WASATCH FRONT FORUM

VOL. V
NO. 1

AUTUMN
1988

EARTHQUAKE HAZARDS PROGRAM

FROM THE EDITOR . . .

The Editor offers a gentle reminder to all readers that they must return the address verification form from the Spring-Summer issue of the Forum or this will be the last issue they receive! To the many of you who have already done so, I extend my appreciation. I am also grateful for the detailed comments and suggestions included on most of the Reader Surveys returned so far. The compiled results will be published in the Winter issue due out in early April.

Set aside January 31-February 1 and plan to attend the 1989 Annual Meeting of the Utah NEHRP. This will be one of the most important Wasatch Front meeting to date. Details are included in the first article of this issue. If you have questions regarding either the 1989 Annual Meeting or the Reader Survey and resulting changes in the mailing list, contact the Editor at (801) 581-6831. See you in January!

Information, contributions, questions, and suggestions, concerning future issues may be sent to the Editor at the address listed below:

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DEADLINES FOR FUTURE ISSUES

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1989 ANNUAL EARTHQUAKE MEETING
JANUARY 31 - FEBRUARY 1, 1989
UNIVERSITY PARK HOTEL, SALT LAKE CITY

The 1989 annual meeting of the Utah NEHRP, sponsored by USGS, FEMA, UGMS, and Utah CEM, will be held at the University Park Hotel in Research Park (1.5 blocks north of UGMS) in Salt Lake City on January 31-February 1, 1989. This meeting will be different from previous meetings in that its goal is to arrive at a consensus, based on research findings over the last 5 years, regarding expected physical effects of a moderate to large earthquake on the Wasatch Front and strategies to reduce earthquake losses. A series of briefings of selected government officials will precede the meeting on January 30 to present a status report and summary of results.

In preparation for the meeting, a draft "synthesis" document has been prepared by Walt Hays, Walter Arabasz, and Don Mabey and reviewed by a select multi-disciplinary group of researchers and users. On the first day of the meeting, the document will be presented to all attendees, along with other information regarding the NEHRP in Utah. The remainder of the meeting will be devoted to review and discussion of the document to strive to build a consensus. In conjunction with the meeting, Utah CEM will conduct several training and instructional courses for emergency response personnel on the afternoon of January 31st and morning of February 1st. At the end of the second day, the revised document will be presented. The meeting will then adjourn for refreshments to celebrate "consensus" and kick-off the next year's effort.

Draft copies of manuscripts submitted for Part B of the Wasatch Front Professional Paper will be distributed at the meeting. Also, plans for the upcoming International Decade of Natural Disaster Reduction will be discussed. The meeting is free of charge, and everyone is urged to attend. Further information will be included in letters of invitation sent out prior to the meeting, but if you have any questions contact the Editor at UGMS, (801) 581-6831.

THE 14 AUGUST 1988 SAN RAFAEL SWELL EARTHQUAKE IN EMERY COUNTY, UTAH

William F. Case

Utah Geological & Mineral Survey

The following is a summary of preliminary seismological data and the geological effects of the San Rafael Swell earthquake. A more detailed discussion will be presented in the forthcoming issue of UGMS Survey Notes, v. 22, no. 1-2. Please note that the seismological parameters reported for the Emery County earthquake in the story: "Earthquake in Central Utah" in the last issue of the Wasatch Front Forum (Spring-Summer, 1988, v. IV, no. 3-4, p. 23) were very preliminary, and have now been refined and better constrained by the University of Utah Seismograph Stations (UUSS) from their portable seismographs deployed near the epicenter and from additional stations outside their established network.

The main shock, local magnitude (M_L) 5.3, which occurred at 2:03 pm MDT was preceeded by two foreshocks of local magnitudes 2.9 and 3.8 (UUSS). The epicenter was on the northwestern edge of the San Rafael Swell, 20 km (12 mi) southeast of Castle Dale and 55 km (34 mi) south of Price (fig. 1). The population of communities west of the epicenter ranges from little more than 2000 (Castle Dale) to 300 (Elmo). The communities are in a populated strip parallel to State Route 10 which connects Price with I-70 and Salina. There are no population centers immediately east of the epicenter.

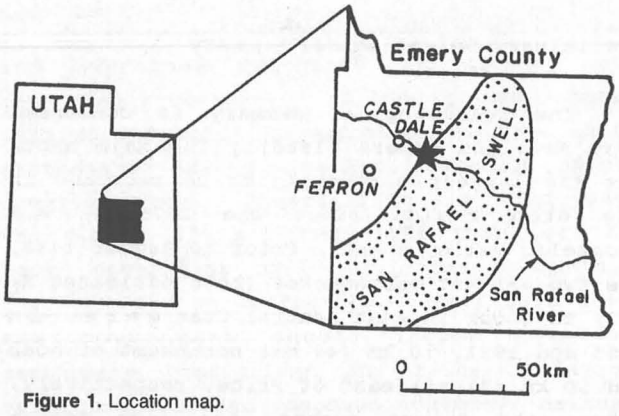

Figure 1. Location map.

Damage was limited to dislodged pieces of plaster and bricks in older structures, broken windows, and only temporary lifeline disruption. A maximum, preliminary Modified Mercalli Intensity value of VI was assigned to communities near the epicenter by Carl Stover (U.S. Geological Survey National Earthquake Information Center, written commun., 21 September, 1988). The earthquakes were not felt by coal miners working underground within 40 km (25 mi) of the epicenter but were felt up to 567 km (353 mi) from the epicenter, at Albuquerque, New Mexico, Golden, Colorado (U.S. Geological Survey, 1988), and Delta and Brigham City, Utah (Salt Lake Tribune, 15 August, 1988). The most visible effect of the main shock was dust produced by perhaps hundreds of rock falls from cliffs in the area. Isolated rock falls were sighted up to 113 km (70 mi) from the epicenter. Cracks and a sand boil caused by liquefaction of saturated alluvium were discovered on the San Rafael River near the epicenter (T.L. Youd, Brigham Young University Civil Engineering Department, oral commun., 17 August, 1988). Water flow in a culinary spring in Huntington Canyon, 47 km (30 mi) from the epicenter, almost doubled following the main shock (Darrel V. Leamaster, Castle Valley Special Service District, written commun., 7 September, 1988). During the main shock, strong motion accelerometers recorded peak accelerations of 0.11g on the crest and 0.06g on the midslope of Joes Valley Dam, 42 km (26 mi) west of the epicenter (Dan Grundvig, Bureau of Reclamation, oral commun., 11 October, 1988).

Preliminary Seismological Summary

The seismological summary is condensed from Nava and others (1988). The main shock was the largest earthquake to be recorded in the Utah region since the 1975 M_L 6.0 Pocatello Valley event. Prior to August 1988, the two largest earthquakes (both estimated M_L 4.3) to occur in east central Utah were in 1953 and 1961, 70 km (44 mi) northwest of Moab and 50 km (31 mi) east of Price, respectively. Before the August events, the most recent activity in the epicentral area was in January, 1988, when a swarm of events of M_L less than or equal to 2.5 was recorded by UUSS.

Before the earthquakes, the nearest seismograph was at Cedar Mountain, 20 km (12 mi) east-northeast of the epicenter. Temporary seismograph stations were installed in the epicentral region by 15 August. Telemetered seismograph stations were installed in the area on August 20 and 21 and continue in operation as of mid-November, 1988.

