GLO1282

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Salt Lake City, UT 84114
Telephone 801-533-4987

office of planning and budget

Scott M. Matheson, Governor
Randy G. Moon, Ph.D., State Science Advisor

STATE ADVISORY COUNCIL
ON
SCIENCE AND TECHNOLOGY

MEETING ANNOUNCEMENT

DATE: Tuesday, November 13, 1984

TIME: 3:00 - 5:00 p.m.

PLACE: Room 305 State Capitol Building

SAC/S&T AGENDA

1. Approval of Minutes
2. Old Business
   a. Natural Resource Information Delivery System - Doug James
   b. Legislative Liaison Committee - Bartell Jensen
   c. Governor's Budget Items - Randy Moon
3. New Business
   a. Great Salt Lake Update - Paul Summers — Div. Water Resources
   b. Committee on Science and Math Education - Jim Brophy
   c. Geological and Environmental Hazard Research Center - Stanley H. Ward and P. Michael Wright
4. Other Business
5. Next Meeting: Tuesday, December 11, 1984 at 3:00 p.m. in room 305 State Capitol Building

0059b

Division of Water Resources
October 1, 1984

WR16ST
13Nov84

GREAT SALT LAKE

SUMMARY OF LAKE CONTROL/MANAGEMENT ALTERNATIVES

The Great Salt Lake Contingency Plan published by the Department of Natural Resources in January 1983, discussed many of the proposals, projects, schemes, etc., that had been identified as possible alternatives for lake level control/management.

The Contingency Plan identified the alternative of pumping water into the West Desert as the best short-term solution. The Plan further suggested that long-term solutions might include development of the Bear River, creation of fresh water ponds in the north end of Bear River Bay or possible development of a peaking power project in Puddle Valley.

The Great Salt Lake Contingency Plan concluded ".. there are presently insufficient data on which to base firm action recommendations" and urged that additional feasibility analyses be completed. During 1983, and to a limited extent in 1984, the Division of Water Resources under special assignment from the Executive Director of the Department of Natural Resources, has conducted technical studies on several alternatives to supplement existing data and to assess the feasibility of the alternatives. The studies undertaken by the Division in 1983 were summarized in the report published by the Division entitled "Great Salt Lake Summary of Technical Investigations Water Level Control Alternatives".

The on-going work in 1984 relates mainly to directions given to the Division of Water Resources through S.B.97. Engineering studies being conducted by the Division include water quality studies on the Bear River, investigations related to the South Fork, Avon, Oneida Narrows reservoirs on the Bear River, the Cedar Valley Project, additional work with Dr. Eckhoff on the West Desert Pumping Alternative and some in-house reconnaissance-level investigations of proposals to dam the North Arm of the Great Salt Lake, dam the Bear River Bay and selective diking along the east shore of the lake.

The attached table attempts to summarize projects, proposals, schemes, etc., which have been identified for possible control/ management of the high levels of the Great Salt Lake. The table identifies the status of the various investigations, classifies then in terms of how long it would take to construct them, identifies the type of control afforded by the alternative, provide information as to impacts to various uses, give cost data and provide information as to the effectiveness in terms of lowering the level of the lake.

Although the table summarizes a lot of information on one page a careful review of the table shows which projects/schemes could be constructed on a short-term schedule and the effect they would have on lowering the level of the South Arm of the lake. The table shows that other projects/schemes such as damming the North Arm and pumping into Puddle Valley have large potential of lowering the Lake level but are very costly, have major impact problems and will take more than 5 years to construct. It shows which of the projects/schemes need additional engineering work to bring them up to a feasibility or final design status such that realistic decisions can be made about their incorporation into some overall policy/plan to control/manage the level of The Great Salt Lake.

PROJECTS/SCHEMES	Status of Project Investigations 1/: Reconnaissance	Feasibility	Final Design	Constructed	Schedule for Construction etc.: Short, 0-2 yrs.	Medium, 2-5 yrs.	Long, 5- yrs.	Type of Control in terms of Storage, evap., etc.: Export From Basin	Storage Above GSL	Storage In/Near GSL	Consumptive Use	Evaporation	Lake Level Adjustment	Impact to various uses. positive or negative 2/: Lake Level Control	Agr., M&I Uses	Recreation	Fishing-Wildlife	Major EIS Prob. Yes-No	S.A. Mineral Ind.	N.A. Mineral Ind.	Status of Cost Information 3/: Status of Data	Capital Costs in Million $	O & M Costs	Effect on Lowering the S.A. Peak in inches 4/: 1st Year Operation	Reduction of Peak Levels Under Conditions 1983
Bear River Basin																									
Mill Creek Reservoir		C					X		X		X			S	L	L	M	?	S	S	F	16.6	n/a	0.3	2.0
Amalga Reservoir		C					X		X		X			M	L	L	M	?	S	S	F	59.3	n/a	1.6	6.0
Honeyville Reservoir		C					X		X		X			S	L	L	M	?	S	S		35.6	n/a	1.1	4.0
East Promontory/West Bay Res.		C			?	X				X		X		M	?	L	M	?	M	M	F	31.5	n/a	3.2	6.0
Oneida Narrows Reservoir	C	U					X			X		X		S	L	L	?	?	S	S	R	n/a	n/a	1.3	3.0
Cutler Reservoir Enlargement	C	P					X			X		X		M	L	L	M	?	S	S	R	n/a	n/a	2.8	9.0
Soda Springs Reservoir		C					X			X		X		S	L	L	?	?	S	S	F	16.4	n/a	0.4	2.0
Hansel Valley Storage	C						X			X		X		S	L	?	?	?	S	S	R	141.3	n/a	7.0	3.0
Diversion to Portneuf River	C	P			?	X		X						M	?	?	?	Y	S	S	R	n/a	n/a	2.0	12.0
Avon Reservoir		U					X		X		X			S	L	L	?	?	S	S	-	n/a	n/a	0.3	2.0
Div. Bear River Water to S.L.C.		U					X				X			S	L	?	?	?	S	S		n/a	n/a	n/a	4.0
Washakie Reservoir		C					X		X		X			S	L	L	M	?	S	S	F	75.0	n/a	1.7	5.0
Lampo Reservoir		C					X		X		X			S	L	L	M	?	S	S	F	14.7	n/a	0.2	1.0
Rozel Irrigation Project	U						X				X			S	L	O	O	?	S	S	-	n/a	n/a	n/a	3.0
Utah Lake/Cedar-Rush Valley Proj.																									
Pumping to maintain Compromise	C	U			?	X			X			X		S	O	?	M	?	S	S	R	70.1	n/a	3.7	n/a
Pumping for irrigation Project	C	U			—		X		?		X			S	L	?	?	?	S	S	R	37.6	n/a	0.8	6.0
Great Salt Lake																									
S.P.R.R. Causeway Breach				C	*						X	X		M	O	O	?	?	L	N	C	3.7	n/a	10.0	10.0
West Desert Pumping		C	P		X					X		X	?	L	O	O	O	Y	L	L	F	40.0	4.0	20.0	40.0
Puddle Valley Storage	C					X	?			X		X	?	L	O	?	?	Y	L	L	R	50.0	27.0	30.0	0.1
Puddle Valley Pump Storage	C						X			X		X	?	L	O	?	?	Y	L	L	R	130.0	47.0	30.0	0.2
Damming Bear River Bay	U	P				X				X		X	?	S	?	L	?	Y	L	N	-	30.0	n/a	12.0	0.1
Damming North Arm GSL	U						X			X		?	?	L	O	?	?	Y	N	L	-	400.0	n/a	60.0	45.0
Total diking East Shore Areas	C	P				X	?			X		?		O	O	?	?	Y	N	N	R	200.0	n/a	- 0.0	- 0.0
Selective diking East Shore Areas	U	P			X					X		?		O	O	?	?	Y	N	N	R	25.0	n/a	- 0.0	- 0.0

1/ C investigation complete at that status, U investigation underway at that level & P proposed investigation at that level.

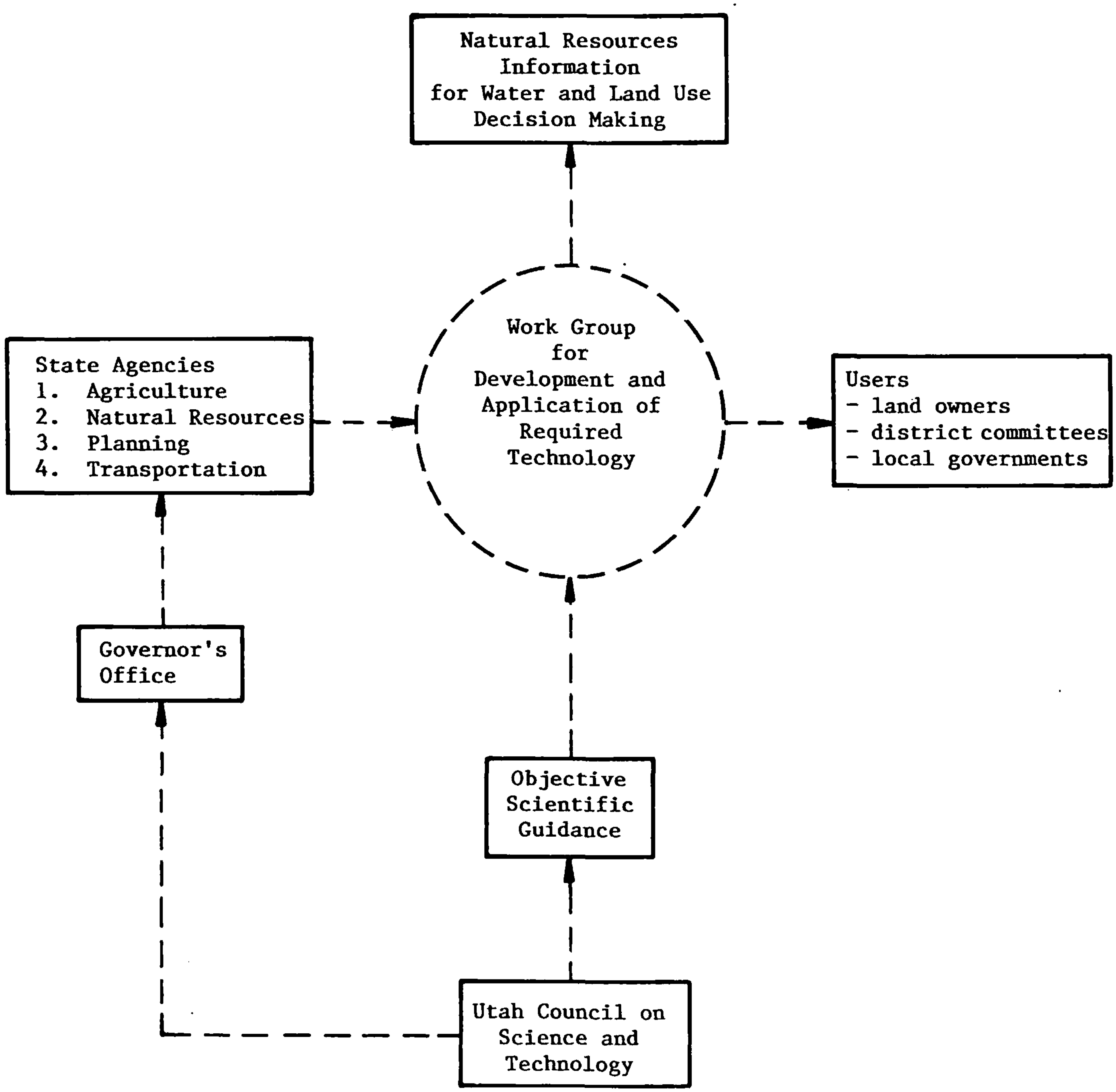
2/ L large benefit, M medium benefit, S a small benefit, O no benefit, N negative benefit, and ? unknown benefit.

3/ R reconnaissance cost estimate, F feasibility level cost estimate, D final design cost estimate, C cost as constructed & n/a cost not available.

4/ The information under the 1st year generally refers to the amount the S.A. would lower in its first year due to storage while the second number generally refers to the reduction of peak lake levels with project/scheme in full operation over several years.

WRIGHT
13 Jan 84
Doug James

ORGANIZATIONAL DIAGRAM



WRIGHT
23 Nov 84
Doug James

Draft Motion
November 13, 1984

The Utah Council on Science and Technology supports the organization of an information system that property owners, economic development groups, and community leaders can use to obtain reliable data and analyses for assessing land development and occupancy alternatives and therefore: 1) authorizes the Chairman to appoint a technology coalition to provide technical oversight, 2) urges the affected state agencies to provide the budget and personnel necessary to initialize an effective demonstration effort, and 3) requests a progress report and structure assessment from the technology council in about six months.

M.K. Wright

M E M O R A N D U M

July 12, 1985

TO: Dr. Stanley H. Ward, Director
Earth Science Laboratory, UURI

FROM: Temple A. Reynolds, Consultant

SUBJECT: Final Report

For the past several months, I have helped you to explore with the several Universities, state and federal agencies the feasibility of pursuing establishment of a "Center for the Study of Geologic and Environmental Hazards".

During this period we have sponsored or otherwise facilitated three workshop sessions and called personally on approximately 20 state and federal government leaders in Utah to explore concepts, attitudes, real and potential problems associated with a Center.

While there seemed to be endorsement of the concept of a multidisciplinary approach to solving complex problems among most agency leaders, there appeared to be some concern with the idea of University based research. Where present these concerns seemed to revolve around two main points: (1) timely performance, and (2) use of possibly poorly supervised students in lieu of work being done wholly by or even under the direct and continuing supervision of the contracted scientist.

At the University level it was my feeling that reactions to the idea of a Center were mixed. In candor, it was my impression that University of Utah (UU) faculty, with the possible exception of Kim McCarter, were almost totally non-supportive of the concept. They seem happy with the status quo and unimpressed with the opportunity for expanded research horizons that would accompany a Center.

Conversely, Brigham Young University (BYU) staff with whom I dealt appeared to be more supportive and could readily see the potentials associated with multi-institutional collaboration.

Utah State University (USU) was, from the outset, non-supportive of the concept. Full realization of possible reasons for this opposition did not become clear until the May 31 workshop at USU. At that time it became apparent that there already existed university-wide collaboration and cooperation on geological and environmental hazards research. It was also apparent that environmental laboratory facilities at USU far surpass those available at UU or UURI (the status of BYU environmental lab facilities is unknown). There may also be something to be said, in terms of USU opposition, for the size and location of USU, where staff depth in any given discipline is limited and physical location encourages on-campus interaction and interdisciplinary collaboration. In a great sense there appears to be a feeling among USU faculty that they have no need for multi-institutional collabortation. Indeed, given their facilities and spirit, they may be right!

While it may be possible for UURI to unilaterally establish a Center, it seems to me that you may be better advised to mount a campaign on several fronts as follows:

- UURI has strong geophysical capabilities. It is perhaps stronger in this regard than any of the other three institutions that we have dealt with. Because of this, you may want to establish a collaborative liaison with USU and/or BYU as well as with UU. Your association with these other institutions could go far toward beginning to realize the aims of a Center.

- Fund granting institutions, e.g. EPA, USGS, appear to favor institutions and researchers with whom they have had past positive experiences over those who may be considered newcomers. Also, it is my experience that administrative agencies who may be a source of money tend to favor contracting with organizations/researchers they have come to know. From this perspective, I would suggest that one or more staff members be assigned to build active liaison with select state and federal agencies to become better acquainted and establish a common ground through informal and unpaid consultation. In some instances that I know of, this type of campaign has resulted in a virtual lock on contract research with a given agency.

In summary then, I suggest that the time and climate are not right for establishing a Center. There is, on the other hand, no reason for UURI not to aggressively pursue collaborative efforts with other institutions, emphasizing all the while its area(s) of expertise. Also, every opportunity should be seized upon to build active complimentary liaison with agency administrators so as to be in a position to counsel and offer assistance in project definition and proposal preparation when needs arise and funding becomes available.

I have very much enjoyed the opportunity to help you in your explorations of feasibility and concept for the proposed Center. If you have questions regarding this report you can contact me, after August 1, 1985, through the Illinois Department of Conservation, Bureau of Natural Resources, 524 South Second St., Springfield, IL 62706 (phone 217/785-8286).

CC: Phillip M. Wright
James Brophy

Mike Wright

M E M O R A N D U M

July 5, 1985

TO: Dr. James Brophy, University of Utah
Dr. Bartell Jensen, Utah State University
Dr. John Lamb, Brigham Young University

FROM: Temple A. Reynolds, Consultant

SUBJECT: Workshop on University Hazards Research Efforts and Capabilities, Utah State University.

On Friday morning, June 21, 1985, faculty and staff researchers from the University of Utah Research Institute (UURI), Utah State University (USU) and Brigham Young University (BYU) met with a small group of state and federal agency representatives in the third floor conference room of the Utah Water Research Laboratory, Utah State University, Logan. (See Attachment No. 1, Attendance List.)

Purpose of the meeting was to explore and showcase current hazards-related research efforts and research capabilities of the institutions present. A secondary purpose of the workshop was to provide opportunity, in an informal setting, for public agency representatives to become better acquainted with university related research capabilities and staff.

