still others have been successfully used in solving landslide, flood, and soil problems, but have not heretofore been applied to earthquake hazards.

These and other techniques are listed (following) under the general headings of discouraging new development, removing or converting existing unsafe development, providing financial incentives or disincentives, regulating new development, protecting existing development, and ensuring the construction of earthquake-resistant structures.

☑ DISCOURAGING NEW DEVELOPMENT IN HAZARDOUS AREAS BY:

- Adopting seismic-safety or alternate-land-use plans
- Developing public-facility and utility service-area policies
- Disclosing the hazards to potential buyers
- Enacting Presidential and gubernatorial executive orders
- Informing and educating the public

☑ REMOVING OR CONVERTING EXISTING UNSAFE DEVELOPMENT THROUGH:

- Acquiring or exchanging hazardous properties
- Clearing and redeveloping blighted areas before an earthquake
- Discontinuing nonconforming uses
- Reconstructing damaged areas after an earthquake
- Removing unsafe structures

☑ PROVIDING FINANCIAL INCENTIVES OR DISINCENTIVES BY:

- Adopting lending policies that reflect risk of loss
- Clarifying the legal liability of real-property owners
- Conditioning Federal and state financial assistance
- Making public capital improvements in safe areas
- Providing tax credits or lower assessments to property owners
- Requiring nonsubsidized insurance related to level of hazard

☑ REGULATING NEW DEVELOPMENT IN HAZARDOUS AREAS BY:

- Creating special hazard-reduction zones and regulations
- Enacting subdivision ordinances
- Placing moratoriums on rebuilding
- Regulating building setbacks from known hazardous areas
- Requiring appropriate land-use zoning districts and regulations

☑ PROTECTING EXISTING DEVELOPMENT THROUGH:

- Creating improvement districts that assess costs to beneficiaries
- Operating monitoring, warning, and evacuating systems
- Securing building contents and nonstructural components
- Stabilizing potential earthquake-triggered landslides
- Strengthening or retrofitting unreinforced masonry buildings

☑ ENSURING THE CONSTRUCTION OF EARTHQUAKE-RESISTANT STRUCTURES BY:

- Adopting or enforcing modern building codes
- Conducting appropriate engineering, geologic, and seismologic studies
- Investigating and evaluating risk of a proposed site, structure, or use
- Repairing, strengthening, or reconstructing after an earthquake
- Testing and strengthening or replacing critical facilities"

(continued)

(Reducing Losses.....)

The report continues with discussions of preparedness measures, responses, recovery operations and reconstruction activities, and in conclusion, Bill states "...a prerequisite to their effective use is public awareness. Turner and others (1980) make the following recommendations for improving public awareness:

* Carefully prepared and selected advice concerning earthquake preparedness for individuals and households should be given widespread and repeated public distribution through the media as well as other channels.

* This preparedness advice should come from some authoritative government agency and should be endorsed by well-known local government officials and public personages.

* Each recommended preparedness measure should be presented in conjunction with a brief but credible explanation justifying that recommendation and suggesting how it can be implemented.

* Some responsible state agency should develop a program to promote earthquake safety in the household making use of local government, private agencies, and citizen groups. An especially useful program of this type would be one that conducted household safety inspections."

1984 WORKSHOP ....follow-up!

At the request of the Bureau of Health Planning and Facilities, State of Utah, Department of Health, Bill Kockelman (USGS, Menlo Park), provided the following materials in response to questions raised during the Workshop, on public health and safety through hazard reduction:

* Photographs of Olive View Hospital, 1971 San Fernando Valley earthquake
* Earthquake damages and losses to hospitals and medical buildings encluding details on failures (Steinbrugge and others, 1971)
* Summary of damages to building units of the city hospital from the 1980 El-Asnam,Algeria earthquake (NRC/EERI, 1983)
* A study of earthquake losses anticipated in the San Francisco bay area and its effects on local medical resources...(NOAA, 1972)
* Reducing the risk of nonstructural earthquake damage with vulnerability keyed to Uniform Building Code seismic zone 3 in Utah (Reitherman,1983)

ASSOCIATION OF BAY AREA GOVERNMENTS
Earthquake Preparedness Publications

Regional and Local Actions

Land Capability Analysis for Planning and Decision Making, February 1976 No Charge*

We're Not Ready for the Big Quake - What Local Governments Can Do, March 1980 $5.00

Liability of Local Governments

Legal References on Earthquake Hazards and Local Government Liability, 1978 No Charge*

Earthquake Hazards and Local Government Liability: Executive Summary, January 1979 No Charge*

Attorney's Guide to Earthquake Liability, May 1979, No Charge*

(* = please include $1.00-postage and handling)

ORDER FROM:

A B A G
P.O. Box 2050
Oakland, California 94604

WHEN THE EARTH MOVES

This U.S. Geological Survey film (16 mm, color, sound, 26.5 minutes) discusses a wide range of geologic hazards including volcanic eruptions, earthquakes, subsidence, landslides, swelling soils, and flooding and discusses some of the alternatives available to people and their governments to lessen or avoid the effects of these hazards. The film uses animation and scenes from actual events to explain the nature of the hazards, dangers associated with them, and their probable locations. Through interviews with land-use planners, government officials, engineers, geologists, and other individuals, the film explorers various ways of coping with natural hazards.

The purpose of the film is to provide awareness about geologic hazards and how through greater awareness, planning, avoidance and mitigation efforts the damage from such hazards can be reduced. Land-use planners, government officials, members of the building industry, students and teachers from intermediate through college levels, and general public would be the targeted audience.

Arrangements to borrow a copy of this film can be made by contacting USGS, Public Inquiries Office, 8105 Federal Building,125 South State, SLC, Utah 84138 - 801-524-5652.