Six foreshocks, M_L 1.8-3.8, occurred on 14 August within 65 minutes of the main shock. The two largest, M_L 2.9 at 12:58 pm MDT, and 1:07 pm MDT, were felt. Between 14 August and 30 September, the UUSS located 147 earthquakes associated with the San Rafael Swell sequence; 24 were greater than or equal to magnitude 2.0. The largest aftershock, of M_L 4.4, occurred at 6:44 am MTD on 18 August and was felt strongly in the surrounding area.

Hypocenters define a 4 x 8 km (2.5 x 5 mi) aftershock zone extending from 8-15 km (5-9 mi) below the surface, dipping 60°-70° E-SE. The preliminary focal mechanism for the main shock is not well constrained, but indicates oblique normal faulting with a rake of -35°. If the fault plane is assumed to be parallel to the aftershock zone, the T-axis of the main shock is constrained to a shallow plunge at an azimuth within 25° of east-west.

The seismogenic zone is within Precambrian basement below about a 3 km (2 mi) thick unit of gently-dipping Mesozoic and Paleozoic sedimentary rocks. Sevier-age deformation consists of east-verging imbricate thrust faulting which does not affect the basement. Fracture zones, NW and NE trending, provide structural control to crustal blocks in the Colorado Plateau including the San Rafael Swell, a broad anticlinal upwarp. Available data suggest that the San Rafael Swell occurred on a Precambrian basement fault striking NNE and dipping moderately to steeply ESE. Focal mechanisms indicate an E to W horizontal extension, similar to the deformation in the Basin and Range/Colorado Plateau transition zone (Arabasz and Julander, 1986), west of the area, but different from

the NNE-SSW to NE-SW extension of the Colorado Plateau (Wong and others, 1987; Wong and Humphrey, 1988).

Geologic Effects

Liquefaction

Cracks caused by liquefaction of saturated alluvium were noted by T. Leslie Youd (oral commun., 17 August, 1988) on 15 August. Youd found small cracks parallel to the San Rafael River approximately 4 km (2.5 mi) from the epicenter. Possible liquefaction cracks were noted by UGMS in recent alluvium on the San Rafael River on 23 August, 1988. The cracks were parallel to the river, and ranged from 1-1.5 m (3-5 ft) long and as much as 2.5 cm (1 inch) wide and deep near the stream bank. A 13 cm (5 inch) diameter sand boil was ejected from a crack in the alluvium.

Rock Falls

Dust clouds produced by rock falls were the most visible effect of ground shaking. Falls and dust continued for almost an hour after the shocks, giving residents the time to take pictures and video tape the dust clouds.

Questionnaires were forwarded by UGMS to respondents in a "call for data" issued in newspapers in the region. A tabulation of questionnaires revealed that rock falls were triggered by both the 14 August main shock and the largest aftershock on 18 August.

The majority of rock falls and/or associated dust were reported along the eastern cliffs of the Wasatch Plateau from Huntington Canyon south to the Emery area, about 40 km (24 mi) from the epicenter, and in Buckhorn Draw within 19 km (12 mi) of the epicenter. Most of the questionnaires reported dust which obscured the cliffs of the Wasatch Plateau and a "curtain of dust" in Buckhorn Draw. Individual rock falls were witnessed in Huntington Canyon, east of Ferron, in Buckhorn Draw, in the Book Cliffs at Columbia, at Balanced Rock near Helper, and near Dead Horse Point State Park, 115 km (70 mi) from the epicenter. Circumstantial evidence of rock falls such as a boulder in the road, an unusual accumulation of clasts below a road cut, or a fresh scar on a cliff with rock fall clasts at its base were noted in Spanish Fork Canyon, Soldiers Summit, Price Canyon (U.S. Highway 50), Salina Canyon (Interstate 70), and on the La Sal Mountain Loop Road near Moab. Evidence indicates that, based on the dust cloud extent, possibly hundreds of rock falls occurred within 40 km (25 mi) of the epicenter; isolated rock falls were initiated up to 113 km (70 mi) from the epicenter, and there is a possibility that some rock falls, as much as 129 km (80 mi) from the epicenter, were triggered by ground shaking.

Emergency Response and Damage Reports

The following is from a Utah Division of Comprehensive Emergency Management (CEM) Affected Location Emergency Response Team (ALERT) report by Tingey and May (1988). CEM reacted to the Emery County earthquakes using established state-to-county emergency response procedures with CEM ALERT visitations to follow-up on possible damage and public needs and reaction. After hearing of the main event, Lorayne Frank (Director, CEM) contacted the following entities: Carbon and Emery County emergency facilities, UUSS, Utah Power and Light, Utah Department of Public Safety, Utah Division of Water Rights, and Utah Department of Transportation. Dams and reservoirs were inspected from the air and on the ground by Ms. Frank and Doug Bodero (Public Safety). The U.S. Bureau of Reclamation inspected their dams. According to Tingey and May (1988), "This moderate event provided a good test of the response mechanism of the state and proved the value of written and exercised emergency notification and reporting procedures." A public meeting was held on August 25 to educate residents about earthquakes and to gather responses using questionnaires. According to the responses, the public did not feel that they, or the local government officials, were adequately prepared for an earthquake. Many felt that the government should inform them of earthquake predictions and risks. Damage reported included deposed chimney bricks,

cracked foundations and driveways, and overturned shelves. Waves were seen on tiled-concrete floors in a church. No lifelines were damaged.

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PROBABILISTIC LIQUEFACTION SEVERITY INDEX MAP OF THE STATE OF UTAH

Mathew A. Mabey and T. Leslie Youd of the Department of Civil Engineering, Brigham Young University, have recently completed a report and series of Liquefaction Severity Index maps for the State of Utah under a contract with the Utah Geological and Mineral Survey (UGMS). Maps in the report are small-scale (page-size), and the abstract from the report is reproduced below. Copies will be available at the annual earthquake meeting in January 1989.

ABSTRACT

Liquefaction Severity Index maps for the State of Utah were generated using probabilistic analysis. The Liquefaction Severity Index (LSI) expresses the maximum magnitude of differential deformation which would be the result of the liquefaction of a soil. LSI is defined as the maximum displacement, in inches, occurring in Holocene flood plain deposits and is a function of distance from the causative earthquake and the magnitude of that earthquake. Maps of LSI have been prepared for 10% probability of exceedence in four different exposure periods, 10 years, 50 years, 250 years, and 1000 years. The latter is intended to approximate a deterministic case. While the Wasatch fault is assumed to be the greatest source of earthquake shaking to cause liquefaction, these maps clearly show that a very broad area has a significant liquefaction hazard arising from the numerous other earthquake generating faults in the state. The occurrence of liquefaction requires shallow ground water, the absence of which reduces the LSI to near zero. The LSI maps quantify the probable maximum hazard due to liquefaction and can be used to reduce the risk to lifelines and other engineered structures by planning for the maximum probable effects of liquefaction.