Following a welcome by Bruce Bishop, Dean, College of Engineering and some general housekeeping announcements, we moved directly into a discussion of current hazards related research efforts and capabilities of the three institutions present. (See Attachment No. 2, Actual Agenda.)

Following is a brief account of the discussions on an institution-by-institution basis:

University of Utah Research Institute/University of Utah -

Duncan Foley briefly outlined the history, mission, and organization of the Institute and described several of the initiatives underway.

The Institute is organized into three main divisions - the Earth Science Laboratory, the Center for Remote Sensing, and the Environmental Studies Laboratory.

The Earth Science Laboratory is currently exploring a number of geologic, and geophysical initiatives associated with further mapping of the Wasatch Fault, earthquake induced avalanches, identification of Radon daughters, and electric/magnetic methods of identifying old toxic waste dump sites on military lands and tracing contaminated ground water plumes.

The Earth Science Laboratory has worked closely with Kim McCarter of the University of Utah (UU) Mining Department in designing, building, installing and maintaining remote telemetry systems used to monitor slide conditions in Rudd Canyon and Johnson Hollow in 1983 and 1984.

UURI facilities include a Utah Department of Health approved chemical analysis laboratory, a petrology laboratory and a computer center.

The Environmental Studies Laboratory is currently engaged in studies relative to acid rain and atmospheric visibility. Acid rain investigations are concentrating on factors affecting lake and stream acidity and alkalinity and changes in wet and dry conditions on particulate depositions in wilderness area waters. Current work will also identify differing pH effects on fish life.

Atmospheric visibility studies center on (1) physical and chemical analysis of particulates in cooperation with the Salt River Project, Arizona, and (2) colorometric measurements of light reflected from canyon walls. This latter project seeks to come up with a comprehensive modeling program to assess air quality and to find ways to articulate and predicate viewer perceptions of air quality.

Merrill Ridd, of the Center for Remote Sensing discussed an integrated hazard mapping project for Davis County, Utah. Objectives of the work have been fourfold: (1) to assemble and integrate existing geotechnical and biological data relative to urban development on the Davis County foothills and augment this with new data; (2) present technical data to bridge the communications gap with the lay public; (3) produce a model ordinance for development, and; (4) create a framework to accommodate on-going research and administration. Davis county is currently the only place in the state where hazards have been identified and classified on the basis of homogeneous, geomorphic land units. In this process, risks are defined on the basis of a combination of judgemental factors.

Utah State University, College of Natural Resources -

Thad Box, Dean, College of Natural Resources, introduced the concerns of his colleagues with a brief discussion of the effects of natural and induced environmental hazards on biological, social and psychological regimes. Cited were drought/flood cycles, desertification, and biological hazards. A goal of the College is to turn natural resources sciences from descriptive to predictive.

Dick Fisher, Head, Department of Forest Science described work underway in several areas, as follows:

Watershed Management -

Work is in process at the Idaho National Energy Laboratory regarding the effects of wind and water erosion on low level nuclear waste sites that were guaranteed to be safe from damage for 100 years.

A project with the U.S. Forest Service in Idaho is assessing stability/hazard potential associated with canyon landfills in terms of mass failure and effects on streams of phosphate-rich run-off from such landfills.

Acid rain process level studies will seek to identify changes in weathering and in hydrologic pathways. Will result in a model to simulate weather and predict times for acid depositions to have effect.

Fire -

Work with the Boise Interagency Fire Center will identify potential wildfire effects on urban/suburban areas and hazards of fire in exurban areas, e.g. it is estimated, for example, that a wildfire with the right wind direction and velocity could wipe out Cedar City.

Biological/Physical/Psychological Hazards -

Insect outbreaks, such as that of the Mountain Pine beetle in the Uinta Mountains, can account for the destruction of millions of acres of forest. Previous social/economic climate would have provided for salvage and use. With no market available and with increasing wilderness designations, natural fire appears to be the major potential for stemming the outbreak and regenerating the ecosystem.

Work is underway to ascertain the impact of hazards on human perceptions, e.g. the effects of a nuclear waste dump on tourism, relationship of wealth to demand for hazard-free recreational opportunities, human preference for hazardous pursuits, and the potential for controlling behavior (within, say, a National Park) through hazards management.

Neil West, Range Science Department, described major ecological and environmental changes that have occurred in the western U.S. with expansion of weeds, including unpalatable native plants and/or exotic annuals. This has lead to increased incidence of fire, soil erosion and overall diminished land productivity. Work is underway to identify methods to more quickly revegetate burned lands, possibly using introduced species; to control fuel build-up by prescribed burns; to explore no-till planting and/or herbicidal control with no-till planting.

Jens Jensen, BLM, commented that his agency has seen additional rangeland insects as a result of the several wet years. There is also an apparent die-off of four-wing salt bush.

It was pointed out that removal of livestock will not return land to previous full production. New species and soil loss mean change.

Jim Richards, Co-Director of the Institute for Land Rehabilitation, outlined the programs and goals of the Institute relative to mine spoil reclamation in the West. It was noted that there are 50 research associates of the Institute on the USU campus.

Mike Allen, of the Ecology Center, described efforts underway in the Powder River Basin to assess revegetation on mine spoils in relation to: (1) the chemical/physical/biological components of the soil; (2) the success of plant species (effects of weeds crops on later success of perennials), and; (3) the pattern or architecture effect of planting, e.g. clumps vs. rows. With understanding of these components, later phases of the work will be to develop modeling techniques and describe theories that will be useable elsewhere. Preliminary conclusions indicate that the biota are more resilient than originally thought.

Brigham Young University, Thermochemical Institute -

Delbert Eatough described current work regarding atmospheric chemical pollution. It has been determined that conversion rates of sulphur oxides to sulfates and other compounds is dependent on temperature. Also, important but little understood chemical processes take place in cloud and fog banks, including atmospheric inversions. Fog banks appear to speed up chemical reactions. In the Utah Valley area, presence of pollutants during inversions appears to increase near the Geneva Mill. Utah Valley data on admittance to hospital respiratory care appear to correlate well with periods of heavy inversion.

Visibility in the Golden Circle area of southern Utah has been impaired. Use of tracers shows that atmospheric pollution from the Los Angeles Basin has now reached this area. Plume tracers from the Mohave generating station near Bullhead City, AZ, have been recognized up to 100 km distant. HF gas, hellites and, especially, spherical silicates appear to be unique long range tracers associated with coal fueled plants.

BYU, Department of Civil Engineering -

Les Youd, formerly of USGS, reported on several geological and engineering investigations underway at BYU.

Bart Kowalis is working on fracturing of rocks with relation to high level nuclear waste storage.

In the Civil Engineering Department, work is underway to identify structural response to earthquakes as a means of optimizing building design for known earthquake prone areas.

Wood Miller has been using remote sensing technology to study and correlate temperature variations and algae growth in Utah Lake. He is now doing the same type of analysis on Lake Powell.

Les' current work is in further regard to the phenomena of liquefaction. He is trenching in pleistocene sediments near the area of the recent Mackay, ID, earthquake to discover any past evidence of liquefaction in that area.

A liquefaction map of the United States will ultimately be prepared. It will show suseptibility and how hard a shake will be required to cause liquefaction.

USU, College of Engineering -

Loren Anderson described some of the work currently being done by the Geotechnical Engineering Division of the Civil Engineering Department and by the Department of Geology. For a more complete listing of research in these two departments and at the Utah Water Research Laboratory, please see Attachment No. 3, Partial List of Recent and Current Hazards Research at Utah State University.

Among projects discussed were:

Earthquake Hazards -

Liquefaction Mapping of Davis, Salt Lake, Utah Counties and the northern Wasatch Front (Weber, eastern Box Elder and Cache Counties).

Seismic Slope Stability mapping is currently underway in Davis and Salt Lake Counties. Work is to get underway soon in Utah, Weber, Box Elder and Cache Counties.

Effects of tectonic subsidence as a result of inundation by the Great Salt Lake and Utah Lake.

Investigation of recent faulting in Hansel Valley and along the east Cache fault.

Land Slide Research -

Debris slides as a result of snow melt in Steed Canyon. Data correlation will come as a result of real time data collected at 5 second intervals and transmitted via GOES West satellite to USU.

Multivariate analysis of landslide suseptibility in Davis County.

Land slide inventory map from Bountiful, north to the south part of Weber Canyon.

Documentation of Utah 1983 landslides. It was mentioned in this regard that Roland Jeppson has developed a model of the hydraulic aspects of debris flows as applied to the Rudd Canyon flow. The model is predictive.

Hazard mapping (digitization) of 19 USGS quadrangles along the Wasatch Front via landsat technology.

Sediment transport from landslides, e.g siltation potentials for plugging culverts.

Dam Safety -

Probabilistic risk analysis of earthen dams.

Waste Embankments -

Probabilistic modeling of tailing embankments. Application to tailings in Arizona and to phosphate mine spoil deposits on forest service lands.

In summary, Loren made the point that the geotechnical group at USU is set up to interact with other organizations and is currently pursuing a number of projects involving other organizations, both public and private. USU is willing to share all data, including hard data as well as electronic readouts from the GOES satellite downlink. In this last regard it was suggested that aerial photos, soil data from liquefaction studies and other similar geological data might be donated to UGMS to be available for future use by all interested parties.

USU, Water Research Laboratory -

David Bowles briefly described a few of the current and on-going research efforts. Again, for a more complete listing of work being conducted by the Water Research Laboratory, please see Attachment No.3. Among the work singled out for mention was:

Erosivity mapping for the Utah Department of Transportation. Coupled with this is use of the computer controlled rainstorm simulator to study erosibility and wind erosion effects on various soils and slopes.

Long term studies of the Great Salt Lake including lake level forecasting, lake level probability estimation, damage estimation in cooperation with UU Bureau of Business and Economic Research, lake level circulation models, climatology and hydrogeology of the west desert with regard to possible uses of the west desert and closed desert basins in general.

Salinity generation in watersheds.

Drought related research, including vulnerability of water supply systems, allocation of water in desert conditions, review of the 1977 drought in terms of lessons learned and policy planning.

Evaluation of weather modification technologies applied in Utah.

USU, Water Research Lab, Division of Environmental Engineering -

Ron Sims, briefly detailed toxic and hazardous waste management programs that have been developed at USU in response to national needs and in conjunction with the Environmental Protection Agency at the Cincinnati Lab, National Headquarters, Kerr Environmental Lab in Oklahoma, Triangle Park in North Carolina and Corvallis, OR.

As a result of this approach, USU has assembled a modern chemical/environmental laboratory together with a 12 person interdisciplinary team for environmental hazards research. They have also retained three full time research scientists and seven full time research technicians as support staff. In addition, five PhD and five Masters candidates are performing a broad range of environmental research.

Quite literally, USU is writing the book on toxic waste disposal and land treatment.

CC: Mailing List

Attachment No. 1

List of Attendees

WORKSHOP ON UNIVERSITY HAZARD RESEARCH EFFORTS AND CAPABILITIES

Utah State University

June 21, 1985

NAME	ORGANIZATION	LOCATION	PHONE
R. Ryan Dupont	USU, Utah Water Lab	Logan	750-3227
Judy Sims	USU, Utah Water Lab	Logan	750-3230
Ronald C. Sims	USU, Utah Water Lab	Logan	750-3185
Joon McLean	USU, Utah Water Lab	Logan	750-3199
David Bowles	USU, Utah Water Labn	Logan	750-3231
Michael Allen	USU, Ecology Center	Logan	750-2096
Neil West	USU, Range Science	Logan	750-2572
Jens Jensen	BLM, Utah State Office	Salt Lake	524-3124
Jim Richards	USU, Range Science	Logan	750-2504
Dick Fisher	USU, Forest Resources	Logan	750-2455
Les Youd	BYU, Civil Engineering	Provo	378-6327
Loren Anderson	USU, Civil Engineering	Logan	750-2780
James McCalpin	USU, Geology	Logan	750-1220
J. Clair Batty	USU, Utah Water Lab	Logan	750-3156
Bruce Bishop	USU, College Engineering	Logan	750-2776
Genevieve Atwood	UGMS	Salt Lake	581-6831
Merrill Ridd	UURI, Remote Sensing	Salt Lake	524-3456
C. Earl Israelson	USU, Utah Water Lab	Logan	750-3176
Paul Riley	USU, Utah Water Lab	Logan	750-2783
Jay M. Bagley	USU, Utah Water Lab	Logan	750-3173
Bruce Vandre	USDA, Forest Service	Ogden	625-5237
Thad Box	USU, Col. Nat. Resources	Logan	750-2445
Loren Rausher	UDOT	Salt Lake	965-4326
Duncan Foley	UURI	Salt Lake	524-3431
Nolan Mangelson	BYU	Provo	378-4845
Delbert Eatough	BYU	Provo	378-6040
Ralph Findlay	CEM	Salt Lake	533-5271
Jim Tingey	CEM	Salt Lake	533-5271
Temple Reynolds	Consultant	Salt Lake	942-7725

Attachment No. 2

WORKSHOP ON UNIVERSITY HAZARD RESEARCH EFFORTS AND CAPABILITIES

UTAH STATE UNIVERSITY

JUNE 21, 1985

ACTUAL AGENDA

Moderator: Temp Reynolds

9:15 - 9:25	Welcome - Bruce Bishop, Dean of Engineering
9:25 - 10:45	University of Utah - UURI
10:45 - 11:00	Break
11:00 - 11:50	USU (Natural Resources)
11:50 - 12:20	BYU (Thermochemical Institute)
12:20 - 1:30	LUNCH (on your own)
1:30 - 2:00	BYU (Engineering)
2:00 - 3:30	USU (Engineering/Water Lab)
3:30 - 4:45	Tour Utah Water Research Laboratory and General Discussion

PARTIAL LIST OF RECENT AND CURRENT
HAZARDS RESEARCH AT UTAH STATE UNIVERSITY

EXAMPLES OF HAZARDS RESEARCH AT THE UTAH WATER RESEARCH LABORATORY - USU

Dates	Title	Amount	Source	Principal Investigator
85-87	A conceptual hydrologic model of a closed desert basin: Great Salt Lake Desert	$24,000 26,000	USGS ML	C. J. Duffy
85-87	A comprehensive study of water cycling in the Great Salt Lake Basin	24,000 25,000	USGS ML	G. Bingham
85-86	Toxicity and environmental health hazards of petroleum products in wells used for drinking water in the Intermountain West	24,000 29,000	USGS ML	S. Parker
85-86	Influence of sediment-phosphorus interactions on water quality in Flaming Gorge Reservoir		USBR	J. J. Messer
85-86	Quantification of aquatic effects of acid precipitation on flowing water in the United States		EPA	J. J. Messer
85	Land treatment of petroleum refinery wastes--protection of groundwater	80,000	ERT	R. C. Sims
85	In situ treatment techniques for inorganic contaminants in soil systems	30,000	EPA	R. C. Sims
84-86	Evaluation of volatilization of hazardous constitutents at hazardous waste land treatment sites		EPA	R. R. Dupont
84-86	Evaluation of high loading rates and assimilation capacities for land treatment of hazardous wastes	480,000	EPA	R. C. Sims
84-85	Forecasting the summer peak water surface elevations of the Great Salt Lake		NOAA	J. P. Riley
84-85	Acid formation potential in mineral mine spoils and overburden	1,634	USFS	D. L. Sorensen

EXAMPLES OF HAZARDS RESEARCH AT THE UTAH WATER RESEARCH LABORATORY - USU

Dates	Title	Amount	Source	Principal Investigator
84-86	Protection of groundwater by immobilization of hazardous metals associated with industrial wastes in land systems	$44,000 45,000	USGS ML	R. C. Sims
84-85	Treatment and disposal of Rocky Hill ponds wastes	73,000	USUF	R. C. Sims
84-85	Identification of odor-causing mechanisms influenced by decreasing salinity of the Great Salt Lake		UDWRES	C. E. Israelsen
84-85	Alternatives for mitigating flood damages at the Great Salt Lake		USWRES	J. P. Riley
84-85	Review and evaluation of the Gibson Dome high level nuclear waste repository environmental assessment: Hydrogeologic issues	10,000	State of Utah	C. J. Duffy
84	Study of factors associated with Utah's 1983 landslides	36,036	USFS	R. W. Jeppson
84	Comparison of direct filtration and conventional water treatment systems to remove pollutants from source water	15,735	OWP	V. D. Adams
83-85	Generalized Fourier analysis of solute movement in Groundwater	57,000	NSF	C. J. Duffy
83-85	Modeling relationships of salt transport from irrigation and weathering of underlying sediments: Price River Basin	48,000	USGS	C. J. Duffy
83-85	Blue-green algae control in the protection of reservoir water quality against toxic organics	92,000	ML	V. D. Adams
83-85	Treatment of oil shale wastewater	45,000	ML	R. R. Dupont
83-85	Evaluation of the mound system of on-site waste disposal for use in Utah	70,000	ML	J. L. Sims
83-85	Design of sampling and analytical scheme for priority pollutant evaluation of groundwater resources	51,624	ML	V. D. Adams

EXAMPLES OF HAZARDS RESEARCH AT THE UTAH WATER RESEARCH LABORATORY - USU

Dates	Title	Amount	Source	Principal Investigator
83-84	Updating the estimation of water elevation probabilities and associated damages for the Great Salt Lake	$21,951	UDWRES	L. D. James
83-84	In situ treatment techniques applicable to large quantities of hazardous waste contaminated soils	94,827	JRB	R. C. Sims
83-84	Land treatment technology for oil shale wastewaters - treatability studies	2,536	UWRL	R. C. Sims
82-85	Design of a sampling and analytical scheme for protecting groundwater resources from priority pollutants	30,000	UWRL	V. D. Adams
82-84	Nitrogen mineralization potential and nitrification potential of coal mine spoils	36,956	USFS	D. L. Sorensen
82-85	Groundwater contamination hazard in Western Salt Lake County	67,859	ML	C. G. Clyde
82-85	Flood hazard delineation in Utah	177,120	ML	L. D. James
82-84	Identification of the source of illegal dumps of oil field brines	48,066	ML	C. G. Clyde
82-84	Evaluation of the potential transport of chlorinated hydrocarbons through land application systems	75,000	ML	D. L. Sorensen
82-84	Guidelines for groundwater withdrawal in Utah	77,000	ML	A. B. Bishop
81-84	The evaluation of heavy metals and potentially carcinogenic organics released into coal mine and oil shale accrual waters	90,566	OWRT	V. A. Lamarra
81-83	Effects of complexation with oil shale leachate on heavy metal bioaccumulation	140,359	OWRT	F. J. Post
81-83	A Utah drought climatology and assessment of potential to alter related weather effects	13,327	UDWRES	D. S. Bowles

EXAMPLES OF HAZARDS RESEARCH AT THE UTAH WATER RESEARCH LABORATORY - USU

Dates	Title	Amount	Source	Principal Investigator
81-83	Use of solar energy for the detoxification of organic pollutants in water for agricultural reuse	$48,803	BARD	V. D. Adams
81-83	Assessment of trihalomethane compounds and their precursors in Salt Lake County	96,096	SLCNTY	V. D. Adams
81-82	Evaluation of particular mulches as plant growth media and erosion inhibitors	3,795	CONWED	C. E. Israelsen
81-82	Factors affecting the potential for biogeochemical homeostasis in mountain watersheds	8,552	VP/MLF	J. J. Messer
81-82	Environmental fate and effect of polynuclear hydrocarbons in aquatic systems	19,520	OWRT	V. D. Adams
81-82	Development of hydraulic methods for solution of flood flows on alluvial fans	34,105	OWRT	R. W. Jeppson
81-82	Enhancement of transport and availability of heavy metals to aquatic microflora by complex organics associated with oil shale development (VDA)	35,700	OWRT	J. J. Messer
81-82	Erosion inhibitor performance evaluation under simulated wind and rain	14,220	CONWED	C. E. Israelsen
80-83	Detection and control of viruses in water			B. B. Barnett
80-81	Hail suppression evaluation	11,000	UDWRES	G. E. Hill
80-81	Exploration of use of solar energy for detoxification of organic pesticides in conditions where water freezes	5,935	UWRL	A. J. Acher
80	Estimation of floods when runoff originates from different sources	762	UWRL	R. V. Canfield
79-82	A survey and evaluation of shallow groundwater contamination hazards in the State of Utah	12,688	ML	C. G. Clyde

EXAMPLES OF HAZARDS RESEARCH AT THE UTAH WATER RESEARCH LABORATORY - USU

Dates	Title	Amount	Source	Principal Investigator
79-82	Risk analysis in civil engineering	$30,660	VP/MLF	D. S. Bowles
79-82	The effect of risk of drought on energy development and water allocations: A programming model for Utah	93,390	OWRT	J. E. Keith
79-81	Assessment of chlorinated hydrocarbons as produced by chlorination in Utah and national water and wastewater ozonation as an alternative to chlorination	31,700	ML	V. D. Adams
79-81	Water requirements and pollution potential of gas production from lignite shale and other carbon sources	29,805	OWRT	V. D. Adams
79-80	Minimizing groundwater contamination along basin margins in the arid west	33,667	ML	C. G. Clyde
79-80	Upstream management alternatives for regulating water levels in the Great Salt Lake	18,150	VP/MLF	J. P. Riley
79-80	Estimation of floods when runoff originates from different sources	8,007	OWRT	R. V. Canfield
78-81	Identification or presumptive carcinogenic compounds released to water supplies by oil shale development	107,418	OWRT	V. D. Adams
78-80	An analysis of flood protection needs, organization, and programs in the State of Utah	65,050	ML	L. D. James
77-81	Evaluation of livestock runoff as a source of water pollution in northern Utah	101,195	ML	D. B. George
77-81	Vulnerability of water supply systems to droughts	32,724	OWRT	D. S. Bowles
76-77	A study of the overall energy efficiency of pollution control technologies for energy conversion processes	28,080	OWRT	A. B. Bishop
76	Intermittent sand filter scrapings, deposition, utilization, and sand recovery	13,382	OWRT	J. H. Reynolds

HAZARDS RESEARCH OF THE GEOTECHNICAL ENGINEERING DIVISION OF THE CIVIL ENGINEERING DEPARTMENT AT UTAH STATE UNIVERSTIY

Dates	Title	Amount	Source	Principal Investigator
85-86*	Development of a Seismic Slope Stability Map of the Urban Corridor of Utah, Weber, Eastern Box Elder, and Cache Counties	$71,851	USGS	Jeffrey R. Keaton Loren R. Anderson
85-86	Evaluation of Potential Consequences of Earthquake Induced Tectonic Subsidence along the Wasatch Front, North-Central, Utah	$15,884	USGS	Jeffrey R. Keaton
85-86	Development of a Liquifaction Potential Map for the Northern Wasatch Front, Utah	$99,753	USGS	Loren R. Anderson Jeffrey R. Keaton
84-85	Debris Slide Initiation Due to Snowmelt in Mountain Terrain	$50,000	NSF	Loren R. Anderson Roland W. Jeppson
84-86	Development of a Seismic Slope Stablity Map of the Urban Corridor of Davis and Salt Lake Counties, Utah	$74,000	USGS	Jeffrey R. Keaton Loren R. Anderson
84-85	Landslide Hazard Mapping Using LANDSAT Data	$10,000	ML	Loren R. Anderson Robert W. Gunderson Mark Jadkowoki
83-85	Probabilistic Assessment of Landslide Potential along the Wasatch Front	$25,000	ML	Loren R. Anderson Robert T. Pack
83-84	Development of a Liquifaction Potential Map for Utah County, Utah	$71,582	USGS	Loren R. Anderson Jeffrey R. Keaton

*Pending

NATURAL HAZARDS RESEARCH OF THE DEPARTMENT OF GEOLOGY AT UTAH STATE UNIVERSTIY

Dates	Title	Source	Principal Investigator
83-84	Quaternary Geology and Tectonic Geomorphology of the Pocatello Valley Area, Idaho-Utah	USU Faculty Res. Grant	James McCalpin
84-85	Quarternary Fault History and Earthquake Potential of the Hansel Valley Area, North-Central Utah	USGS	James McCalpin
85-87*	Late Quaternary Tectonics and Earthquake Hazard in Cache Valley, Utah	USGS	James McCalpin
83	Landslide Inventory of 100,000 Acres in the Northern Brdger-Teton National Forest, Wyoming	USFS	James McCalpin
84-85	Landslide Age and Activity Determination from Relative-Dating (RD) Criteria: A New Approach	USU Faculty Res. Grant	James McCalpin

HAZARDS RESEARCH OF THE GEOTECHNICAL ENGINEERING DIVISION OF THE CIVIL ENGINEERING DEPARTMENT AT UTAH STATE UNIVERSTIY

Dates	Title	Amount	Source	Principal Investigator
82-83	Application of Probabilistic Slope Stability Model to a Tailings Dam	$13,000	USBM	Loren R. Anderson
81-83	Development of a Liquifaction Potential Map for Salt Lake County, Utah	$99,934	USGS	Loren R. Anderson Jeffrey R. Keaton
80-82	Development of a Liquifaction Potential Map for Davis County, Utah	$79,938	USGS	Loren R. Anderson Jeffrey R. Keaton
79-82	Probabilistic Modeling of Tailings Embankment Designs	$199,609	USBM	Loren R. Anderson David S. Bowles Ronald V. Canfield

PMW-
FYI - N.Y. Times
DF.

Radioactive Gas in Soil Raises Concern in Three-State Area

By PHILIP SHABECOFF
Special to The New York Times

BOYERTOWN, Pa., May 15 — A natural environmental hazard of uncertain but potentially grave dimensions has been discovered beneath the meadows of eastern Pennsylvania.

State and Federal investigators have found that many houses are contaminated with radon, a radioactive gas that can cause lung cancer after long exposure.

Levels in some houses were the highest ever recorded in the United States. A state survey of more than 1,600 houses in Berks County found that nearly 40 percent had unsafe levels of radon.

But the risk may be spread far beyond this semirural county.

Three State Affected

The radon is seeping up from uranium deposits in the earth below. The uranium is part of a geologic formation, the Reading Prong, which begins near Reading, Pa., and stretches eastward through Allentown and Easton, across northern New Jersey northwest of Morristown and into New York State west of Suffern and Peekskill.

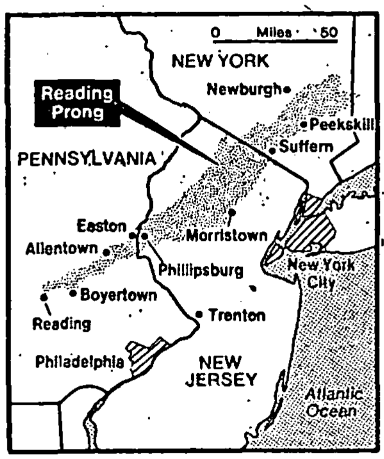
Officials in the three states say they know little about the extent of the contamination, but they believe it varies from place to place, depending on the permeability of the soil and other factors. All three states, with Pennsylvania taking the lead, are trying to determine the nature and magnitude of the problem.

Pennsylvania officials are telling residents that the radon does not constitute an immediate health risk, although it may pose serious long-term problems. They also say that examination of death certificates in Berks County shows no unusual number of cancer deaths, although the data are inconclusive because of the area's small population and cancer's long latency period.

The state has undertaken an educational program to tell people what must be done to their houses to prevent radon from seeping in and to instruct contractors on how to make the necessary changes in the houses.

Nicholas De Benedictis, the state's

Radon Stirs Cancer Fears in 3 States



The New York Times/May 19, 1985

Radioactive gas is seeping from deposits in the Reading Prong.

Continued From Page 1

Secretary of Environmental Resources, said the 21,000 homes in Pennsylvania's Reading Prong area were "potentially at risk." He said the state would examine them over the next 12 to 18 months. "There is no way to gauge the total impact of this problem," he said.

Joseph E. Rizzuto, program manager for New York's Energy Research and Development Authority, said he had heard that "there may be a problem of relatively great magnitude" involving radon from the Reading Prong, but said he had no data on the area.

James Staples, spokesman for the New Jersey Department of Environmental Protection, described the situation as "an entirely new area of concern that nobody even guessed at six months ago." He said the Reading Prong traversed some heavily populated areas in New Jersey and estimated that at least 100,000 people lived atop it.

"Our people are only now poring over geological maps and getting a handle on this," he said. "We have to guess where we are heading on this one."

'A Worldwide Problem'

Dr. Bernard Cohen, a professor of physics at the University of Pittsburgh and a leading authority on radon, said virtually every state had areas of radon contamination that might pose a health threat. It is "really a worldwide problem," Dr. Cohen said.

"Most lung cancer among nonsmokers is due to radon," he went on. "If anybody is worried about radiation, this is what they should worry about. People worry about nuclear reactor or shipment accidents or medical radiation. These are all trivial risks compared to this."

Sheldon Meyers, director of the office of radiation at the Federal Environmental Protection Agency, agreed that there was no doubt radon caused cancer but added that there were "a lot of uncertainties" about the danger presented by natural radon seeping into homes.

There is "almost no data base on radon in the homes," he said.

The environmental agency, he said, has no authority to act on the radon problem because its powers under the Clean Air Act apply only to outdoor air. He said, however, that the State of Pennsylvania had acted responsibly.

Robert E. Yuhnke, the Environmental Defense Fund's regional counsel in Denver, who has been active on radon issues, said he checked the test results after residents of the area sought his help.

"I have never seen a situation where so many many people are facing such extreme risks from an environmental hazard," he said, adding, "What we are seeing is the early stages of a cancer time-bomb waiting to go off."

The radon contamination in Pennsylvania was discovered through a fluke when Stanley J. Watras, an engineer working on the construction of the Philadelphia Electric Company's Limerick nuclear power plant outside Pottstown, set off a radiation alarm when he entered the plant. The alarm showed he was bringing radiation into the plant.

Mr. Watras asked the company to test his home. The tests, later confirmed by the state and the E.P.A., showed 16 "working levels" of radon in his living room. A working level is the measure used by the Government to measure the exposure of uranium miners to radon gas. The E.P.A. recommends radiation levels of no more than two one-hundredths of one working level.

The radiation level inside Mr. Watras's living room was the highest ever found in the United States from radon contamination, according to Mr. De Benedictis. At that level the chances of contracting lung cancer over a lifetime of exposure are 100 percent, experts say. In fact, they say, there is an extremely high risk of contracting lung cancer within relatively few years.

Family Moves From House

Acting on the advice of the state environmental agency, Mr. Watras and his family have moved out of their house, which they had moved into only a year before.

"It was really a tormenting time," Mr. Watras said. "We were dealing with the unknown and it was horrifying."

Radon, which is given off by uranium as a gas, soon decays, turning into polonium, a radioactive chemical element, and then into solid particles of bismuth and lead. These particles are known as radon daughters. In the open air, radon disperses and does not pose a problem. But when it collects in homes, residents inhale it and the resulting solid lead and bismuth particles tend to lodge in their lungs. Over time, the particles can cause lung cancer.

The problem has been compounded over the last decade by efforts to conserve energy by making homes airtight. Radon accumulating in airtight houses does not leak out, so its risk to health is increased.

Philadelpha Electric is now reconstructing the Watras house as an example of how a home could be well insulated and still keep radon levels down.

Until recently, this area of Pennsylvania was largely rural, populated by farmers who did not spend much time indoors. But today the area is becoming a suburb of Philadelphia.

Many Homes Are Contaminated

Although the highest levels of radon were recorded in Mr. Watras's home, many other houses in the county had levels that would almost assure cancer after a lifetime of exposure.

The state has advised these homeowners to remodel their homes. But many of the residents say they cannot afford to do so because the cost is $20,000 or more. These residents also say that the problem has sent the value of their homes plummeting. And there is no private party liable for damages and no Government program to cover this kind of environmental damage.

Kay Jones, whose home across the street from the Watras house contained a dangerous 2.3 working levels of radon, wants the Government to declare Berks County a disaster area so that it would be eligible for Government relief. She noted that the Government was rebuilding homes in Grand Junction, Colo., that were contaminated by radon from uranium tailings produced in the manufacture of weapons for the Government.

"We are angry and frightened and frustrated," Mrs. Jones said, adding that residents of the area intended to go to Washington to seek Federal aid.

Kathleen Varaday, who lives nearby with her husband, four children, two cats and two dogs, said state officials told her that her house showed 2.12 working levels of radon, and that that level was equivalent to smoking 22 packs of cigarettes a day.

"We are living in a home that all the experts tell us we should not be living in," she said. "But where can we go? I can't afford to move out and live somewhere else and pay the mortgage on this home."

Mr. Rizzuto, the New York energy official, said the state was just starting a random sample of 2,000 homes across the state to test for radon. "We certainly will be looking at areas we think are important," he said. The state will publish in a few weeks the results of a more limited radon study it undertook in the Buffalo area with Niagara Mohawk, a utility company.

In addition to the uranium tailings in Colorado, there have been a number of other hazards from radioactive soils, but they have all been a result of human activity, including phosphate mining in Florida and Tennessee.

April 3, 1985

MEMORANDUM

TO; Mike, Dennis
FROM: Duncan
RE: Hazards book

This is to inform you that I am talking with Dr. Fred May, Utah CEM, about the possibility of our writing a popular book directed toward geologic hazards in Utah. Our discussions so far have been preliminary, but we both feel there is a market for such a book, and the U of U press has called me about being interested in being the publisher.

My work on this book would not interfear or conflict with my work at ESL, as it would be done on outside time (or vacation when unavoidable daytime efforts would be required). I would be basically writing up my lecture notes from my class; Fred would be adding the history of hazards in Utah.

I will keep you posted on the progress of this work.

D.F.

April 3, 1985

MEMORANDUM

TO: Mike
FROM: Duncan
RE: DOE and geologic hazards

Whereas: 1. ESL is very good at getting funding from DOE, and, 2. ESL could be aided by development of programs in geologic hazards, and 3. DOE is concerned about the vulnerability of power supplies to geologic hazards; I therefore suggest that we consider a proposal to DOE that would combine these three elements.

We could create a program to evaluate the most likely places for geothermal plants to be located and come on line, and develop an integrated assessment of geologic hazards at these sites. It is true that these data will be developed in more detail during the EIS phase of plant siting (where required), but ESL's proposal would be to do a system-wide evaluation. We could look at volcanic, flood, landslide, earthquake, avalanche and other hazards. Our report could assess the reliability (from the hazard standpoint) of the geothermal contribution to the electric power grid, and could suggest hazard mitigation strategies.