EARTHQUAKE KNOWLEDGE, PERCEPTIONS OF RISK AND MITIGATION PRIORITIES OF PLANNERS AND BUILDING OFFICIALS IN SALT LAKE COUNTY

Gary E. Madsen

Department of Sociology
Utah State University

During the last several years, USGS sponsored research programs have been undertaken to more accurately assess earthquake hazards along the Wasatch Front. In addition, workshops and other educational programs have been directed toward local government officials to inform them of the hazards. Do these recent efforts correspond to high levels of knowledge of earthquake hazards among local officials? Are local officials generally unconcerned about earthquake risks in their communities, or do they believe a damaging earthquake is likely to occur in the future? Furthermore, have they given much thought to mitigation strategies? These questions were addressed in a recent survey of planners and building officials in Salt Lake County as part of an implementation project funded through USGS's Earthquake Hazard Reduction Program.[1]

Salt Lake County contains twelve municipalities, ten of which have at least one planning or building official. Unincorporated areas are served by personnel of Salt Lake County government. Twenty-eight officials were identified for inclusion in the survey. In the largest governmental units, the highest level administrative personnel were identified. Each individual was interviewed in person during May and June of 1988. The completion ratio was one hundred percent. Among the findings are those which pertain to the assessment of three factors: earthquake hazard knowledge, perceptions of earthquake risks, and earthquake risk reduction priorities.

Respondents were asked to rank seven causes of damage from potential earthquakes in the Salt Lake Valley. They were asked to assign the number one to the item with the highest potential for damage and the number seven to the item with the lowest potential, with corresponding numbers assigned to items between the extremes. The results are presented in Table 1. They indicate a high correspondence between the local officials and the scientific community (see Christenson, 1987).[2] For example, the problem of ground shaking is considered to be the greatest potential hazard based upon scientific investigations.

Table 1. Ranking of Potential Damage From Earthquake Hazards in the Salt Valley by Local Government Planners and Building Officials.

Causes of Damage	Mean of Ranks*	Standard Deviation of Ranks
Ground Shaking	1.52	.75
Ground Failure Induced by Liquefaction	2.26	1.13
Fault Rupture	3.63	1.55
Landslides and Rockfalls	4.04	1.29
Tectonic Deformation	4.82	1.39
Dam Failure	5.22	.94
Water Waves	6.52	1.37

*Very high was assigned a point value of 5, high = 4, moderate = 3, low = 2, and very low = 1.

How do local planners and building officials perceive earthquake risks? They were asked to indicate how likely it is that there will be an earthquake causing widespread and severe damage in the Salt Lake Valley

[1]The implementation project team is composed of Gary Madsen, sociologist; Jerold Barnes, planner; Loren Anderson, civil engineer; Jeffrey Keaton, geologist; Lawrence Reaveley, structural engineer; and Craig Nelson, geologist.

[2]Several fixed alternative items were derived from W.J. Kockelman, 1986, Community planning to reduce mudflow and mudflow hazards, in Improving the effectiveness of flood plain management in arid and semi-arid regions: Proceedings of the Association of State Flood Plain Managers, Inc., March, 1986, Las Vegas, Nevada, p. 65-71.

during three time periods: within the next 100 years, the next 50 years, and the next 10 years. The response alternatives were very high, high, moderate, low and very low. The results are presented in Table 2.

Table 2. Perceptions of the Likelihood of a Future Damaging Earthquake in the Salt Lake Valley by Local Government Planners and Building Officials.

Earthquake Risk Time Period	Mean of Ranks*	Standard Deviation of Ranks
How likely do you think it is that there will be an earthquake causing widespread and severe damage in the Salt Lake Valley within the next 100 years?	4.64	.62
How likely do you think it is that there will be an earthquake causing widespread and severe damage in the Salt Lake Valley within the next 50 years?	4.18	.77
How likely do you think it is that there will be an earthquake causing widespread and severe damage in the Salt Lake Valley within the next 10 years?	3.14	.71

*Very high was assigned a point value of 5, high = 4, moderate = 3, low = 2, and very low = 1.

These data indicate a great deal of concern about the likelihood of future damaging earthquakes affecting the Salt Lake Valley. In the one hundred year period, the average approaches the maximum level of very high likelihood. Even the shortest time span of ten years yields an average of three, corresponding to moderate likelihood.

Respondents were also asked open-ended and fixed alternative questions regarding actions they felt should be taken to reduce the risks from earthquakes in the Salt Lake Valley. Items receiving the highest overall ranks using both methods are presented below. The list is not presented in order of importance.

Controlling the location and specific design requirements of new hospitals, schools, police facilities and fire stations to better prepare for earthquakes.

Strengthening existing hospitals, schools, police facilities and fire stations to better prepare for earthquakes.

Informing and educating the public about earthquake hazards and earthquake preparedness.

Providing public officials with earthquake hazard information for use in reducing earthquake risks.

Providing public officials with professional technical assistance in order to help reduce earthquake risks.

Promoting land use planning which considers earthquake hazard areas.

Adhering to existing earthquake-related building codes, zoning ordinances and building inspections.

Adopting uniform earthquake-related building codes, zoning ordinances, and building inspections.

Requiring disclosure of the earthquake hazard(s) to real estate buyers.

Encouraging public agency programs which improve emergency responses to earthquakes.

These findings indicate that local officials are knowledgeable about earthquake hazards, are concerned about earthquake risks, and support specific mitigation policies.

REFERENCES

Christenson, G.E., 1987, Suggested Approach to Geologic Hazards Ordinances in Utah, Utah Geological and Mineral Survey Circular 79, 16 p.

CONTINUING INVESTIGATIONS OF EARTHQUAKE RISK TO UTAH WATER AND GAS SYSTEMS

By Craig E. Taylor, Mike Salmon, Ron Aguchi, Robert Campbell, and Craig Tillman
NTS Engineering

Editors Note: The following was taken from the Executive Summary of the report. The entire report is available from NTS Engineering, 6695 East Pacific Coast Highway, Long Beach, CA 90803. In may also be inspected and reviewed at the UGMS Library, 606 Black Hawk Way, Salt Lake City, UT 84108-1280, (801) 581-6831.

In a previous study sponsored by the U.S. Geological Survey, earthquake risks to culinary water and natural gas systems in Salt Lake and Davis Counties were examined (see Taylor, et al., 1986). Expected pipe breaks were emphasized relative to a variety of earthquake scenarios. Also emphasized was the use of study outputs to assist local utility earthquake risk reduction programs (see McDonough and Taylor, 1986). This study extends methods previously used to Weber and Utah Counties. Earthquake risk results are developed for culinary water and natural gas systems in these counties so that local officials may improve their risk reduction programs. Uncertainties in these risk estimates have been examined. Consistent with the iterative nature of seismic risk analyses, this examination has led to recommendations for further research to reduce the uncertainties.

Methods Summarized

Figure 1 outlines the main tasks performed in this study. As a result of deficiencies perceived in the earlier study and progress made in disciplines directly relevant to lifeline seismic risk analysis, methods used previously have been expanded and revised. The important procedures in risk studies include exposure inventories, hazard definition, vulnerability analysis, and risk analysis.