DF

UNIVERSITY OF UTAH RESEARCH INSTITUTE

UURI

EARTH SCIENCE LABORATORY
391 CHIPETA WAY, SUITE C
SALT LAKE CITY, UTAH 84108—1295
TELEPHONE 801-524-3422

PMW

March 20, 1985

Mr. John Varley
Research Administrator
National Park Service
P.O. Box 168
Yellowstone National Park, WY 82190

Dear John:

The Earth Science Laboratory/University of Utah Research Institute is interested in preparing a proposal for submittal to the National Science Foundation for a study of hydrothermal alteration in the Grand Canyon of the Yellowstone. This is one of the areas of Earth Science Lab interest in geological research in Yellowstone that I discussed with you last fall.

The NSF proposal would involve a major effort to document the nature of hydrothermal alteration in the Grand Canyon. This would include mineralogical and chemical studies of rocks and alteration products, chemical studies of appropriate fluids, and hopefully age dating of changes in alteration regimes, which could be related to episodes of downcutting. Our conversations with U.S. Geological Survey personnel indicate they have no plans to do a study of this sort in the next few years.

We are interested in doing a preliminary study this summer, which would involve the collection of a few samples, to strengthen our proposal. We have not been able to find in the geologic literature any geochemical analytic data from the altered rocks of the Grand Canyon. Such preliminary data would allow us to identify datable minerals, and establish the likely framework of alteration in the canyon.

At this time, however, the Earth Science Lab may not be able to internally fund the analytic portion of the preliminary study, and we are interested in knowing if the National Park Service would be able to fund a small amount (approximately $1,000) of rock chemistry and X-ray diffraction studies. We would provide results of the preliminary analyses to the NPS; these would be useful in Canyon interpretation. Dr. Dennis Nielson and I would provide the field time, and ESL would provide the report writing and proposal preparation funding.

I recognize that this inquiry for funding is coming late in your planning for the summer season, but any assistance you might be able to provide to our proposal preparation efforts would be greatly appreciated. The Grand Canyon of the Yellowstone is one of the most accessible, least known geologic features in the U.S., and if we are able to secure funding for a major study, we will be able to generate much new data of interest to the Park Service and geologists.

If you have any questions, please do not hesitate to call me (FTS 524-3431), and if you have a chance when you are in Salt Lake City, please feel free to stop by our facilities.

Sincerely,

Duncan Foley

Duncan Foley
Geologist

DF/jp

HAZARDS RESEARCH CENTER

	Action Item	Timing	Resources Required	Personnel
1.	Visit Ada, OK to learn about their extramural research program	by 15 June	3 days/travel	Wright
2.	Conduct meeting on state problems/ priorities	31 May	3 days x 3 people	Ward, Wright, Nielson
3.	Contact Hatch's office about - money for a start - money for one or two selected research projects	by 1 June	--	Wright
4.	Write a directed, unsolicited proposal to Ada office	by 1 July	14 days, 5 days consulting	Wright, Nielson, Consultant
5.	Talk with FEMA about matching funds	by 15 July	travel to WDC to visit FEMA, EPA, Hatch	Wright?
6.	Write a group shoot proposal to mining companies with Raab on directed environmental research	by 1 July	14 days, UURI + 5 days Raab + $3000 marketing	Wright, Nielson, Raab
7.	Identify additional UURI staff needed	by 15 July	--	--
8.	Appoint a director for the Center	when first big project comes in (> $250K)	--	--

M E M O R A N D U M

June 7, 1985

TO: Dr. James Brophy, University of Utah
Dr. Bartell Jensen, Utah State University
Dr. John Lamb, Brigham Young University

FROM: Temple A. Reynolds, Consultant

SUBJECT: Workshop/meeting with public sector agency representatives to identify and discuss geologic and environmental hazards related problems.

On Friday morning, May 31, 1985, a group of state and federal agency representatives met with faculty and staff researchers from the University of Utah Research Institute (UURI), the University of Utah (UU), Utah State University (USU) and Brigham Young University (BYU) in the Little Theatre of the University of Utah Union Building. (See Attachment No. 1, Attendance List.)

Purpose of the meeting was to explore with the public sector agencies geologic and environmental hazards related problems or problem areas, research and remedial work underway and possible future work priorities in this area. It was specifically requested that problem areas covered by the 1984 Governors Conference on Geologic Hazards, hosted by the Utah Geological and Mineral Survey, be excluded from the discussions.

After a welcome and some general housekeeping announcements, I spent the first few minutes of the session recaping the history of the proposal for a Center for the Study of Geologic and Environmental Hazards and tracing events that had transpired since the UU, USU, BYU and UURI representatives initially met to discuss concepts on March 6, 1985. Because many of the state/federal agency participants present had not been directly involved in the one-on-one meetings we had had with the agency directors, it was necessary to recap in greater detail than had been planned. Questions and discussions centered on the interdisciplinary approach, and the role, operation and function of the proposed Center.

Following introductions of those present a number of problem areas were placed before the group for discussion purposes. Agency, spokesman, a brief statement of concerns and associated discussions were as follows:

Utah Geological and Mineral Survey (UGMS) - Don Mabey discussed five problem areas:

1 - Systemic Geologic Hazards Inventory - In Utah the primary governmental responsibility for actions to mitigate and reduce geologic hazards is with local governments; however, local governments do not have the capability to develop the data base upon which to base actions. The UGMS has the statutory responsibility to assist local governments in this effort. The United States Geological Survey (USGS) is providing some support. A state-wide compilation of geologic hazards information and hazard inventory has been started. Three new geologists have been added to the UGMS staff to work with several counties along the Wasatch front. Two new hazards geologists will go to work with UGMS beginning the first of July, 1985 and one staff member will be assigned full time to compile existing information.

2 - Geologic Hazards Process Research - All actions relative to geologic hazard reduction, monitoring, and mitigation require an understanding of the geologic processes involved. Research to develop this improved understanding is being done by UGMS, USGS and Universities, primarily with funding from the USGS. In Utah, the UGMS is working with USGS to develop and implement this research.

3 - Geologic Hazard Monitoring and Warning - Earthquake monitoring by the University of Utah Seismograph Stations is a continuing program. More recently other monitoring programs relating to earthquakes and slope failures have been started in programs involving the UGMS, Division of Comprehensive Emergency Management (CEM), USGS, Federal Emergency Management Agency (FEMA), local governments, UU and USU. Programs of continuous and emergency monitoring should be continued and expanded.

Discussion on this point indicated that some very limited funding had been made available through the legislative appropriation process for purchase of monitoring equipment beginning on July 1, 1985. There appeared to be concensus on the need for a project or projects to develop low cost, expendable monitoring instrumentation for installation in areas of known or suspected faulting and slope instability to more closely monitor these areas in the future.

4 - Geologic Hazard Reduction and Mitigation - The primary responsibility for hazard reduction and mitigation is with local governments and State and Federal agencies that need technical assistance in developing and implementing these efforts.

While local governments have had some experience in dealing with hazard related public health and safety, there has been little local experience in dealing with the liabilities associated with active leadership in hazard reduction and mitigation. USGS has provided funding to the University of Utah Geography Department, Salt Lake City and West Valley City to develop techniques in this area.

5 - Geologic Hazards and Facility Siting - Many public facilities do not obtain a geologic hazard review early in the project planning phase, before proceeding with project design and construction. State and local agencies and private organizations constructing critical facilities need guidance on geologic hazards. The UGMS responds to requests for assistance from government agencies.

There is a need to devise a system (statute?) that will insure that geologic hazards information is utilized more effectively in siting public and private developments.

U. S. Bureau of Reclamation (BuRec), Brent D. Taylor discussed seven problem areas:

1 - Air Pollution Problems - There is a need to define what constitutes air pollution and a parallel need to develop airshed-wide control strategies. Practical illustrations associated with this problem statement are associated with the current Utah-Colorado disparity in air quality designations in the Uinta Basin and with the official position of the Utah Air Quality Committee, as recently reported, regarding monitoring or air quality in Utah.

2 - Integrated Approach to Water Management in the State - There are changing environments and attitudes with regard to water use, conservation and irrigation. Should new approaches to water management be developed, the Bureau may be interested.

3 - Dam Safety - Technical and social standards should be developed for siting and construction of earth fill dams. Questions to ponder -- How safe is safe enough in terms of public health and safety? What are people willing to pay for in terms of safety?

4 - Development/Evaluation of Techniques to Look Inside Existing Dams to Document Fluid Movement - Little is known about how earth dams hold up internally over time. The Bureau has had continuing problems with Fontinelle Dam in Wyoming and would welcome studies that would provide techniques for routine inspections.

Stan Ward, UURI, inquired regarding present methods used to monitor dams. Brent responded that the primary method was well monitoring, though temperature and seismic activity is also considered.

5 - Multi Hazards Study, Ogden Area - The study has been completed. There is now a need to prioritize remedial steps and/or offsetting actions to mitigate or treat identified hazards. Public interaction is a needed step in making these determinations.

6 - Integrated Management, Use and Development of the Great Salt Lake - The Great Salt Lake is a unique phenomenon in terms of its geology, mineral wealth and impact on the environment, public health and safety. Lake side industries have repeatedly requested that the State develop and actively implement a policy regarding control and management of the lake. New transportation, public health, industrial, residential and recreational developments on and near the lake shore also require assurances with regard their proposed investments, as does the United States Military establishment.

Paul Gillette, Utah Division of Water Resources (DWR), suggested the need for definitive legal, ecologic, geologic, hydrologic and other studies associated with the various options (west desert pumping, major dikes, minor dikes) to contain the lake, now being considered by the State Legislature. The time frame for anticipated action, however, seems to preclude thorough integrated investigations.

Stan Ward, UURI, asked about anticipated subsurface return flows from west desert pumping. Paul responded that this has not been considered inasmuch as formations are relatively tight and there is very little head differential between the west desert and the lake surface.

Don Mabey, UGMS, mentioned climatological problems associated with the lake as an area of inadequacy identified from the recent Great Salt Lake Conference. Data from stream gauges and weather stations are not adequate to predict flows. He suggested the possible need for tree ring studies to identify wet cycles. Most studies of tree rings have been oriented toward understanding drought cycles.

7 - Longer Term Studies for Flood Control Along the Wasatch Front - It was suggested that slides, flows and floods associated with the past several years are not, in an historical context, isolated instances. There is potential for future repetitions of these phenomena. The brush fire approach to problem solving in this regard is inefficient. In-depth studies should be carried out as soon as possible to plan for future recurrences.

U. S. Forest Service (USFS) - Earl P. Olson, Geologist, submitted proposals regarding four problem areas and selectively discussed several of these:

1 - Lack of Knowledge Relative to the Literature Dealing with Geologic and Environmental Hazards - Much important work relative to the technical aspects of mud and debris flows exists in untranslated foreign literature. Funds should be sought (possibly from the National Academy of Science) to accomplish one translation per year. For a list of proposed translations see Attachment No. 2.

It would be helpful to practitioners if an annual list of Masters Thesis and Doctoral Dissertations on Geologic and Environmental Hazards generated in Utah schools could be published.

Don Mabey, UGMS, suggested the possibility of a periodic news letter to practitioners, rather like the one currently and temporarily being done by UGMS for the Wasatch front area.

Fred May, CEM, suggested the need for some agency to assume a "clearinghouse" function. Problems seem to be associated with collation and distribution.

Earl Olson, USFS, indicated that it was his understanding that USGS was soon to publish a "Grey List" of Geologic Hazards maps. He further suggested that the "Grey Literature" is extremely rich in information regarding geologic and environmental hazards and that because of the context, there is probably more relevant hazard information here than in more pure forms of geologic or environmental literature.

UGMS is compiling an Earthquake Bibliography relative to Utah earthquake occurrences and hazards. Don Mabey estimated that there will be approximately 1000 entries.

2 - Lack of Data Regarding Holocene Ruptures - There is insufficient data on age dating of Holocene ruptures of the Wasatch Fault, especially from the area north of Kaysville. Additional data from the area south of Kaysville is also desirable.

Some age dating of Holocene fault ruptures from throughout the State would be highly desirable. First priority for data collection should be near population centers.

3 - Insufficient Sequential Data on Aseismic Deformation of all the Locked Portions of the Wasatch Front.

4 - Ground Water Studies of the Bear River Range, Wasatch Range and Wasatch Plateau - Work needs to be undertaken to analyze existing well logs and data regarding spring flows. Where such data is not available efforts should be made to begin monitoring activities.

Tom Collins, USFS, also suggested that, in terms of identifying possible future hazards or environmental problem areas, it would be desirable to identify and move to protect ground water recharge areas. It was suggested that very little is known with regard recharge in the State's mountainous areas and the influences of recharge on streams, and springs.

Earl Olson also pointed out the the importance of work in the mountains. Information regarding recharge is needed to help manage the water at the valley floor level, where everyone lives.

Division of Comprehensive Emergency Management (CEM) -- DeeEll Fifield discussed the need for a county by county hazard hazard analysis. Such an analysis must be included in county emergency management plans. Mr. Fifield indicated that the counties simply do not have the expertise or financial resources to complete the required analyses.

Don Mabey, UGMS, indicated that his agency is working on a Sevier County hazard map at the present time and intends to continue this effort over time in other counties. Completion of a county hazard mapping program will be very time consuming without additional funding. Outlying Counties, especially, are sensitive that they are not getting as much help as they would like.

U. S. Forest Service (USFS) -- Bruce Vandre suggested the need for a Generic Decision Making Model for Dealing with Hazards. Such a model, it was felt, could assure that at least the same factors would be evaluated in the same way in similar situations. Currently, we appear to think only in terms of probability of occurrence.

Earl Olson suggested the need to define Hazards. This would assure that widely used specific terminology would be well understood in its appropriate context.

In Open Discussion, Stan Ward, UURI, raised the question of the need for snow avalanche research and a support level that the Forest Service might be willing to provide. Earl Olson, USFS, responded that avalanche safety in the National Forests is the responsibility of individual permittees, e.g. ski resort operators. The Forest Service has largely discontinued its avalanche work except for about a half man-year annually in Colorado.

It was pointed out that more people are killed each year in the United States as a result of snow avalanche than from any other geologic hazard. Don Mabey, UGMS, observed that this was an important area of hazards study that was "slipping through the cracks".

Stan Ward also made general inquiry regarding the current state of knowledge about aquifer contamination. Don Mabey responded that Davis County landfill authorities had asked UGMS to provide them with a monitoring system. Don said that his agency did not have sufficient knowledge to design such a system.

Conclusion:

Those present supported the idea of further contacts with the State's Congressional Delegation and continued close liaison with governmental leaders to seek seed money for funding needed hazards research. The question of whether or not a formal Center for the Study of Geologic and Environmental Hazards was left unresolved.

Workshop to Showcase Geological and Environmental Hazards Research Capabilities and Current Efforts of University Researchers. It had been hoped that we could conduct this kind of a one-day workshop earlier this spring. Loren Anderson and Clair Batty, USU, have now set a date of June 27, 1985 for the workshop. Representatives from BYU, UU, UURI and USU will discuss their hazards related research activities and capabilities. The workshop will be held at a site to be determined on the Utah State University campus. A tour of the Utah Water Research Laboratory will be included in the day's activities. State and Federal agency representatives are invited to attend so that they can become better aware of University capabilities and better acquainted with University researchers. Complete details will follow.

The meeting adjourned at approximately 11:20 AM.

Attachments

CC: Participants
State/Federal Agency heads
University participants, March 6 meeting

Attachment No. 1

List of Attendees

HAZARD PROBLEMS WORKSHOP

May 31, 1985

NAME	ORGANIZATION	LOCATION	PHONE
Don Mabey	UGMS	Salt Lake	581-6831
Les Youd	BYU	Provo	378-6327
Loren Anderson	USU	Logan	750-2780
Bart Kowallis	BYU	Provo	378-2467
Clair Batty	USU, Utah Water Lab	Logan	750-3156
Tom Collins	USDA, Forest Service	Ogden	625-5357
Earl P. Olson	USDA, Forest Service	Ogden	625-5358
Brent D. Taylor	Interior, Reclamation	Salt Lake	524-3297
Bruce Vandre	USDA, Forest Service	Ogden	625-5237
Loren Rausher	UDOT	Salt Lake	965-4326
Lorin Larsen	CEM	Salt Lake	533-5271
Ralph Findlay	CEM	Salt Lake	533-5271
DeeEll Fifield	CEM	Salt Lake	533-5271
Fred May	CEM	Salt Lake	533-5271
Richard Hall	Water Rights	Salt Lake	533-6071
Paul Gillette	Water Resources	Salt Lake	533-5401
George Diwachak	BLM	Salt Lake	524-3006
Stan Ward	UURI	Salt Lake	524-3454
Dennis Nielson	UURI	Salt Lake	524-3422
Mike Wright	UURI	Salt Lake	524-3422
Kim McCarter	UU	Salt Lake	581-8603
Temple Reynolds	Consultant	Salt Lake	942-7725

Attachment No. 2

MOST NEEDED TRANSLATIONS

complied by

Earl P. Olson, U.S. Forest Service
801/625-5358

Albert Heim, 1932. Bergsturz and Menschenleben. Zurich. 218 pp.

Josef Stini, 1910. Die Muren. Innsbruck. 139 pp.

G.K. Tushinskii, E.S Troshkina, 1980. Sklonouye Protsessy (Slope Processes). Moscow. Izd-vo Moskouskogo Universitete. 134 pp.

Iv. B. Vinogradou; T.L. Kirenskaia, 1980. Seleuye Potoki (Mudflows). Moscow. Gidromet eoizdat.

Ni shi liu lun wen ji (collected papers on mudflows). 1981. Chungging, Kexue dishu Wexian chubanshe.

Mud Flow Phenomens And Their Control. 1940. Izd ZaknIIvkh. Tbilisi.

Mudflows And Their Control. 1957. Izd An SSSR. Moscow.

Ravines And Mudflow Deposits. Dorizdat. Moscow. 1947.

PROPOSAL TO ESTABLISH

CENTER FOR GEOLOGICAL AND ENVIRONMENTAL HAZARDS RESEARCH

Earth Science Laboratory

University of Utah Research Institute
391 Chipeta Way, Suite C
Salt Lake City, Utah 84108
(801) 524-3422

MAY, 1985

PROPOSAL TO ESTABLISH

CENTER FOR GEOLOGICAL AND ENVIRONMENTAL HAZARDS RESEARCH

by

UNIVERSITY OF UTAH RESEARCH INSTITUTE
391 CHIPETA WAY, SUITE C
SALT LAKE CITY, UTAH 84108

May, 1985

INTRODUCTION

Recent landslides and flooding in Utah have brought to public attention the economic importance of geological and environmental hazards. Hazards problems are on the increase nationwide and pose a growing challenge to society. For instance, Utah is now looking at detailed characterization of over 200 hazardous waste sites; consultants believe that many more sites exist.

Although state agencies have been doing an admirable job in the identification and monitoring of potential hazards, these organizations have neither research nor technology development mandates. There is a definite research need to understand the processes involved in many types of geological and environmental hazards. We not only lack techniques to assess and mitigate most hazards, but we also lack the public awareness necessary to implement measures to prepare for potential disasters. With increased scientific knowledge, we will be able to move from passively monitoring events to active mitigation and education procedures designed to protect life and property. The need for research exists not only in Utah, but throughout the United States. The talent needed for scientific investigations presently resides within Utah's universities and colleges, state agencies and the private sector. What is required is to bring together this talent and coordinate their efforts to solve tough, interdisciplinary problems.

We perceive most geologic and environmental problems to be interdisciplinary in nature in that understanding the phenomena and designing warning and mitigation measures involves the disciplines of earth science, atmospheric science, physics, chemistry, and engineering, among others. In addition, understanding the social and economic impact of hazards requires input from the disciplines of medicine, economics, sociology, and psychology.

PROPOSAL

The University of Utah Research Institute (Attachment A) proposes to form a Center for Geological and Environmental Hazards Research. The purpose of this center will be to organize the talent within Utah's universities, colleges and private companies in order to attract and successfully complete large, interdisciplinary research projects. The Center will work closely with State and Federal agencies to ensure that research results are applied and that problems of highest priority receive greatest attention. The proposed Center will serve four functions: 1) marketing the broad range of talents available; 2) organizing the scientific staff required to complete the research; 3) subcontracting for the research projects; and, 4) managing the projects to their successful completion. This Center will neither compete with ongoing academic research or state agency programs nor seek to control all hazards research. The history of this concept and a list of informational meetings with State and Federal agencies and universities are outlined in Attachment B.

BENEFITS

There are many benefits to the approach proposed here.

- It immediately brings together a pool of scientific expertise to work on complex interdisciplinary projects.
- It establishes a center of excellence which will attract new research monies into the State.
- It provides a full-time management infrastructure for the timely completion of complex projects.
- It will work closely with State agencies to be responsive to State needs.
- It will establish an organization to work on problems which are now

done by out-of-state firms.

- It will spin off commercial products which will add to Utah's industrial base.

PROPOSED MANAGEMENT

The center for will require a strong management to ensure timely completion of deliverables within budget. We propose the management structures shown in Attachments C and D. The Center for Geological and Environmental Hazards Research will be established as a division of the University of Utah Research Institute which will be headed by a Director. We propose Mr. Temple A. Reynolds for the position of Director; his resume is Attachment E. Although directly responsible to UURI management, the Director will be in contact with participating universities at the Vice President level. The Director will be responsible for coordination of the Center's activities with State agencies. He will also assume responsibility for the Program Management, Finance and Marketing functions.

Proposed project management is shown in Attachment D. A Program Manager will be assigned to a project from UURI's full-time staff. This person's principal responsibility will be to ensure that contract obligations are satisfied. The technical portion of the project will be managed by a Principal Investigator who will be from the staff of one of the participating institutions. This person will be assigned on the basis of scientific credentials, and will assemble and coordinate the staff required to complete the project.

PROPOSED BUDGET

Once established, the Center will be financed by fees from successful research proposals. In order to remain competitive, these fees will have to be kept at a low level. We do require one-time start-up funds for the Center, which we estimate at $100,000. These funds will be used as seed money to support the full-time director who will be responsible for selecting potential research projects and writing research proposals.

UNIVERSITY OF UTAH RESEARCH INSTITUTE

- SELF-SUPPORTING, NON-PROFIT CORPORATION. NO STATE SUPPORT.

  PRESIDENT: JAMES J. BROPHY

  SECRETARY/TREASURER: STANLEY H. WARD

  TECHNICAL VICE PRESIDENT: PHILLIP M. WRIGHT

- SEVEN-MEMBER BOARD OF DIRECTORS:

  CHASE N. PETERSON - CHAIRMAN
  IRWIN ALTMAN
  JAMES J. BROPHY - PRESIDENT
  EDWARD W. CLYDE
  JOHN A. DAHLSTROM
  WALTER P. GNEMI
  WARREN E. PUGH
  ROY W. SIMMONS
  DON E. DETMER

- MISSION:
  - TO ACT AS AN INTERFACE BETWEEN ACADEMIC RESEARCH AND THE COMMUNITY
  - TO ORGINATE AND PERFORM APPLIED SCIENTIFIC RESEARCH
  - TO STIMULATE INTERSTATE AND INTRASTATE COOPERATIVE, MULTIDISCIPLINARY RESEARCH

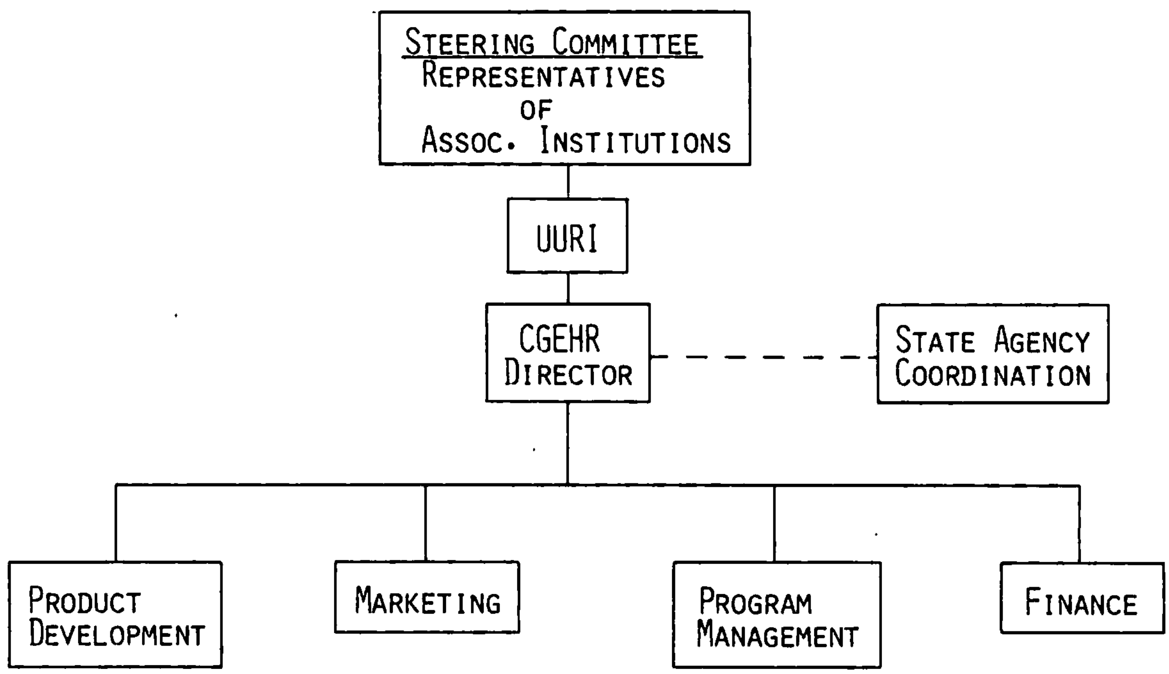
HISTORY OF CENTER FOR GEOLOGICAL AND ENVIRONMENTAL HAZARDS RESEARCH

1. CONCEIVED AT UURI LATE 1984.
2. PRESENTATION TO STATE SCIENCE ADVISORY COUNCIL 13 NOVEMBER 1984. THEY ENDORSED CONCEPT.
3. DISCUSSED BY JIM BROPHY WITH COUNTERPARTS AT USU AND BYU. THEY WERE SUPPORTIVE.
4. MEETING ON 6 MARCH 1985 WITH SCIENTISTS FROM UURI, UU, USU, BYU TO DISCUSS CONCEPT. SCIENTISTS WERE SUPPORTIVE.
5. INDIVIDUAL MEETINGS WITH THE FOLLOWING STATE AND FEDERAL AGENCIES IN UTAH TO INFORM THEM OF PLANS FOR CENTER.

PERSON	POSITION
RUTH ANN STOREY	ADM. ASST. TO GOVERNOR BANGERTER
DR. RANDY MOON	STATE SCIENCE ADVISOR, OFFICE OF PLANNING AND BUDGET
DEE C. HANSEN	EXECUTIVE DIRECTOR, UTAH DEPT. OF NATURAL RESOURCES
D. LARRY ANDERSON	DIRECTOR, DIV. OF WATER RESOURCES
ROBERT MORGAN	STATE ENGINEER, DIV. OF WATER RIGHTS
GENEVIEVE ATWOOD	DIRECTOR, UTAH GEOLOGICAL AND MINERAL SURVEY
KEN ALKEMA	DIRECTOR, DIV. OF ENVIRONMENTAL HEALTH
WILLIAM HURLEY	DIRECTOR, UTAH DEPT. OF TRANSPORTATION
TED ARNOW	DISTRICT CHIEF, U.S. GEOLOGICAL SURVEY
ROLAND G. ROBISON, JR.	STATE DIRECTOR, BUREAU OF LAND MANAGEMENT
CLIFFORD I. BARRETT	REGIONAL DIRECTOR, UPPER COLORADO REGION, U.S. BUREAU OF RECLAMATION
ARTHUR J. CARROLL	SUPERVISOR, WASATCH-CACHE NATIONAL FOREST
DANIEL DAKE	DIVISION ADMINISTRATOR, FEDERAL HIGHWAY ADMN.
LEE J. MCQUIVEY	ENG. DIV. REP., U.S. ARMY CORPS OF ENGINEERS
MAJ. GEN. JOHN MATTHEWS	THE ADJUTANT GENERAL, UTAH NATIONAL GUARD

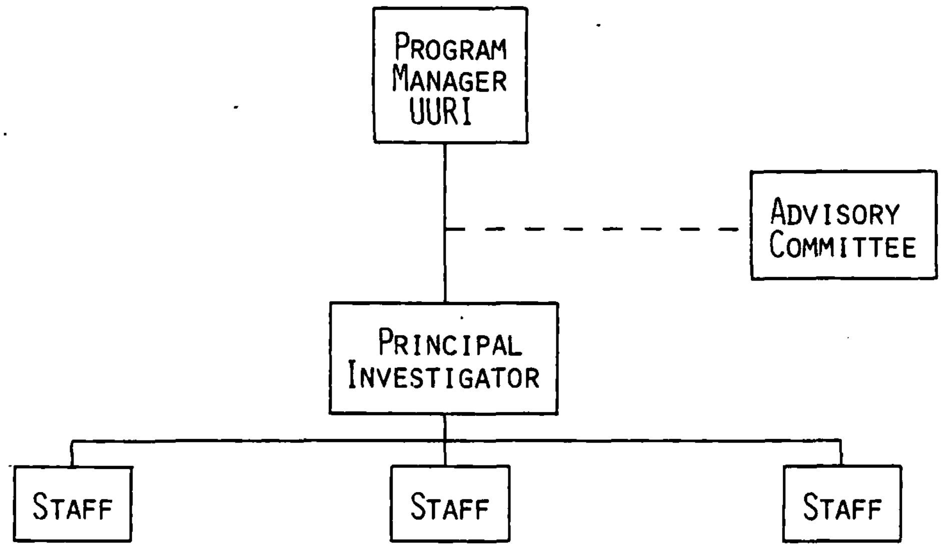
CENTER FOR GEOLOGICAL AND ENVIRONMENTAL HAZARDS RESEARCH

PROPOSED ORGANIZATION



CENTER FOR GEOLOGICAL AND ENVIRONMENTAL HAZARDS RESEARCH

PROPOSED PROJECT MANAGEMENT



Attachment E

Resume of:

TEMPLE A. (TEMP) REYNOLDS
6936 Nye Drive
Salt Lake City, Utah 84121
(801) 942-7725

OBJECTIVE: An assignment in **GENERAL MANAGEMENT** and **ADMINISTRATION** based on successful experiences and a record of growth and accomplishment in these areas. Qualifications include:

Directing a statewide, cabinet level natural resources management agency;

Developing and implementing administrative policies and legislative strategies;

Field level management and supervision of multi-faceted operations;

Analyzing and evaluating ongoing and potential new projects and initiatives for need, cost effectiveness and viability.

BACKGROUND AND EXPERIENCE IN:

Management of Organizations
Public Relations
Program Planning and Evaluation
Writing and Editing
Comprehensive Land Use and Development Planning
Public Administration
Intergovernmental Relations
Contract Administration
Field Supervision

BUSINESS HISTORY

UTAH DEPARTMENT OF NATURAL RESOURCES (UDNR), from 1980 to 1985.

Executive Director, UDNR, Salt Lake City, UT., 1981 to 1985.

Total management and administrative responsibility for eight divisions with 1200 employees and $55 million annual budget. Cabinet advisor to Governor, liaison with State Legislature and Policy Boards.

- Direct development of Project BOLD, a proposal to the Congress to block 3.5 million acres of scattered state lands into manageable units.

- Devise and implement a comprehensive planning system for state park, forest and wildlife lands.

- Direct a comprehensive review and analysis of the need for the multimillion dollar Bonneville Unit of the Central Utah Water Project.

- Restructure Department to increase responsiveness to direction and reduce administrative overhead costs.

Deputy Director, UDNR, Salt Lake City, UT., 1980 to 1981.

- Establish Automated Geographic Referencing System.

- Increase productivity through Office Automation.

U.S. NATIONAL PARK SERVICE (NPS), from 1969 to 1980.

Associate Regional Director, Management and Operations, Pacific Northwest Region, Seattle, WA., 1978 to 1980.

Responsible for management oversight of 31 National Park areas In Oregon, Washington, Idaho and Alaska. Develop cyclic maintenance program.

Superintendent, Glen Canyon National Recreation Area, Page, AZ., 1974 to 1978.

Direct Operations on and manage all external affairs related to a 1,932 square mile area with 100 employees, 2 million visitors per year and $15 million annual budget.

Assistant Superintendent, Lake Mead National Recreation Area, Boulder City, NV., 1970 to 1974.

Manage all operations on 2,338 square mile area with 110 employees, 3.5 million visitors per year and $18 million annual budget. Revise and edit portions of Southwest Energy Study. Write first NPS related environmental impact statement.

Staff Assistant to the Secretary, U.S. Department of the Interior, Washington, D.C., 1969 to 1970.

Develop and/or review major programs in areas of public land management and national parks. Edit first Nationwide Outdoor Recreation Plan.

Other Positions: BUREAU OF OUTDOOR RECREATION in Denver, San Francisco and Washington, D.C., and UTAH DIVISION OF WILDLIFE RESOURCES in Salt Lake City. Responsibility for grants-in-aid administration, comprehensive planning, public relations and biological research.

EDUCATION:	Ph.D.	Zoology, Minor in Ecology (Dissertation not completed) University of Utah, Salt Lake City, UT 1960
	M.S.	Wildlife Management Utah State University, Logan, UT 1956
	B.S.	Forestry Penn State University, University Park, PA 1954

EARTH SCIENCE LABORATORY
391 CHIPETA WAY, SUITE C
SALT LAKE CITY, UTAH 84108
(801) 524-3422

PROPOSALS FOR

GEOLOGICAL HAZARDS RESEARCH

Earth Science Laboratory
University of Utah Research Institute
391-C Chipeta Way
Salt Lake City, Utah 84108

SUMMARY FOR THE SMITHSONIAN SCIENCE INFORMATION EXCHANGE

Congressional District: Utah 2nd

Project Title: Physical Conditions During Development of a Major Low-Angle Fault Zone in the Eastern Great Basin, Utah with Implications for the Generation of Large Earthquakes

Date Project Started:

Program Objective: Determine the physical conditions under which a major low-angle fault developed in order to evaluate the seismogenic potential of such zones.