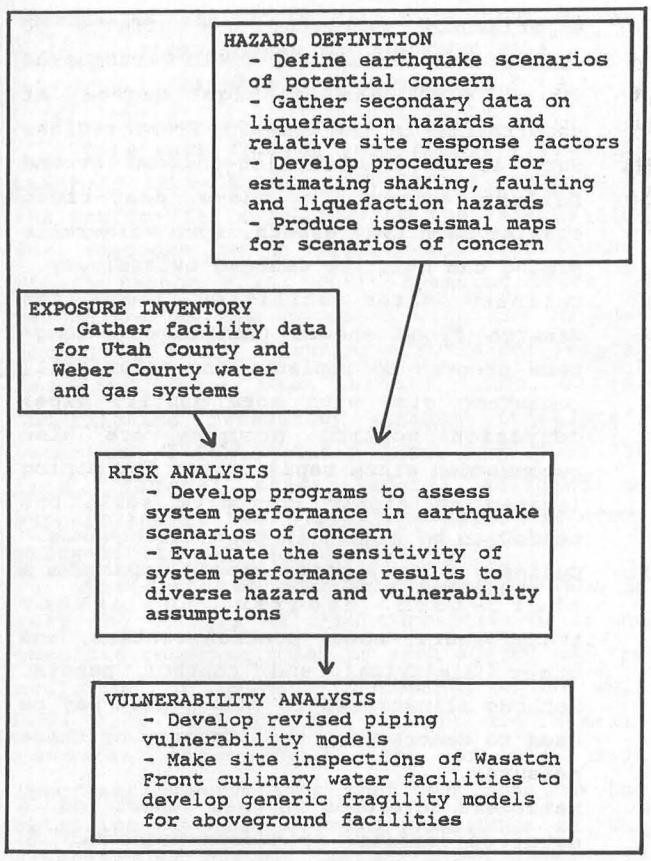

Figure 1. Main Tasks Performed

Recommendations

Continuation of the considerable valuable research upon which this study has been built would improve the estimates made in this report. At the same time, utility risk reduction programs can benefit from current risk estimates. Further research that improves these estimates and reduces their uncertainties will rarely and typically only selectively revise policy decisions based on current estimates. Given specific study findings, we make the following recommendations:

1. A research program is needed to define procedures for assigning probabilities of liquefaction-induced ground failures. This would include a re-examination of multipliers used to adjust for the number of strong motion cycles; this would also include an examination of earthquake incidents in which liquefaction-induced ground failures did not occur, or were not extensive. Without such field and/or

experimental research, the effects of smaller magnitude, near-field earthquakes ($M \leq 6.4$) has a high degree of uncertainty in the Wasatch Front region. But, if no liquefaction-induced ground failure occurs in these near-field smaller magnitude events, more vulnerable piping can still be damaged extensively.

2. Culinary water utilities along the Wasatch Front should undertake a long-term program to replace less seismically resistant pipe with more ductile pipe; corrosion control programs are also recommended since repair rates for piping located in highly corrosive soils has tended to be higher in past earthquakes.
3. Culinary water systems should undertake a short-term program to anchor transformers, motor control centers, and other electrical and control panels. Methods illustrated in this report may be used to demonstrate the efficacy of these measures.
4. Materials developed in this report and in detailed computer printouts presented to local officials should be used to prioritize other pre- and post-earthquake planning needs. Natural gas company planning, as well as planning efforts by selected major local water utilities, should serve as a guide to what can be accomplished through this planning.
5. Continuing risk analyses should further examine whether or not use of very simple fault models (ignoring even dip angles for the Wasatch normal fault) are sufficiently accurate for Weber, Davis, and Utah County exposures in view of their extremely close proximity to the surface trace of the Wasatch fault; our previous studies showed that these very simple models are not accurate enough for many Salt Lake County exposures.
6. Additional soil boring data are needed to refine estimates of liquefaction susceptibilities in the region; in view of the very low probabilities of liquefaction-induced ground failure in moderate-to-low susceptible regions, efforts should emphasize further samples in regions and/or sites suspected to have high susceptibility and that are near potential or actual exposures.
7. Similar efforts should continue to identify and develop the means to analyze sites susceptible to other permanent ground failure modes such as landsliding. Canyons, often serving as utility corridors, should not be overlooked.

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PUBLIC HEARING
HAZARDS ORDINANCE FOR SALT LAKE COUNTY

Tuesday, January 24, 1989
Salt Lake County Government Center
2001 South State Street, #N1100

Because local governments are charged with protecting the health, safety, and welfare of their citizens, there is a general belief that when a local government issues a building permit, it includes an implicit endorsement that the site is safe. Although the liability of local governments in Utah has not been well defined, it is possible that after a seismic event occurs and damage and/or casualties result, local governments would be found negligent for allowing unconstrained development in known hazard areas. The primary reason that buildings have been allowed in hazardous areas is that under existing ordinances the local governments did not have the power to regulate development based on geologic problems. Information regarding geologic hazards and their inherent

risks is available for areas along the Wasatch Front but no method currently exists for providing such pertinent information to those making real estate purchases.

The Salt Lake County Planning Division has proposed a Natural Hazards Ordinance that would require site specific geologic study and avoidance or mitigation of geologic problems prior to approval of new developments. It will have no effect on existing structures. These requirements will only apply to sites within "Special Study Areas" for: 1) fault zones; 2) liquefaction areas; and 3) avalanche paths. The ordinance would not require new developments of single lot homes to provide site-specific data, but would require disclosure so that buyers would be aware that the site is in a geologic hazard area, and they could use this knowledge to make informed decisions. The purpose of this ordinance is to help protect the safety and property of citizens. The ordinance is not meant to restrict or prohibit development or to add unnecessary costs to construction. The ordinance will help insure that developments within the "Special Study Areas" have addressed the geologic problems present.

The Natural Hazards Ordinance is now under consideration by the Salt Lake County Planning Commission. If they recommend adoption, the ordinance could begin to be used in the unincorporated portion of the county. These decisionmakers rely greatly on public input when voting for policy changes. There has been some opposition to the ordinance and particularly the hazards disclosure segment. Your comments and suggestions are needed.

A copy of the proposed ordinance can be obtained from Craig Nelson, Salt Lake County Geologist, 2001 South State Street, #N3700, Salt Lake City, Utah 84190-4200, (801) 468-20611.

A public comment hearing is scheduled for Tuesday, January 24, 1989. Please try to attend or write the Planning Commission to voice your opinion. Written comments can be sent to Craig Nelson at the aforementioned address or to Salt Lake County Planning Commission, c/o Administrative Assistant, 2001 South State Street, #N3600, Salt Lake City, Utah 84190.

UPDATE ON FEMA REGION VIII SUPPLEMENT TO THE FEDERAL PLAN FOR RESPONSE TO A CATASTROPHIC EARTHQUAKE

Once each federal year quarter, meetings are held in Salt Lake City on the progress of the Region VIII supplement to the Federal Plan for response to a catastrophic earthquake. Within Region VIII, Utah's Wasatch Front is recognized as the location with the highest earthquake risk. Planning efforts for Federal response have been broken into eleven interlinking "emergency support functions", each with a particular Federal agency as the lead, several other Federal agencies as support and at least one state agency as "ESF" state counterpart representative.

The last two quarterly meetings held in July and October of 1988 concentrated on the specific response roles of each agency and the evolution of planning documents which will come from each ESF to make up the overall response documents. One of the most important observations that has come to the attention of the planning committee is the diversity of day to day operating procedures of Federal, State, and other cooperating agencies.

Agencies such as FEMA, U.S. Army Corps. of Engineers, American Red Cross, and U.S. Forest Service (Interagency Fire) have emergency operations procedures, sections, planning guidelines and most importantly, experience in disaster response which other agencies do not. In contrast an agency such as the General Services Administration (GSA) has the actual resources which must be tapped during initial response and into the recovery stage of a disaster. GSA's usual contractual, equipment or services request procedures may not be sufficient in an operation where the first forty-eight hours are crucial. However, other more response oriented entities may not be able to function without GSA resources.