Principal Investigator: Dennis L. Nielson

Organization and Address: Earth Science Laboratory
University of Utah Research Institute
391 Chipeta Way, Suite C
Salt Lake City, Utah 84108

Estimated Cost for Current Fiscal Year: $94,100

States to which project pertains: Utah specifically, Great Basin in general

Key Words: Low-angle fault, geothermometry, geobarometry, water-rock ratios

ABSTRACT

Geologic mapping has defined a 100-meter thick zone of cataclasis which we believe is representative of one of the major low-angle detachments which have been recently discovered by seismic surveys in the eastern Great Basin. Several authors have suggested that such zones could serve as the sources for large earthquakes. The exposure of this zone through the processes of uplift and erosion provides us with the opportunity to determine the conditions under which this zone underwent brittle fracture. The fault zone as well as the footwall and hanging wall blocks will be sampled in detail paying particular attention to the textures which can indicate brittle or ductile behavior. The conditions under which the faulting took place will be quantified using stable isotope geothermometry and fluid inclusions. This information, as well as calculations of chemical mass transfer, will establish the amount and types of fluids present in the rock during the faulting events. These data will allow an evaluation of the depths at which potentially large earthquakes have been formed along this and similar low-angle detachments.

Principal Investigator: Dennis L Nielson Date: 3/1/85

OMB Approval No. 0348-0006

FEDERAL ASSISTANCE

1. TYPE OF SUBMISSION (Mark appropriate box)

- ☐ NOTICE OF INTENT (OPTIONAL)
- ☐ PREAPPLICATION
- ☒ APPLICATION

2. APPLICANT'S APPLICATION IDENTIFIER
a. NUMBER
b. DATE Year month day 19 85 2 28

3. STATE APPLICATION IDENTIFIER NOTE: TO BE ASSIGNED BY STATE
a. NUMBER UT850301-050
b. DATE ASSIGNED Year month day 19 85 3 1

Leave Blank

4. LEGAL APPLICANT/RECIPIENT
a. Applicant Name University of Utah Research Institute
b. Organization Unit Earth Science Laboratory
c. Street/P.O. Box 391 Chipeta Way
d. City Salt Lake City
e. County Salt Lake
f. State Utah
g. ZIP Code 84108
h. Contact Person (Name & Telephone No.) W. L. Forsberg (801) 524-3442

5. EMPLOYER IDENTIFICATION NUMBER (EIN)

6. PROGRAM (From CFDA)
a. NUMBER N A
MULTIPLE ☐
b. TITLE NA

SECTION I—APPLICANT/RECIPIENT DATA

7. TITLE OF APPLICANT'S PROJECT (Use section IV of this form to provide a summary description of the project.)
Physical Conditions During Development of a Major Low-Angle Fault Zone in the Eastern Great Basin, Utah with Implications for the Generation of Large Earthquakes

8. TYPE OF APPLICANT/RECIPIENT
A—State
B—Interstate
C—Substate Organization
D—County
E—City
F—School District
G—Special Purpose District
H—Community Action Agency
I—Higher Educational Institution
J—Indian Tribe
K—Other (Specify): ~~Non-profit~~
Enter appropriate letter K

9. AREA OF PROJECT IMPACT (Names of cities, counties, states, etc.)
Beaver County

10. ESTIMATED NUMBER OF PERSONS BENEFITING
unknown

11. TYPE OF ASSISTANCE
A—Basic Grant
B—Supplemental Grant
C—Loan
D—Insurance
E—Other
Enter appropriate letter(s) A

12. PROPOSED FUNDING

a. FEDERAL	$ 94,100 .00
b. APPLICANT	.00
c. STATE	.00
d. LOCAL	.00
e. OTHER	.00
f. Total	$ 94,100 .00

13. CONGRESSIONAL DISTRICTS OF:
a. APPLICANT 2
b. PROJECT 1

14. TYPE OF APPLICATION
A—New
B—Renewal
C—Revision
D—Continuation
E—Augmentation
Enter appropriate letter A

15. PROJECT START DATE Year month day 19 85 10 01

16. PROJECT DURATION 12 Months

17. TYPE OF CHANGE (For 14c or 14e)
A—Increase Dollars
B—Decrease Dollars
C—Increase Duration
D—Decrease Duration
E—Cancellation
F—Other (Specify):
N/A
Enter appropriate letter(s)

18. DATE DUE TO FEDERAL AGENCY ► Year month day 19 85 03 04

19. FEDERAL AGENCY TO RECEIVE REQUEST U.S. Geological Survey
a. ORGANIZATIONAL UNIT (IF APPROPRIATE) Branch of Procurement and Contracts
b. ADMINISTRATIVE CONTACT (IF KNOWN) Duleep I. Pandite
c. ADDRESS Mail Stop 205C Room 1D104
12201 Sunrise Valley Drive
Reston, Virginia 22092

20. EXISTING FEDERAL GRANT IDENTIFICATION NUMBER

21. REMARKS ADDED ☐ Yes ☐ No

SECTION II—CERTIFICATION

22. THE APPLICANT CERTIFIES THAT ► To the best of my knowledge and belief, data in this preapplication/application are true and correct, the document has been duly authorized by the governing body of the applicant and the applicant will comply with the attached assurances if the assistance is approved.

a. YES, THIS NOTICE OF INTENT/PREAPPLICATION/APPLICATION WAS MADE AVAILABLE TO THE STATE EXECUTIVE ORDER 12372 PROCESS FOR REVIEW ON:
DATE 3-1-85

b. NO, PROGRAM IS NOT COVERED BY E.O. 12372 ☐
OR PROGRAM HAS NOT BEEN SELECTED BY STATE FOR REVIEW ☐

23. CERTIFYING REPRESENTATIVE
a. TYPED NAME AND TITLE James J. Brophy, President
b. SIGNATURE R. H. Ward for

SECTION III—FEDERAL AGENCY ACTION

24. APPLICATION RECEIVED 19 Year month day

25. FEDERAL APPLICATION IDENTIFICATION NUMBER

26. FEDERAL GRANT IDENTIFICATION

27. ACTION TAKEN
- ☐ a. AWARDED
- ☐ b. REJECTED
- ☐ c. RETURNED FOR AMENDMENT
- ☐ d. RETURNED FOR E.O. 12372 SUBMISSION BY APPLICANT TO STATE
- ☐ e. DEFERRED
- ☐ f. WITHDRAWN

28. FUNDING

a. FEDERAL	$ .00
b. APPLICANT	.00
c. STATE	.00
d. LOCAL	.00
e. OTHER	.00
f. TOTAL	$ .00

29. ACTION DATE ► 19 Year month day

30. STARTING DATE 19 Year month date

31. CONTACT FOR ADDITIONAL INFORMATION (Name and telephone number)

32. ENDING DATE 19 Year month date

33. REMARKS ADDED ☐ Yes ☐ No

SUMMARY FOR THE SMITHSONIAN SCIENCE INFORMATION EXCHANGE

Congressional District: Utah 2nd

Project Title: Definition and Analysis of Bedrock Traces of the Wasatch Fault, Salt Lake County, Utah

Date Project Started:

Program Objective: R-1

Principal Investigator(s): Duncan Foley and Bruce S. Sibbett

Organization and Address: Earth Science Laboratory
University of Utah Research Institute
391 Chipeta Way, Suite C
Salt Lake City, Utah 84108

Estimated cost for current fiscal year: $78,575

States (or foreign countries) to which project pertains: Utah

Key Words (to indicate major emphasis of project): Geologic mapping, Wasatch fault identification

In 200 words or less, give a succinct statement of the project objectives, work plans, and implications of anticipated results for the proposed duration of the project:

Present maps of the Wasatch fault zone do not define the fault traces and related structure in sufficient detail to allow analysis of fault zone characteristics and relationships to inherited structures. In particular, bedrock exposures of faults and pre-existing structures have not been documented. This study will define Wasatch fault traces in the bedrock, their correlation with faulting in alluvium, faulting configuration relative to structural fabric and the influence of inherited structures on the fault trend and rupture patterns. This study will allow development of a structural model, define zones of possible surface rupture in the bedrock, define fault segment characteristics and segment boundary controls.

Determination of Quaternary offset in bedrock exposures, and relative and absolute age determination, where possible, will define frequency and probability of fault movement. An improved understanding and delineation of the Wasatch fault zone will facilitate earthquake hazard reduction planning.

Signature of Principal Investigator: Duncan Foley Date: Feb. 28, 1985

Bruce Sibbett Date: 1 Mar 85

OMB Approval No. 0348-0006

FEDERAL ASSISTANCE

1. TYPE OF SUBMISSION (Mark appropriate box) ☐ NOTICE OF INTENT (OPTIONAL) ☐ PREAPPLICATION ☐ APPLICATION	2. APPLICANT'S APPLICATION IDENTIFIER: a. NUMBER; b. DATE (Year month day) 19 85 2 28	3. STATE APPLICATION IDENTIFIER (NOTE: TO BE ASSIGNED BY STATE): a. NUMBER UT850301-040; b. DATE ASSIGNED (Year month day) 19 85 3 1
	Leave Blank	

4. LEGAL APPLICANT/RECIPIENT

a. Applicant Name: University of Utah Research Institute
b. Organization Unit: Earth Science Laboratory
c. Street/P.O. Box: 391 Chipeta Way, Suite C
d. City: Salt Lake City   e. County: Salt Lake
f. State: Utah   g. ZIP Code: 84108
h. Contact Person (Name & Telephone No.): W. L. Forsberg (801) 524-3442

5. EMPLOYER IDENTIFICATION NUMBER (EIN)

6. PROGRAM (From CFDA) a. NUMBER N A . MULTIPLE ☐ b. TITLE N/A

SECTION I—APPLICANT/RECIPIENT DATA

7. TITLE OF APPLICANT'S PROJECT (Use section IV of this form to provide a summary description of the project.)

Definition and Analysis of Bedrock Traces of the Wasatch Fault, Salt Lake County, Utah

8. TYPE OF APPLICANT/RECIPIENT
A—State; B—Interstate; C—Substate Organization; D—County; E—City; F—School District; G—Special Purpose District; H—Community Action Agency; I—Higher Educational Institution; J—Indian Tribe; K—Other (Specify): Non-Profit
Enter appropriate letter: K

9. AREA OF PROJECT IMPACT (Names of cities, counties, states, etc.): Salt Lake County

10. ESTIMATED NUMBER OF PERSONS BENEFITING: unknown

11. TYPE OF ASSISTANCE A—Basic Grant; B—Supplemental Grant; C—Loan; D—Insurance; E—Other. Enter appropriate letter(s): A

12. PROPOSED FUNDING	
a. FEDERAL	$ 78,575 .00
b. APPLICANT	.00
c. STATE	.00
d. LOCAL	.00
e. OTHER	.00
f. Total	$ 78,575 .00

13. CONGRESSIONAL DISTRICTS OF: a. APPLICANT 2; b. PROJECT 1 & 2

14. TYPE OF APPLICATION A—New; B—Renewal; C—Revision; D—Continuation; E—Augmentation. Enter appropriate letter: A

15. PROJECT START DATE (Year month day) 19 85 08 01

16. PROJECT DURATION 13 Months

17. TYPE OF CHANGE (For 14c or 14e) A—Increase Dollars; B—Decrease Dollars; C—Increase Duration; D—Decrease Duration; E—Cancellation; F—Other (Specify): N/A. Enter appropriate letter(s):

18. DATE DUE TO FEDERAL AGENCY ► (Year month day) 19 85 03 04

19. FEDERAL AGENCY TO RECEIVE REQUEST U.S. Geological Survey
a. ORGANIZATIONAL UNIT (IF APPROPRIATE): Branch of Procurement and Contracts
b. ADMINISTRATIVE CONTACT (IF KNOWN): Duleep L. Pandite
c. ADDRESS: Mail Stop 205C, Room 1D104
12201 Sunrise Valley Drive
Reston, Virginia 22092

20. EXISTING FEDERAL GRANT IDENTIFICATION NUMBER

21. REMARKS ADDED ☐ Yes ☐ No

SECTION II—CERTIFICATION

22. THE APPLICANT CERTIFIES THAT► To the best of my knowledge and belief, data in this preapplication/application are true and correct, the document has been duly authorized by the governing body of the applicant and the applicant will comply with the attached assurances if the assistance is approved.

a. YES, THIS NOTICE OF INTENT/PREAPPLICATION/APPLICATION WAS MADE AVAILABLE TO THE STATE EXECUTIVE ORDER 12372 PROCESS FOR REVIEW ON: DATE 2-28-85

b. NO, PROGRAM IS NOT COVERED BY E.O. 12372 ☐ OR PROGRAM HAS NOT BEEN SELECTED BY STATE FOR REVIEW ☐

23. CERTIFYING REPRESENTATIVE a. TYPED NAME AND TITLE: James J. Brophy, President   b. SIGNATURE: S. H. Ward for

SECTION III—FEDERAL AGENCY ACTION

24. APPLICATION RECEIVED 19 (Year month day)
25. FEDERAL APPLICATION IDENTIFICATION NUMBER
26. FEDERAL GRANT IDENTIFICATION

27. ACTION TAKEN
☐ a. AWARDED
☐ b. REJECTED
☐ c. RETURNED FOR AMENDMENT
☐ d. RETURNED FOR E.O. 12372 SUBMISSION BY APPLICANT TO STATE
☐ e. DEFERRED
☐ f. WITHDRAWN

28. FUNDING	
a. FEDERAL	$ .00
b. APPLICANT	.00
c. STATE	.00
d. LOCAL	.00
e. OTHER	.00
f. TOTAL	$ .00

29. ACTION DATE► 19 (Year month day)
30. STARTING DATE 19 (Year month date)
31. CONTACT FOR ADDITIONAL INFORMATION (Name and telephone number)
32. ENDING DATE 19 (Year month date)
33. REMARKS ADDED ☐ Yes ☐ No

SUMMARY FOR THE SMITHSONIAN SCIENCE INFORMATION EXCHANGE

Congressional District: Utah 2nd

Project Title: Earthquake-induced Avalanches along the Wasatch Front, Utah

Date Project Started:

Program Objective: Element III. Regional Earthquake Hazards Assessments, Objective R-1: Mapping and synthesis of geologic hazards and establishment of information systems

Principal Investigator(s): Dr. Duncan Foley

Organization and Address: Earth Science Laboratory
University of Utah Research Institute
391 Chipeta Way, Suite C
Salt Lake City, Utah 84108

Estimated cost for current fiscal year: $76,500

States (or foreign countries) to which project pertains: Utah

Key Words (to indicate major emphasis of project): Avalanches, Earthquakes, Snow mechanics, Lifeline destruction, Avalanche path identification

In 200 words or less, give a succinct statement of the project objectives, work plans, and implications of anticipated results for the proposed duration of the project:

The potential for earthquake-induced avalanches along the Wasatch Front of Utah has never been evaluated, despite the high probability of a major earthquake and the often unstable nature of the Utah snowpack. This study has two parts: to assess the mechanical stability of the Wasatch snowpack, and to identify sites where lifelines or other critical facilities are threatened by avalanches. Data on mechanical stability of the snowpack will be useful in modeling trigger mechanisms for shaking-induced release of the snowpack. Sites identified with presently unknown hazards will be important data for emergency planners.