As questions like these are exposed, discussed and worked out, the implementation of the actual plan takes shape. Each agency sees the role of sister agencies in a new light and comprehends the "whole" as a complex machine working on a common problem. Only in

a large scale disaster or national security situation must large governmental entities work together like a small community in a crisis. The quarterly meetings and intermeeting contacts of the Federal Earthquake Planning Committee are establishing common working ground with both State and Federal benefits.

Another avenue of planning which involves input from each ESF and the State, is the location and alternate locations of the Disaster Field Office (DFO). The DFO is to be the co-location for emergency operation of the State response groups. The State response group will involve approximately fifty to sixty persons working in two shifts while the Federal group may involve over one thousand response personnel. This number of people will obviously require a large operating center with the capability to house, feed and handle communication equipment. In addition the predesignated site and its alternates should be relatively free from structural damage from the main shock and aftershocks. CEM will be working with the State of Utah Department of Administrative Services to compile a preliminary list of possible DFO sites during 1989.

ANNOUNCING UPCOMING SHORT COURSES IN GEOTECHNICAL AND ENVIRONMENTAL GEOPHYSICS

OBJECTIVE: The objective is to provide the specialist and nonspecialist state-of-the-art presentations on the correct theory for, and case history applications of, geophysics applied to such geotechnical and environmental problems as groundwater delineation/evaluation, groundwater contamination, crop land salinization, landfills, chemical waste disposal, nuclear waste disposal, earthquake risk evaluation, landslides, land subsidence, and general geotechnical applications such as dams and reservoirs, tunnels and cavities, roads, foundations, rippability, permafrost, pile integrity testing, and archaeological site delineation. The actual topics discussed will be tied to the interests of the participants.

DATES: Jan. 23-27, 1989 GG592 Electromagnetic and Radar Methods [1 credit hour, register Winter Qtr.]

May 8-12, 1989 GG592 Shallow Reflection and Refraction Seismic Methods (Schuster) [1 credit hour, register Spring Qtr.]

INSTRUCTORS:

STANLEY H. WARD - Dr. Ward has taught courses in Exploration Geophysics, Groundwater, Well Logging, Geophysics in Geotechnical Engineering, the Environment, and Geological Engineering. He currently is editor of a three-volume special publication entitled "Environmental Geophysics" to be published by the Society of Exploration Geophysicists.

GERARD T. SCHUSTER - Dr. Schuster has taught courses in reflection seismology, forward and inverse modeling, inverse theory, and signal processing. He worked for ARCO as an exploration geophysicist and is currently supported by a consortium of oil companies to conduct research in seismic tomography.

FORMAT: Four two-hour lectures plus 1 two-hour demonstration per week.

PREREQUISITES: B.S. degree in Geology, Geological Engineering, Geophysics, Civil Engineering, or Mining Engineering.

REGISTRATION: University of Utah Registrar or Division of Continuing Education, University of Utah.

TIMES: 3:20 PM to 5:30 PM daily.

LOCATION: Room 707 William Browning Bldg., University of Utah.

For further information contact:

GEOLOGY AND GEOPHYSICS DEPT.
UNIVERSITY OF UTAH
717 W.C. BROWNING BLDG.
TELEPHONE: 581-7162

UGMS RELEASES NEW HAZARD MAP

"Flood hazard from lakes and failures of dams in Utah", by K.M. Harty and G.E. Christenson, UGMS Map 111, represents the second in a series of geologic hazard maps to be published over the next several years.

The map is intended to be used by planners and community officials as a guide for identifying areas which are susceptible to flood hazards. The map can also be used by regulatory agencies and local governments as justification for requiring further studies in hazard areas.

Although few inundation studies have been completed for dams in Utah, the map serves to alert planners, local officials, emergency response personnel, and private citizens to the availability of information regarding potentially flooded areas should these dams fail. Where a city or other entity is shown on this map to be in a potential inundation area, planners can acquire the detailed inundation studies from the sources indicated on the map and listed in the references for this report to determine the extent of potential flooding. In many cases, these detailed studies are sufficiently accurate to be used by local emergency response personnel to determine the areas of their jurisdictions that will require warning, evacuation, and/or rescue should dam failure occur, and to identify the safest and most readily accessed areas for refuge.

Earlier this year, "Shallow ground water and related hazards in Utah", by Suzanne Hecker, K.M. Harty, and G.E. Christenson, UGMS Map 110, was released. UGMS will be producing additional statewide maps showing earthquake, landslide, debris-flow, problem soil (expansive, collapsible soils), and subsidence hazards. All are at a scale of 1:750,000. Map 111 costs $6.00 (plus $.38 sales tax for Utah residents). Map 110 costs $3.50 (plus $.22 sales tax for Utah residents). Shipping and postage for each map is $2.00. Available from Publications Sales Office, Utah Geological and Mineral Survey, 606 Black Hawk Way, Salt Lake City, Utah 84108-1280, (801) 581-6831.

UGMS RELEASES DIGITAL FORMAT DATA

"Significant drill hole data of the Wasatch Front valleys including Cache Valley and Tooele Valley, Utah", by W.F. Case and C.D. Burt, UGMS Open-File Report 82-DF (digital format version) has just been released.

The digital format version of Open-File Report 82 consists of a data base ASCII file, SIGWELL.TXT, a Utah Geological and Mineral Survey (UGMS) file manager, UPEDD.EXE, and an instructional ASCII file, README.TXT. SIGWELL.TXT is a data base of records of 292 significant well logs and descriptions from holes drilled in the major valley areas of the Wasatch Front and originally published in 1985 as UGMS Open-File Report 82. Drill holes which are judged to be "significant" are those with complete surface to total depth lithology logs which are approximately 1000 feet deep or deeper, and/or which terminate in bedrock. The data was gathered to facilitate development of a geophysical interpretation of the subsurface of Wasatch Front valleys (see Mabey, D.R., 1987, Subsurface geology along the Wasatch Front, in Gori, P.L. and Hays, W.W., Assessment of regional earthquake hazards and risk along the Wasatch Front, Utah: U.S. Geological Survey Open-File Report 87-585, p. C1-C39.). Most of the wells are water wells, a few are research, geothermal, or exploration wells. The search area includes portions of Box Elder, Cache, Weber, Davis, Salt Lake, Tooele, and Utah Counties. Wells were drilled during the 1940s to early 1980s. Appendix A is the introductory text of Open-File Report 82. A table lists wells ordered by Township, Range, and Section, well number (sequence of data entry), total depth, and lithologic characteristics are also indicated in the table. Publication of Open-File Report 82 was made possible by a generous grant from the U.S. Geological Survey (USGS) National Earthquake Hazards Reduction Program (NEHRP).

The file manager (UPEDD) has been included with the database so that the digital format publication is usable off-the-shelf without the need for purchase of other

software. UPEDD performs searches for well locations by Township and Range, well number, and for some wells, USGS well nomenclature. It can also search for characteristics noted in well logs such as presence of bedrock, a stipulated rock type such as lava, or a specific formation. A print-out of an individual record (well) or the entire data base can be obtained.

UGMS Open-File Report 82-DF, 27 p., 1 diskette, is available for $5.00 (Utah residents add $.31 sales tax) plus $1.00 shipping, from the Sales Office, UGMS, 606 Black Hawk Way, Salt Lake City, Utah 84108-1280, (801) 581-6831.