Signature of Principal Investigator: Duncan Foley Date: 28 Feb, 1985

OMB Approval No. 0348-0006

FEDERAL ASSISTANCE

1. TYPE OF SUBMISSION (Mark appropriate box)	☐ NOTICE OF INTENT (OPTIONAL) ☐ PREAPPLICATION ☒ APPLICATION
2. APPLICANT'S APPLICATION IDENTIFIER	a. NUMBER: — b. DATE: Year month day 19 85 2 28
3. STATE APPLICATION IDENTIFIER (NOTE: TO BE ASSIGNED BY STATE)	a. NUMBER: UT850228-050 b. DATE ASSIGNED: Year month day 19 85 02 28
Leave Blank	

SECTION I—APPLICANT/RECIPIENT DATA

4. LEGAL APPLICANT/RECIPIENT
- a. Applicant Name: University of Utah Research Institute
- b. Organization Unit: Earth Science Laboratory
- c. Street/P.O. Box: 391 Chipeta Way, Suite C
- d. City: Salt Lake City
- e. County: Salt Lake
- f. State: Utah
- g. ZIP Code: 84108
- h. Contact Person (Name & Telephone No.): W. L. Forsberg (801) 524-3442

5. EMPLOYER IDENTIFICATION NUMBER (EIN): 51-0204678

6. PROGRAM (From CFDA)
- a. NUMBER: N/A . MULTIPLE ☐
- b. TITLE: N/A

7. TITLE OF APPLICANT'S PROJECT (Use section IV of this form to provide a summary description of the project.)
Earthquake-Induced Avalanches along the Wasatch Front, Utah

8. TYPE OF APPLICANT/RECIPIENT
A—State; B—Interstate; C—Substate Organization; D—County; E—City; F—School District; G—Special Purpose District; H—Community Action Agency; I—Higher Educational Institution; J—Indian Tribe; K—Other (Specify): Non-profit
Enter appropriate letter: K

9. AREA OF PROJECT IMPACT (Names of cities, counties, states, etc.)
Salt Lake, Davis, Morgan, Summit, Utah, Wasatch

10. ESTIMATED NUMBER OF PERSONS BENEFITING: Unknown

11. TYPE OF ASSISTANCE
A—Basic Grant; B—Supplemental Grant; C—Loan; D—Insurance; E—Other
Enter appropriate letter(s): A

12. PROPOSED FUNDING

a. FEDERAL	$ 76,500 .00
b. APPLICANT	.00
c. STATE	.00
d. LOCAL	.00
e. OTHER	.00
f. Total	$ 76,500 .00

13. CONGRESSIONAL DISTRICTS OF:
- a. APPLICANT: 2
- b. PROJECT: 1,2,3

14. TYPE OF APPLICATION
A—New; B—Renewal; C—Revision; D—Continuation; E—Augmentation
Enter appropriate letter: A

15. PROJECT START DATE Year month day: 19 85 08 01

16. PROJECT DURATION: 17 Months

17. TYPE OF CHANGE (For 14c or 14e)
A—Increase Dollars; B—Decrease Dollars; C—Increase Duration; D—Decrease Duration; E—Cancellation; F—Other (Specify):
N/A
Enter appropriate letter(s):

18. DATE DUE TO FEDERAL AGENCY ► Year month day 19

19. FEDERAL AGENCY TO RECEIVE REQUEST: U. S. Geological Survey
- a. ORGANIZATIONAL UNIT (IF APPROPRIATE): Branch of Procurement and Contracts
- b. ADMINISTRATIVE CONTACT (IF KNOWN): Duleep I. Pandite
- c. ADDRESS: Mail Stop 205C, Room 1D104, 12201 Sunrise Valley Drive, Reston, Virginia 22092

20. EXISTING FEDERAL GRANT IDENTIFICATION NUMBER

21. REMARKS ADDED ☐ Yes ☐ No

SECTION II—CERTIFICATION

22. THE APPLICANT CERTIFIES THAT► To the best of my knowledge and belief, data in this preapplication/application are true and correct, the document has been duly authorized by the governing body of the applicant and the applicant will comply with the attached assurances if the assistance is approved.

a. YES, THIS NOTICE OF INTENT/PREAPPLICATION/APPLICATION WAS MADE AVAILABLE TO THE STATE EXECUTIVE ORDER 12372 PROCESS FOR REVIEW ON: DATE 2-28-85

b. NO, PROGRAM IS NOT COVERED BY E.O. 12372 ☐ OR PROGRAM HAS NOT BEEN SELECTED BY STATE FOR REVIEW ☐

23. CERTIFYING REPRESENTATIVE
- a. TYPED NAME AND TITLE: James J. Brophy, President
- b. SIGNATURE: Stanley H. Ward for

AGENCY ACTION

24. APPLICATION RECEIVED Year month day 19

25. FEDERAL APPLICATION IDENTIFICATION NUMBER

26. FEDERAL GRANT IDENTIFICATION

27. ACTION TAKEN
- ☐ a. AWARDED
- ☐ b. REJECTED
- ☐ c. RETURNED FOR AMENDMENT
- ☐ d. RETURNED FOR E.O. 12372 SUBMISSION BY APPLICANT TO STATE
- ☐ e. DEFERRED
- ☐ f. WITHDRAWN

28. FUNDING

a. FEDERAL	$ .00
b. APPLICANT	.00
c. STATE	.00
d. LOCAL	.00
e. OTHER	.00
f. TOTAL	$ .00

29. ACTION DATE► Year month day 19

30. STARTING DATE Year month date 19

31. CONTACT FOR ADDITIONAL INFORMATION (Name and telephone number)

32. ENDING DATE Year month date 19

33. REMARKS ADDED ☐ Yes ☐ No

LANDSLIDE RESEARCH IN UTAH

During the past two years, landslide hazards in Utah have received national attention. The Utah Division of Comprehensive Emergency Management (CEM) has estimated that the Thistle landslide of 1983 caused more than $200 million in damage. Although other landslides have not been of such magnitude, they have caused many problems. This is particularly true along the highly populated Wasatch Front, where damage in Farmington during 1983 and 1984 has been estimated to be more than $1 million, and along the Wasatch Plateau in central Utah, where several towns have had their water supply threatened or disrupted.

Geologic studies show that landslides have been a common phenomenon in Utah for many thousands of years, and it is apparent that they will continue to occur in the future. Even though no comprehensive assessment of the landslide hazard has been made for Utah, more than a hundred potentially hazardous slide areas are known, and many hundreds of partially detached slide blocks exist. Sliding seems to occur more frequently during years of high precipitation, but significant landslides also occur in relatively dry years, as exemplified by the Manti slide during the mid-1970s. With mounting population, especially along the Wasatch Front where slide potential is great, we can only conclude that landslides will cause increasing damage in the future unless steps are taken to mitigate the problem.

The increase in hazards from mass movements implies that at least two areas of study are needed: development of simple and inexpensive monitoring systems, and geoscientific and engineering studies aimed at predicting movement in advance and mitigating its effects.

In November, 1983, a team of scientists from the University of Utah Research Institute (UURI), University of Utah (UU), CEM, and the Utah

Geological and Mineral Survey (UGMS) installed experimental instruments in Rudd Canyon east of Farmington and in Reynolds Gulch in Big Cottonwood Canyon to monitor earth movement. This equipment included instruments to measure tilting and stretching of the earth. Although the data were collected primarily for scientific study, they were useful in the development of a warning system, as they were transmitted by radio to a police dispatcher a few times every minute. The equipment operated successfully throughout the winter and during spring snowmelt. Small movements that proved to be precursors to much larger debris flows were detected in both areas. During 1985 another system has been added at Johnson's Hollow in Emigration Canyon east of Salt Lake City, where a partially detached slide threatens several houses and could possibly dam the creek.

With this highly successful feasibility effort concluded, the University of Utah Research Institute, along with the Departments of Mining and Civil Engineering of the University of Utah, propose a more detailed multi-year program of instrumentation, remote monitoring, and engineering studies on selected high-risk landslide areas of Utah. This work will involve new sites in additional geologic terrains of Utah where the hazard from land movements is high. Data on earth movement will be provided to CEM for dissemination to state and local personnel on a real-time basis for use in dealing with potential emergencies, and these data will also be used by UURI and UU, and made available to other Utah researches, to further our understanding of ways to monitor, predict and mitigate mass earth movement.

The tasks outlined is this proposal form the first phase of a two-phase, five-year comprehensive program to develop landslide monitoring, prediction and mitigation techniques. A phased approach is indicated because of the many scientific and engineering unknowns at the present time. At the completion of this first phase of the project, we expect to be able to:

1. Develop a reliable, hopefully low-cost landslide monitoring system, including instrument design and determination of the critical parameters to measure;
2. Specify the precursor signatures in the monitored data that indicate that sliding is imminent and perhaps even the amount of time before rapid sliding begins;
3. Specify the geologic conditions that tend to facilitate development of a slide;
4. Develop a preliminary model of the mechanical mechanism of the sliding process; and
5. Suggest potential mitigation procedures that may be effective for the sites studied.

During the second phase, results of the instrument development and data analysis will be applied to further sites throughout Utah. This effort will greatly expand our knowledge of landslide phenomena, and transfer technical accomplishments into low-cost practical actions that can be taken by affected communities.

Federal Emergency Management Agency

Washington, D.C. 20472

JAN 28 1985

University of Utah Research Institute
Earth Science Laboratory
391 Chipeta Way, Suite C
Salt Lake City, Utah 84108

Dear Sir:

Your proposal concerning Landslide Monitoring, Prediction and Mitigation has been reviewed and we regret to advise you that at this time there is no interest within the Agency to fund this project.

If there are any questions concerning this matter please direct them to Mr. Eugene Morgan, at area code 202/646-3741. Your interest in the Federal Emergency Management Agency is appreciated.

Sincerely,

J. A. Pegnato

Joseph A. Pegnato, Chief
Policy and Evaluation Division
Office of Acquisition Management

TEMPLE A. REYNOLDS
6936 Nye Drive
Salt Lake City, Utah 84121

June 11, 1985

Mr. Phillip M. Wright
Technical Vice President
University of Utah Research Institute
Research Park
391 Chipeta Way, Suite C
Salt Lake City, UT 84108

Dear Mike:

During the past several months we have met together, either individually or in a workshop setting, to discuss establishment of a proposed Center for the Study of Geologic and Environmental Hazards and/or to discuss possible geologic and environmental problem areas that need investigation.

At that time, it was indicated that a workshop to showcase geological and environmental hazards research capabilities and current efforts of university researchers was planned for Utah State University this spring and that we would be delighted if you could arrange to attend.

The purpose of this letter is to inform you that final arrangements have now been completed and the workshop will be held on June 21, 1985, beginning at 9 AM, at the Utah Water Research Laboratory, near the Utah State University Campus in Logan.

This one day workshop provides an opportunity for all of us who may become involved with the study of geologic and environmental hazards, by way of proposing projects, providing project guidance, participating in data collection or analysis, or application of solutions, to find out more about each other and what we do.

I look forward to seeing you at the Water Lab in Logan on June 21 should your schedule permit. If you have questions regarding the workshop, please call me at 942-7725.

Sincerely,

Temple A. Reynolds
Consultant

M E M O R A N D U M

June 7, 1985

TO: Dr. James Brophy, University of Utah
Dr. Bartell Jensen, Utah State University
Dr. John Lamb, Brigham Young University

FROM: Temple A. Reynolds, Consultant

SUBJECT: Workshop/meeting with public sector agency representatives to identify and discuss geologic and environmental hazards related problems.

On Friday morning, May 31, 1985, a group of state and federal agency representatives met with faculty and staff researchers from the University of Utah Research Institute (UURI), the University of Utah (UU), Utah State University (USU) and Brigham Young University (BYU) in the Little Theatre of the University of Utah Union Building. (See Attachment No. 1, Attendance List.)

Purpose of the meeting was to explore with the public sector agencies geologic and environmental hazards related problems or problem areas, research and remedial work underway and possible future work priorities in this area. It was specifically requested that problem areas covered by the 1984 Governors Conference on Geologic Hazards, hosted by the Utah Geological and Mineral Survey, be excluded from the discussions.

After a welcome and some general housekeeping announcements, I spent the first few minutes of the session recaping the history of the proposal for a Center for the Study of Geologic and Environmental Hazards and tracing events that had transpired since the UU, USU, BYU and UURI representatives initially met to discuss concepts on March 6, 1985. Because many of the state/federal agency participants present had not been directly involved in the one-on-one meetings we had had with the agency directors, it was necessary to recap in greater detail than had been planned. Questions and discussions centered on the interdisciplinary approach, and the role, operation and function of the proposed Center.

Following introductions of those present a number of problem areas were placed before the group for discussion purposes. Agency, spokesman, a brief statement of concerns and associated discussions were as follows:

Utah Geological and Mineral Survey (UGMS) - Don Mabey discussed five problem areas:

1 - Systemic Geologic Hazards Inventory - In Utah the primary governmental responsibility for actions to mitigate and reduce geologic hazards is with local governments; however, local governments do not have the capability to develop the data base upon which to base actions. The UGMS has the statutory responsibility to assist local governments in this effort. The United States Geological Survey (USGS) is providing some support. A state-wide compilation of geologic hazards information and hazard inventory has been started. Three new geologists have been added to the UGMS staff to work with several counties along the Wasatch front. Two new hazards geologists will go to work with UGMS beginning the first of July, 1985 and one staff member will be assigned full time to compile existing information.

2 - Geologic Hazards Process Research - All actions relative to geologic hazard reduction, monitoring, and mitigation require an understanding of the geologic processes involved. Research to develop this improved understanding is being done by UGMS, USGS and Universities, primarily with funding from the USGS. In Utah, the UGMS is working with USGS to develop and implement this research.

3 - Geologic Hazard Monitoring and Warning - Earthquake monitoring by the University of Utah Seismograph Stations is a continuing program. More recently other monitoring programs relating to earthquakes and slope failures have been started in programs involving the UGMS, Division of Comprehensive Emergency Management (CEM), USGS, Federal Emergency Management Agency (FEMA), local governments, UU and USU. Programs of continuous and emergency monitoring should be continued and expanded.

Discussion on this point indicated that some very limited funding had been made available through the legislative appropriation process for purchase of monitoring equipment beginning on July 1, 1985. There appeared to be concensus on the need for a project or projects to develop low cost, expendable monitoring instrumentation for installation in areas of known or suspected faulting and slope instability to more closely monitor these areas in the future.

4 - Geologic Hazard Reduction and Mitigation - The primary responsibility for hazard reduction and mitigation is with local governments and State and Federal agencies that need technical assistance in developing and implementing these efforts.

While local governments have had some experience in dealing with hazard related public health and safety, there has been little local experience in dealing with the liabilities associated with active leadership in hazard reduction and mitigation. USGS has provided funding to the University of Utah Geography Department, Salt Lake City and West Valley City to develop techniques in this area.

5 - Geologic Hazards and Facility Siting - Many public facilities do not obtain a geologic hazard review early in the project planning phase, before proceeding with project design and construction. State and local agencies and private organizations constructing critical facilities need guidance on geologic hazards. The UGMS responds to requests for assistance from government agencies.

There is a need to devise a system (statute?) that will insure that geologic hazards information is utilized more effectively in siting public and private developments.

U. S. Bureau of Reclamation (BuRec), Brent D. Taylor discussed seven problem areas:

1 - Air Pollution Problems - There is a need to define what constitutes air pollution and a parallel need to develop airshed-wide control strategies. Practical illustrations associated with this problem statement are associated with the current Utah-Colorado disparity in air quality designations in the Uinta Basin and with the official position of the Utah Air Quality Committee, as recently reported, regarding monitoring or air quality in Utah.

2 - Integrated Approach to Water Management in the State - There are changing environments and attitudes with regard to water use, conservation and irrigation. Should new approaches to water management be developed, the Bureau may be interested.

3 - Dam Safety - Technical and social standards should be developed for siting and construction of earth fill dams. Questions to ponder -- How safe is safe enough in terms of public health and safety? What are people willing to pay for in terms of safety?

4 - Development/Evaluation of Techniques to Look Inside Existing Dams to Document Fluid Movement - Little is known about how earth dams hold up internally over time. The Bureau has had continuing problems with Fontinelle Dam in Wyoming and would welcome studies that would provide techniques for routine inspections.

Stan Ward, UURI, inquired regarding present methods used to monitor dams. Brent responded that the primary method was well monitoring, though temperature and seismic activity is also considered.

5 - Multi Hazards Study, Ogden Area - The study has been completed. There is now a need to prioritize remedial steps and/or offsetting actions to mitigate or treat identified hazards. Public interaction is a needed step in making these determinations.

6 - Integrated Management, Use and Development of the Great Salt Lake - The Great Salt Lake is a unique phenomenon in terms of its geology, mineral wealth and impact on the environment, public health and safety. Lake side industries have repeatedly requested that the State develop and actively implement a policy regarding control and management of the lake. New transportation, public health, industrial, residential and recreational developments on and near the lake shore also require assurances with regard their proposed investments, as does the United States Military establishment.

Paul Gillette, Utah Division of Water Resources (DWR), suggested the need for definitive legal, ecologic, geologic, hydrologic and other studies associated with the various options (west desert pumping, major dikes, minor dikes) to contain the lake, now being considered by the State Legislature. The time frame for anticipated action, however, seems to preclude thorough integrated investigations.

Stan Ward, UURI, asked about anticipated subsurface return flows from west desert pumping. Paul responded that this has not been considered inasmuch as formations are relatively tight and there is very little head differential between the west desert and the lake surface.

Don Mabey, UGMS, mentioned climatological problems associated with the lake as an area of inadequacy identified from the recent Great Salt Lake Conference. Data from stream gauges and weather stations are not adequate to predict flows. He suggested the possible need for tree ring studies to identify wet cycles. Most studies of tree rings have been oriented toward understanding drought cycles.

7 - Longer Term Studies for Flood Control Along the Wasatch Front - It was suggested that slides, flows and floods associated with the past several years are not, in an historical context, isolated instances. There is potential for future repetitions of these phenomena. The brush fire approach to problem solving in this regard is inefficient. In-depth studies should be carried out as soon as possible to plan for future recurrences.

U. S. Forest Service (USFS) - Earl P. Olson, Geologist, submitted proposals regarding four problem areas and selectively discussed several of these:

1 - Lack of Knowledge Relative to the Literature Dealing with Geologic and Environmental Hazards - Much important work relative to the technical aspects of mud and debris flows exists in untranslated foreign literature. Funds should be sought (possibly from the National Academy of Science) to accomplish one translation per year. For a list of proposed translations see Attachment No. 2.

It would be helpful to practitioners if an annual list of Masters Thesis and Doctoral Dissertations on Geologic and Environmental Hazards generated in Utah schools could be published.

Don Mabey, UGMS, suggested the possibility of a periodic news letter to practitioners, rather like the one currently and temporarily being done by UGMS for the Wasatch front area.

Fred May, CEM, suggested the need for some agency to assume a "clearinghouse" function. Problems seem to be associated with collation and distribution.

Earl Olson, USFS, indicated that it was his understanding that USGS was soon to publish a "Grey List" of Geologic Hazards maps. He further suggested that the "Grey Literature" is extremely rich in information regarding geologic and environmental hazards and that because of the context, there is probably more relevant hazard information here than in more pure forms of geologic or environmental literature.