NEW PALEOSEISMIC DATA FOR THE WASATCH FRONT

Much of the new Wasatch Front paleoseismic data presented in abstracts at the 1988 Rocky Mountain Regional GSA meeting, has now been published in greater detail in "In the Footsteps of G.K. Gilbert - Lake Bonneville and Neotectonics of the Eastern Basin and Range Province", UGMS Miscellaneous Publication 88-1, which served as the guidebook for Fieldtrip 12 of GSA's Centennial Annual Meeting in October-November of 1988. Papers that include discussions of the most recent data are: "A brief summary of the surficial geology along the Brigham City segment of the Wasatch fault zone", by Stephen A. Personius; "The northern part of the Weber segment of the Wasatch fault zone near Ogden, Utah", by Alan R. Nelson; "G.K. Gilbert's observations of post-Bonneville movement along the Warm Springs fault, Salt Lake County, Utah", by William E. Scott; "Fault scarp studies of the Oquirrh Mountains, Utah, and "Fault scarp studies of the Stansbury Mountains, Utah", by Theodore P. Barnhard; "Paleoseismicity and earthquake recurrence at Little Cottonwood Canyon, Wasatch fault zone, Utah", by David P. Schwartz and William R. Lund; "American Fork Canyon, Utah: Holocene faulting, the Bonneville fan-delta complex, and evidence for the Keg Mountain oscillation", by Michael N. Machette.

UGMS Miscellaneous Publication 88-1 can be obtained for $8.50 (Utah residents add $.53 sales tax) plus $3.00 for shipping from Publications Sales Office, UGMS, 606 Black Hawk Way, Salt Lake City, UT 84108-1280, (801) 581-6831.

DUCK, HIDE, ENJOY THE RIDE
NEW EARTHQUAKE VIDEO

By Deedee O'Brien

Utah Museum of Natural History

"Duck, Hide, Enjoy the Ride" is the title of a half hour video demonstrating earthquake safety instruction in a combination of second grade classrooms at Farnsworth Elementary School in the Granite School District. The title is a motto originated by a sixth grade student, Jay D. Draper of Magna. It is intended to emphasize to young children the idea that although the earth movement experienced during a quake will be frightening, they can be safe if they will take cover and simply ride it out.

The curriculum being demonstrated includes a simplified explanation of cause (myth and reality) and what it will be like (duration, sound, movement). Children then "experience" the ground movement by attempting to balance themselves while standing on a board on a rock while the instructor holds their hands and manipulates them in all directions (the $1.50 version of the "quakey, shakey van"). Realizing that many things around them would fall if the whole room were moving like that board, they readily accept the solution of taking cover to protect themselves. The curriculum is appropriate for kindergarten through third grade and has been utilized in teacher workshops co-sponsored by the Utah Division of Comprehensive Emergency Management (CEM) and the Utah Museum of Natural History.

This video is available for checkout from CEM (533-5271) and the Utah Museum of Natural History (581-6928; ask for Deedee O'Brien).

A REVIEW OF EARTHQUAKE RESEARCH APPLICATIONS IN THE NEHRP PROGRAM - 1977-1987

In 1987, the tenth year of the NEHRP, the principal federal agencies responsible for the program convened three regional workshops to bring together approximately 100 individuals who had used seismic safety knowledge to enact and implement loss reduction measures in their communities. Their experiences are summarized in this volume as a permanent record for public agencies and others to use in planning future programs and in adopting and implementing seismic safety policies. Sixty essays appear in the volume, almost all of which are concerned with social procedures to assure the effective mitigation of earthquake hazards. The papers are grouped under three headings: "Evaluation of Applications for Enlightenment Uses" considers such topics as the effectiveness of regional earthquake preparedness projects, the success of awareness and education programs, and assessments of mitigation progress made since recent (and not so recent) U.S. earthquakes; "Evaluation of Applications for Decisionmaking Uses" focuses on the achievements of seismic safety commissions, the efficacy of legislative tools, and the contributions of earthquake risk and vulnerability assessment groups; "Evaluation of Applications for Practice Uses" examines improvements in seismic design, land use planning, hazardous building mitigation, and response and recovery planning. Essays of special interest to Wasatch Front readers include: "A review of the Regional Earthquake Hazards Assessment Program for the Wasatch Front area - will Utah meet the challenge?", by Douglas A. Sprinkel; "Research applications and the Utah earthquake preparedness program", by James L. Tingey; "Four years after the Borah Peak, Idaho earthquake - what mitigation activities have occurred?", by Clark D. Meek; "The western states seismic policy council", by John O. Truby; "Application of a process for assessing the potential effectiveness of land use planning measures for earthquake hazard mitigation: Provo, Utah and Bellingham, Washington", by Patricia Bolton; "Utilization of hazard maps in Salt Lake County", by Jerold H. Barnes; "The process of dealing with existing hazardous buildings in Utah", by Lawrence D. Reaveley.

Copies of "A Review of Earthquake Research Applications in the National Earthquake Hazards Reduction Program - 1977-1987", Walter W. Hays, editor, USGS Open-File Report 88-13-A, 583 p., can be obtained for $90.75 from U.S. Geological Survey, Books and Open-File Reports Section, Federal Center, Box 25425, Denver, CO 80225. A limited number of copies are available at no charge from Paula Gori, U.S. Geological Survey, 905 National Center, Reston, VA 22092, (703) 648-6707.

GRANTS

Earthquakes and hazardous spills. "Mitigating Hazardous Material Incidents during Earthquakes," National Science Foundation, $118,975, 22 months. Project Manager: Jeanne Perkins, Association of Bay Area Governments, P.O. Box 2050, Oakland, CA 94604-2050, (415) 464-7934.

Planning for hazardous spill prevention and response rarely considers the effects of earthquakes. Similarly, with the exception of nuclear power plants and natural gas lines, earthquake planners have only recently begun to examine hazardous materials releases as an accompanying hazard. Nevertheless, there is an increasing awareness among emergency response personnel that such spills could be a major concern if even a moderate quake were to strike an industrialized urban area. This project will analyze alternative strategies for reducing the number and severity of hazardous materials incidents during earthquakes.

- From Natural Hazards Observer

THIRTEENTH ANNUAL HAZARDS RESEARCH WORKSHOP

The crucial link between research and practice was the talking point in the sessions of the thirteenth annual Hazards Research Workshop, held in Boulder, Colorado, July 17-

20, 1988. In attendance were 256 public and private sector professionals involved in hazards research or mitigation activities in the United States, Canada, Latin America and the Caribbean, and Europe. Over the last 15 years, the processes of hazard reduction have come to involve close working relationships among researchers and practitioners. Today, it is not uncommon for decision makers to draw upon research findings as they frame new policies and programs; similarly, researchers work to identify improved hazard management techniques or to increase understanding of social and political factors that inhibit mitigation and response efforts. The workshop highlighted instances in which research has stimulated management and planning initiatives and vice versa, programs that demonstrate close cooperation between scientists and policy makers, and innovative approaches to disaster preparedness and public awareness programs.

Abstracts provided to workshop participants, as well as summaries of all the sessions, can be obtained from the Information Center. Abstracts are of three kinds: descriptions of new research projects, overviews of completed projects, and reports on hazard mitigation projects and programs. All abstracts include the name and address of an individual to contact for further information. A maximum of six individual abstracts or session summaries can be ordered at no cost; six to 12 abstracts or session summaries cost $3.00; and a complete workshop packet (all abstracts and summaries, the program, and a participant list) cost $10.00.

Abstract titles that could be of interest to Forum readers include:

NR88-3 The economics of building damage following the Whittier earthquake, Charles Hotchkiss, California State Polytechnic University.

NR88-4 Temporary sheltering after the Whittier Narrows earthquake, Robert Bolin, New Mexico State University.

NR88-5 Preparedness and response of lifeline organizations in community disasters, E.L. Quarantelli, University of Delaware.

NR88-11 Interorganizational coordination in disaster management: a model for an interactive information system, Louise Comfort, University of Pittsburgh.

NR88-13 EERI's learning from earthquakes program, Susan K. Tubbesing, Earthquake Engineering Research Institute.

NR88-15 Evacuation of special facilities in the aftermath of the Whittier earthquake, Antoine Hobeika, Virginia Polytechnic Institute and State University.

NR88-16 Seismic hazard mitigation methods for use in art museums, William S. Ginell, Getty Conservation Institute, M.S. Agbabian, University of Southern California.

NR88-19 Seismic microzonation: method for linking land use planning and geologic knowledge, Robert Twiss, University of California, Berkeley.

NR88-20 Business disruption and initial recovery in the Whittier Narrows earthquake, Kathleen Tierney, University of Southern California.

NR88-21 Chemical hazards, mitigation, and preparedness in areas of high seismic risk, Kathleen Tierney and William Petak, University of Southern California.

NR88-22 Assessment of lifeline response and recovery performance: Whittier Narrows earthquake, Ronald Eguchi, Dames and Moore.

RC88-3 Local government liability for earthquake hazards and losses, Jeanne B. Perkins, Association of Bay Area Governments.

RC88-7 Designing for earthquakes in the United States: workshops for Architects and Other Building Professionals, Donald E. Geis, AIA/ACSA Council on Architectural Research.

RC88-8 Architectural/urban design lessons from the 1985 Mexico City earthquake, Donald E. Geis, AIA/ACSA Council on Architectural Research.

RC88-9 Mexico City earthquake recovery-the health sector, Bruce Baird, California Specialized Training Institute.

RC88-12 EERI's U.S./Mexico research coordination project, Nancy Segal, Earthquake Engineering Research Institute.

PP88-7 Seismic safety of existing buildings, Ugo Morelli, Federal Emergency Management Agency.

PP88-8 Risk area situation: scenario for catastrophic earthquake response planning, Timothy Maywalt, FEMA/Region VIII.

PP88-9 Effective use of seismic information in local land use planning, George Mader and Thomas Vlasic, William Spangle and Associates.

Session Summaries of interest to Forum readers include:

1. What information do governmental agencies need to develop earthquake hazard reduction plans, building codes, land use regulations, and public education programs?
2. Earthquake insurance: an update.

All orders must be prepaid - make checks out to the University of Colorado - and should be directed to the Publications Clerk at the Natural Hazards Research and Applications Information Center, Institute of Behavioral Science, Campus Box 482, University of Colorado, Boulder, CO 80309-0482, (303) 492-1409.

- Excerpted from the Natural Hazards Observer

MEETINGS AND CONFERENCES

January 31 - February 1, 1989, Annual Wasatch Front Earthquake Hazards Reduction Program Meeting sponsored by USGS, FEMA, Utah Geological and Mineral Survey, and the Utah Division of Comprehensive Emergency Management, held at the University Park Hotel in Salt Lake City, Utah. See related article, this issue.

February 8, 1989, Liability of local governments for earthquake hazards and losses workshop, sponsored by The Association of Bay Area Governments, held at Golden Gateway Holiday Inn in San Francisco, California. For further information contact Jeanne B. Perkins, Earthquake Program Manager, ABAG, P.O. Box 2050, Oakland, CA 94604-2050, (415) 464-7900.

February 9-11, 1989, Annual Meeting of the Earthquake Engineering Research Institute held at the Golden Gateway Holiday Inn in San Francisco, California. The meeting is geared to three themes: Mexico/Chile research applications, earthquake preparedness and response, and special theme sessions by EERI Committees which will focus on: methods of dealing with earthquake hazards; analysis of strong ground motion data for use by practitioners and researchers; strengthening techniques; historic preservation; code provisions; the issues of serviceability versus survivability; and the interaction of experimental research and practice. Pre-registration deadline for the Annual Meeting is January 13, 1989. Registration fee is $275 for EERI members and $135 for EERI student members; non-member fee is $300, and non-member student fee is $160. There will be a $20 surcharge for late and on-site registrations. For more information, write or call EERI at 6431 Fairmount Avenue, Suite 7, El Cerrito, CA 94530, (415) 525-3668.

February 13-14, 1989, Geophysics of the Rocky Mountains, sponsored by the Front Range Chapter of the American Geophysical Union, held in Golden, Colorado. For information, contact Front Range AGU Service Center, P.O. Box 18-P, Denver, CO 80218, (303) 831-6338.

March 13-16, 1989, Application of geophysics to engineering and environmental problems, sponsored by the Society of

Engineering and Mineral Exploration Geophysicists, held in Golden, Colorado. For information, contact Ron Bell, BellWest Geoservices, P.O. Box 10845, Edgemont Branch, Golden, CO 80401, (303) 237-5697.

March 13-17, 1989, Third short course on soil dynamics and foundation engineering, conducted by the Department of Civil Engineering, University of Missouri-Rolla, in San Francisco, California. Dynamic loads due to earthquakes and other sources pose a serious hazard for structures and foundations. Understanding dynamic behavior of foundations and soils is of great importance in developing earthquake-resistant design of foundation systems. In this course, dynamic soil-structure interaction, retaining structures, mat and pile foundations, liquefaction of soils, earth dam stability, and selection of design soil parameters will be covered. Emphasis will be placed on behavior and design of structures. Workshop sessions will be devoted to problem solving both with computers and by manual methods. For more information contact Shamsher Prakash, Course Director, Third Short Course on Soil Dynamics and Foundations Engineering, 308 Civil Engineering, Rolla, MO 65401.

March 20-23, 1989, Engineering geology and geotechnical engineering Annual Meeting, sponsored by the University of Nevada, held in Reno, Nevada. For information, contact Engineering Symposium, Division of Continuing Education, University of Nevada, Reno, NV 89557-0024, (702) 784-4046.

April 17-21, 1989, International conference on architectural, planning, and social implications of natural disasters, including earthquakes, high winds, landslides and floods, sponsored by the National Center for Earthquake Engineering Research, the Disaster Management Center of Oxford Polytechnic and Virginia Polytechnical Institute, held in Buffalo, New York. This conference will bring together 60 to 75 natural disaster researchers and practitioners from the U.S. and abroad. The event is still in the early stages of preparation, but one can receive further information by contacting any of the following: Ian Davis, Oxford Polytechnic, Headington, Oxford OX3 0BP, U.K., (0865) 60035; Frederick Krimgold, Virginia Polytechnic Institute, 101 North Columbus Street, Alexandria, VA 22314, (703) 548-0099; or Jelena Pantelic, National Center for Earthquake Engineering Research, 103 Red Jacket Quadrangle, SUNY at Buffalo, Buffalo, NY 14261, (716) 636-3391.

April 19-21, 1989, Seismological Society of America Annual Meeting at the Victoria Conference Center in Victoria, British Columbia, Canada. For more information contact: SSA Office, 201 Plaza Professional Building, El Cerrito, CA, 94530, (415) 525-5474; or Dr. Garry C. Rogers, Geological Survey of Canada, Pacific Geoscience Center, P.O. Box 6000, Sidney, B.C., Canada, V8L 4B2, (604) 356-6500.

May 7-10, 1989, Rocky Mountain and Cordilleran Sections, Geological Society of America joint meeting, held in Spokane, Washington. For information, contact Sandra Rush, GSA Communications Department, P.O. Box 9140, 3300 Penrose Place, Boulder, CO 80301, (303) 443-8489.

July 9-19, 1989, 28th International Geological Congress, in Washington, DC. For information contact Bruce B. Hanshaw, Box 1001, Herndon, VA 22070-1001, (703) 648-6053.

September, 1989, International conference on reinforced and prestressed prefabricated concrete structures in seismic areas, held in Iasi, Romania. For information contact Prof. A. Negoita, Polytechnical

Institute, Bd. Karl Marx 38, 6600 Iasi, Romania.

October 1-6, 1989, Association of Engineering Geologists Annual Meeting, held in Vail, Colorado. For information, contact Denver Section, AEG, P.O. Box 15124, Denver, CO 80215.

October 23-26, 1989, Fourth International Conference on soil dynamics and earthquake engineering, held in Mexico City, Mexico. The objectives of this meeting are to provide a forum for the presentation and discussion of new and advanced ideas in soil dynamics and earthquake engineering and to encourage and enhance the role of mechanics, geology, and seismology by providing an opportunity for the presentation of the work of applied mathematicians, scientists, and engineers involved in solving problems in the field of earthquake and geotechnical engineering. Abstracts of 300 words or less should be submitted by February 1, 1989. For further information contact either Prof. A.S Cakmak, Department of Civil Engineering, Princeton University, Princeton, NJ 08544, (609) 452-4601; or Prof. I. Herrera, Instituto de Geofisica, Universidad Nacional, Autonomo de Mexico, Apartado Postal 22-582, 14000 Mexico, D.F., (905) 548-5892.

May 20-24, 1990, Fourth U.S. National Conference on Earthquake Engineering, sponsored by the Earthquake Engineering Research Institute, California Institute of Technology, University of California at Irvine, University of California at Los Angeles and University of Southern California, held at the Riviera Hotel in Palm Springs, California. The participants at this meeting will discuss both the state-of-the-art in seismic risk reduction through earthquake engineering as well as the most current approaches to earthquake preparedness. Future trends and needs will also be addressed. Papers are welcome from anyone working in the field of earthquake hazard mitigation; abstracts are due by July 31, 1989. For additional information contact Dee Czaja, 4NCEE Office, Civil Engineering Department, University of California, Irvine, CA 92717, (714) 856-8693.

RECENT PUBLICATIONS

Allen, C.R., 1988, Earthquake hazard reduction in the past and next century [abs.]: Geological Society of America Abstracts with Programs, v. 20, no. 7, p. A81.

Ambraseys, N.N., and Menu, J.M., 1988, Earthquake-induced ground displacements: Earthquake Engineering and Structural Dynamics, v. 16, no. 7, p. 985-1006.

Arulanandan, Kandiah, and Muraleetharan, K.K., 1988, Level ground soil-liquefaction analysis using in situ properties: I: Journal of Geotechnical Engineering, v. 114, no. 7, p. 753-770.

Arulanandan, Kandiah, and Muraleetharan, K.K., 1988, Level ground soil-liquefaction analysis using in situ properties: II: Journal of Geotechnical Engineering, v. 114, no. 7, p. 771-790.

Bakun, W.H., 1988, Parkfield, California earthquake prediction experiment - a status report [abs.]: Seismological Research Letters, v. 59, no. 1, p. 33.

Barnhard, T.P., and Dodge, R.L., 1988, Map of fault scarps formed on unconsolidated sediments, Tooele 1 degree X 2 degree Quadrangle, northwestern Utah: U.S. Geological Survey Miscellaneous Field Studies Map MF-1990, scale 1:250,000, $2.50. Available from USGS Public Inquiries Office, 8105 Federal Building, 125 South State Street, Salt Lake City, Utah, 84138-1177, (801) 524-5652.

Case, W.F., and Burt, C.D., 1988, Significant drill hole data of the Wasatch Front valleys, including Cache Valley and Tooele Valley, Utah: Utah Geological and Mineral Survey Open-File Report 82-DF, 27 p., 1 diskette, $5.00 (plus $.31 sales tax for Utah residents) plus $1.00 shipping. Available from Publication Sales Office, UGMS, 606 Black Hawk Way, Salt Lake City, UT, 84108-1280, (801) 581-6831. See related article, this issue.

Clarke, A.O., 1988, Better graphical representation of earthquake magnitude: Bulletin of the Association of Engineering Geologists, v. 25, no. 3, p. 343-348.

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Duenas, C., and Fernandez, M.C., 1988, Temporal variations in soil gas radon: any possible relation to earthquakes?: Tectonophysics, v. 152, p. 137-145.

Ellis, M.A., Bodin, Paul, and Anderson, J.G., 1988, Geological and geophysical constraints on the existence of low angle normal faults [abs.]: Geological Society of America Abstracts with Programs, v. 20, no. 7, p. A235-A236.

Engdahl, E.R., and Rinehart, W.A., 1988, Seismicity map of North America [abs.]: Seismological Research Letters, v. 59, no. 1, p. 14.

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Harty, K.M., and Christenson, G.E., 1988, Flood hazards from lakes and failures of dams in Utah: Utah Geological and Mineral Survey Map 111, 8 p., 1 pl., scale 1:750,000, $6.00 (plus $.38 sales tax for Utah residents) plus $2.00 shipping. Available from Publication Sales Office, UGMS, 606 Black Hawk Way, Salt Lake City, UT, 84108-1280, (801) 581-6831. See related article, this issue.

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Hays, W.W., editor, 1988, A review of earthquake research applications in the National Earthquake Hazards Reduction Program - 1977-1987: U.S. Geological Survey Open-File Report 88-13-A, 583 p., $90.75. Available from Books and Open-File Reports Section, Federal Center, P.O. Box 25425, Denver, CO, 80225. See related article, this issue.

Hopper, M.G., 1988, Large earthquakes in Sevier County, Utah, in 1901 and 1921: U.S. Geological Survey Open-File Report 88-44, 11 p., $85.75. Available from Books and Open-File Reports Section, Federal Center, P.O. Box 25425, Denver, CO, 80225. Also available for review at USGS Public Inquiries Office, 8105 Federal Building, 125 South State Street, Salt Lake City, Utah, 84138-1177, (801) 524-5652.

Jackson, M.E., and Ruzicka, J., 1988, Holocene paleoseismic history of the Levan and Nephi segments, Wasatch fault zone, Utah: application of the thermoluminescence (TL) method [abs.]: Geological Society of America Abstracts with Programs, v. 20, no. 7, p. A54.

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Kaliser, B.N., and Slossen, J.E., 1988, Geologic consequences of the 1983 wet year in Utah: Utah Geological and Mineral Survey Miscellaneous Publication 88-3, 109 p., $13.50 (plus $.84 sales tax for Utah residents) plus $3.00 shipping. Available from Publication Sales Office, UGMS, 606 Black Hawk Way, Salt Lake City, UT, 84108-1280, (801) 581-6831.

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