UGMS is compiling an Earthquake Bibliography relative to Utah earthquake occurrences and hazards. Don Mabey estimated that there will be approximately 1000 entries.

2 - Lack of Data Regarding Holocene Ruptures - There is insufficient data on age dating of Holocene ruptures of the Wasatch Fault, especially from the area north of Kaysville. Additional data from the area south of Kaysville is also desirable.

Some age dating of Holocene fault ruptures from throughout the State would be highly desirable. First priority for data collection should be near population centers.

3 - Insufficient Sequential Data on Aseismic Deformation of all the Locked Portions of the Wasatch Front.

4 - Ground Water Studies of the Bear River Range, Wasatch Range and Wasatch Plateau - Work needs to be undertaken to analyze existing well logs and data regarding spring flows. Where such data is not available efforts should be made to begin monitoring activities.

Tom Collins, USFS, also suggested that, in terms of identifying possible future hazards or environmental problem areas, it would be desirable to identify and move to protect ground water recharge areas. It was suggested that very little is known with regard recharge in the State's mountainous areas and the influences of recharge on streams, and springs.

Earl Olson also pointed out the the importance of work in the mountains. Information regarding recharge is needed to help manage the water at the valley floor level, where everyone lives.

Division of Comprehensive Emergency Management (CEM) -- DeeEll Fifield discussed the need for a county by county hazard hazard analysis. Such an analysis must be included in county emergency management plans. Mr. Fifield indicated that the counties simply do not have the expertise or financial resources to complete the required analyses.

Don Mabey, UGMS, indicated that his agency is working on a Sevier County hazard map at the present time and intends to continue this effort over time in other counties. Completion of a county hazard mapping program will be very time consuming without additional funding. Outlying Counties, especially, are sensitive that they are not getting as much help as they would like.

U. S. Forest Service (USFS) -- Bruce Vandre suggested the need for a Generic Decision Making Model for Dealing with Hazards. Such a model, it was felt, could assure that at least the same factors would be evaluated in the same way in similar situations. Currently, we appear to think only in terms of probability of occurrence.

Earl Olson suggested the need to define Hazards. This would assure that widely used specific terminology would be well understood in its appropriate context.

In Open Discussion, Stan Ward, UURI, raised the question of the need for snow avalanche research and a support level that the Forest Service might be willing to provide. Earl Olson, USFS, responded that avalanche safety in the National Forests is the responsibility of individual permittees, e.g. ski resort operators. The Forest Service has largely discontinued its avalanche work except for about a half man-year annually in Colorado.

It was pointed out that more people are killed each year in the United States as a result of snow avalanche than from any other geologic hazard. Don Mabey, UGMS, observed that this was an important area of hazards study that was "slipping through the cracks".

Stan Ward also made general inquiry regarding the current state of knowledge about aquifer contamination. Don Mabey responded that Davis County landfill authorities had asked UGMS to provide them with a monitoring system. Don said that his agency did not have sufficient knowledge to design such a system.

Conclusion:

Those present supported the idea of further contacts with the State's Congressional Delegation and continued close liaison with governmental leaders to seek seed money for funding needed hazards research. The question of whether or not a formal Center for the Study of Geologic and Environmental Hazards was left unresolved.

Workshop to Showcase Geological and Environmental Hazards Research Capabilities and Current Efforts of University Researchers. It had been hoped that we could conduct this kind of a one-day workshop earlier this spring. Loren Anderson and Clair Batty, USU, have now set a date of June 27, 1985 for the workshop. Representatives from BYU, UU, UURI and USU will discuss their hazards related research activities and capabilities. The workshop will be held at a site to be determined on the Utah State University campus. A tour of the Utah Water Research Laboratory will be included in the day's activities. State and Federal agency representatives are invited to attend so that they can become better aware of University capabilities and better acquainted with University researchers. Complete details will follow.

The meeting adjourned at approximately 11:20 AM.

Attachments

CC: Participants
State/Federal Agency heads
University participants, March 6 meeting

Attachment No. 1

List of Attendees

HAZARD PROBLEMS WORKSHOP

May 31, 1985

NAME	ORGANIZATION	LOCATION	PHONE
Don Mabey	UGMS	Salt Lake	581-6831
Les Youd	BYU	Provo	378-6327
Loren Anderson	USU	Logan	750-2780
Bart Kowallis	BYU	Provo	378-2467
Clair Batty	USU, Utah Water Lab	Logan	750-3156
Tom Collins	USDA, Forest Service	Ogden	625-5357
Earl F. Olson	USDA, Forest Service	Ogden	625-5358
Brent D. Taylor	Interior, Reclamation	Salt Lake	524-3297
Bruce Vandre	USDA, Forest Service	Ogden	625-5237
Loren Rausher	UDOT	Salt Lake	965-4326
Lorin Larsen	CEM	Salt Lake	533-5271
Ralph Findlay	CEM	Salt Lake	533-5271
DeeEll Fifield	CEM	Salt Lake	533-5271
Fred May	CEM	Salt Lake	533-5271
Richard Hall	Water Rights	Salt Lake	533-6071
Paul Gillette	Water Resources	Salt Lake	533-5401
George Diwachak	BLM	Salt Lake	524-3006
Stan Ward	UURI	Salt Lake	524-3454
Dennis Nielson	UURI	Salt Lake	524-3422
Mike Wright	UURI	Salt Lake	524-3422
Kim McCarter	UU	Salt Lake	581-8603
Temple Reynolds	Consultant	Salt Lake	942-7725

Attachment No. 2

MOST NEEDED TRANSLATIONS

complied by

Earl P. Olson, U.S. Forest Service
801/625-5358

Albert Heim, 1932. Bergsturz and Menschenleben. Zurich. 218 pp.

Josef Stini, 1910. Die Muren. Innsbruck. 139 pp.

G.K. Tushinskii, E.S Troshkina, 1980. Sklonouye Protsessy (Slope Processes). Moscow. Izd-vo Moskouskogo Universitete. 134 pp.

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Mudflows And Their Control. 1957. Izd An SSSR. Moscow.

Ravines And Mudflow Deposits. Dorizdat. Moscow. 1947.

Sent to mailing list, dated April 23, 1985.
Copies to Loren Anderson, USU
Clair Batty, USU
John Lamb, BYU

Draft -
Folowup - 2. URI

TEMPLE A. REYNOLDS
6936 Nye Drive
Salt Lake City, Utah 84121

Stan Ward

April ^C, 1985

Notice to Dean

^F1^
^F2^
^F3^

Dear ^F4^:

A short while ago, ^C of the University of Utah Research Institute and I visited with you to provide information regarding establishment of a proposed Center for the Study of Geologic and Environmental Hazards.

At that time, we indicated what we believed was a need for a workshop where state and federal people could discuss geologic and environmental problem areas from their perspective. We see this as necessary in order to insure that any research efforts launched in the future by an organization such as the proposed Center for the Study of Geologic and Environmental Hazards retains a practical problem orientation. Such a workshop is also a necessary precursor to any future meeting where participants would work toward drafting a topical projects priority list.

The purpose of this letter is to advise you that arrangements are now in process for a Geologic and Environmental Problems Workshop to be held on the University of Utah Campus beginning at 8:30 AM on May 31, 1985. Please mark the date on your calendar. We will communicate the specific meeting place to you my letter or phone no later than May 20.

This workshop will provide an opportunity for all of us who may become involved with the activities of a Hazards Center to find out more about each other and our agencies concerns.

I look forward to seeing you on May 31 should your schedule permit.

Sincerely,

Temple A. Reynolds
Consultant

TEMPLE A. REYNOLDS
6936 Nye Drive
Salt Lake City, Utah 84121

May 15, 1985

Dr. Loren R. Anderson
College of Engineering
UMC - 41
Utah State University
Logan, UT 84322

Dear Loren,

As you know from the copy of my April 23 letter which was sent to state and federal agency directors, we are moving ahead with a workshop to identify and discuss geologic and environmental problems. It will be held here in Salt Lake City on May 31. We should have a site for the meeting designated within a few days. I'll let you know as soon as we do.

I have not yet heard from you with regard the workshop session, discussed by the full grouip which assembled on March 6, to showcase the talent and efforts of the University research community in the geologic and environmental hazard area. You'll recall that this was the subject of my April 1, 1985 letter to you together with several telephone calls prior to and following that date.

Given the nearness of the summer field season for may researchers, the fact that we are moving ahead with a May 31 workshop to identify problem areas of concern to public agencies, and because I have not heard from you regarding the proposed USU gathering, it would seem practical at this point to defer the so-called University Showcase workshop until some later date. If you have a problem with this, or have already made substantial arrangements for this workshop session, please let me know as soon as possible.

Sincerely,

Temple A. Reynolds

CC: Clair Batty, Water Research Lab
John Lamb, BYU
Stanley Ward, UURI

DRAFT

Utah's state announcement

PROGRAM ANNOUNCEMENT

Technological Excellence and Economic Development

I. INTRODUCTION

The Department of Economic and Community Development believes that an important element to economic development in the State is a high level of technological excellence in appropriate subject fields. In order to increase technological excellence in Utah, the department plans to fund several Centers of Technological Excellence in Research that will lead to creation of new businesses or expansion of existing businesses in the State.

Proposals will be accepted from Utah colleges, universities, and research institutions requesting one-time support for Research Center activities having clearly demonstrable economic impact in Utah. Preference will be given to those research efforts displaying a strong history of technological excellence leading to commercialization.

II. PROPOSAL FORMAT

Proposals are limited to ten double-spaced typewritten pages including a 200-word summary and a one-page budget sheet. The Table of Contents (required) and a Cover Page are not counted as part of the ten pages. Limited supporting information, e.g., curriculum vitae may be submitted, if bound separately.

The body of the proposal should contain a concise description of the proposed research together with justification of excellence and details of experience in commercialization. Briefly describe special facilities and research strengths including the names of all project personnel. Show specifically how the funds requested will contribute to the effort. Estimate the magnitude and timing of impact on the Utah economy.

The proposal must include certification by an authorized institutional representative that the proposed activity can be undertaken. The Principal Investigator must be specifically identified.

III. COST MATCHING

It is contemplated that the State support will be matched on a two-to-one basis from Federal or industrial sources (two matching dollars for each State dollar). If required, a minor portion of the total budget requested from the State can be viewed as seed money not requiring matching funds from other sources. Preference will be given to proposals listing support from corporations located in Utah.

IV. BUDGET PAGE

The budget page should include all items for which state funds will be expended, including indirect costs, if any. Sources of matching funds must be specifically identified. State funding in the range of $50,000 to $250,000 to be expended over three years is contemplated, subject to the matching fund commitments.

V. EVALUATION CRITERIA

A committee of the state Advisory Council for Science and Technology will evaluate all proposals submitted to the Department of Community and Economic Development in response to this Program Announcement. In addition to the items mentioned above, the following criteria will be used in evaluating proposals:

1. Appropriateness of research activity to economic development in Utah.
2. History of research support and technology development.
3. Extent of industrial participation.
4. State funds requested and magnitude of Federal or industrial matching funds.

VI. SUBMISSION OF PROPOSALS

Ten copies of each proposal should be submitted to

Mr. David J. Grant
Deputy Director
Department of Community
& Economic Development
6290 State Office Building
Salt Lake City, Utah 84114

before September 1, 1985. Inquiries regarding the Technological Excellence and Economic Development Program should also be addressed to this office. Awards are expected to be announced by November 1, 1985.

State / Federal Mailing list
re "Center for Study of Geologic + Environmental Hazards"

3 Mr. Dee C. Hansen, Executive Director
Utah Department of Natural Resources
1636 West North Temple
Salt Lake City, UT 84116

14 Mr. D. Larry Anderson, Director
Division of Water Resources
1636 West North Temple
Salt Lake City, UT 84116

5 Mr. Robert Morgan, State Engineer
Division of Water Rights
1636 West North Temple
Salt Lake City, UT 84116

8 Mr. William Hurley, Director
Utah Department of Transportation
4501 South 2700 West
Salt Lake City, UT 84119

9 Mr. Ted Arnow, District Chief
U.S. Geological Survey
1745 West 1700 South
Salt Lake City, UT 84104

12 Mr. Arthur J. Carroll, Supervisor
Wasatch-Cache National Forest
125 South State St.
Salt Lake City, UT 84111

6 Ms. Genevieve Atwood, Director
Utah Geological and Mineral Survey
606 Black Hawk Way
Salt Lake City, UT 84108-1280

15 Major General John Matthews
The Adjutant General
Utah National Guard
1543 Sunnyside Avenue
Salt Lake City, UT 84105

10 Mr. Roland G. Robison, Jr., State Director
Bureau of Land Management
324 South State St., Suite 301
Salt Lake City, UT 84111

13 Mr. Daniel Dake, Division Administrator
Federal Highway Administration
P.O. Box 11563
Salt Lake City, UT 84147

Mr. Lee J. McQuivey
Engineering Division Representative
14 U.S. Army Corps of Engineers
8402 Federal Building
125 South State St.
Salt Lake City, UT 84111

Mr. Clifford I. Barrett, Regional Director
Upper Colorado Region
11 U.S. Bureau of Reclamation
P.O. Box 11568
Salt Lake City, UT 84147

Mr. Ken Alkema, Director
Division of Environmental Health
7 3266 State Office Building
Salt Lake City, UT 84114

Ms. Lorayne Tempest, Director
Division of Comprehensive Emergency Management
1543 Sunnyside Avenue
Salt Lake City, UT 84105

Mr. John T. Nielsen, Commissioner
Utah Department of Public Safety
4501 South 2700 West
Salt Lake City, 84119

Dr. Suzanne Dandoy, Executive Director
Utah State Department of Health
3180 State Office Building
Salt Lake City, UT 84114

Dr. Randy Moon
State Science Advisor
2 c/o Office of Planning and Budget
116 State Capitol
Salt Lake City, UT 84114

Ms. Ruth Ann Storey
Natural Resources Policy Assistant
Office of the Governor
Utah State Capitol
Salt Lake City, UT 84114

Ms. Sharon Matthews
c/o Senator Orrin Hatch
United States Senate
SR135 Russell Senate Office Building
Washington, D.C. 20510

PWW
NOV 1984

CONCEPT PAPER

CENTER FOR GEOLOGICAL AND ENVIRONMENTAL HAZARDS RESEARCH ~~CENTER~~

Summary

During 1983 and 1984, a number of natural events occurred in Utah and elsewhere in the West that have focused attention on the substantial destructive power of geologic hazards. These events included among others, the large Thistle landslide, which severed a railway and main highway and caused an estimated $200 million in economic loss, and the dramatic rise of the Great Salt Lake, which has caused tens of millions of dollars in flood damage. Attention has also been called to a number of hazards resulting from man-caused pollution of the environment. One of the largest problems is the contamination by hydrocarbons of shallow groundwaters in the vicinity of the refinery complex at North Salt Lake.

There is a clear need for applied research and development of technologies to monitor, predict and mitigate a wide range of geologic and environmental hazards. The University of Utah Research Institute is proposing to coordinate such efforts in Utah by forming a Geologic and Environmental Hazards Research Center. The Center would initiate a program of applied research and technology development using the large array of talent available in the State's universities and colleges, state agencies and private industry. The Center would also include a capability to evaluate the social aspects of hazards, and to implement measures to ensure preparedness. Once established, the Center would attract both federal and state funds.

Hazards in Utah

Precipitation in Utah during the past two years has broken records. It has directly caused floods, rise in lake levels and has triggered landslides and mud flows. Moreover, the geologic record makes it clear that such phenomena have occurred regularly in the past. Former shorelines of the Great Salt Lake have been identified that are nearly 10 feet above the present lake level, and we know that the level of the Great Salt Lake was nearly what it is now in the late 1800s. Scars of landslides, both large and small, are to be seen in all of Utah's mountains and foothills. Some historic slides, including the Manti slide of the mid-1970s, have occurred in dry years.

A potential natural hazard with perhaps the most capability for destruction and death in Utah would be a major earthquake. The Wasatch Front, where the majority of Utah's population is located, is a known area of historic and prehistoric faulting and earthquakes. Evidence from large fault scarps indicates that some of the prehistoric earthquakes were very large and probably as destructive as the 1906 San Francisco earthquake. A major earthquake would cause collapse of buildings, disruption of electrical, gas, telephone and water supplies and could initiate failure in one or more of the dams in the canyons above large population centers in Utah.

These and other geologic hazards have been identified in the Governor's Conference on Geologic Hazards (Circular 74, Utah Geological and Mineral Survey, 1983), a report on a conference brought together by the UGMS and the Division of Comprehensive Emergency Management. This report makes recommendations of technical and social scope to deal with geologic hazards. It correctly identifies the broad range of talents that will require coordination in order for a hazards mitigation program to be successfully implemented in Utah.

Environmental hazards, both natural and man-caused in nature, also exist in Utah. Each year storms cause damage from flash flooding, hail and lightning. There is considerable potential for health problems from the temperature inversions that trap stagnant air in many of the populated valleys along the Wasatch Front during winter months. Man-caused hazards include the apparently substantial groundwater pollution problem in the vicinity of the petroleum refinery complex at North Salt Lake. We understand that the EPA has identified this site as one of the top priority areas in the U.S. for clean-up. Other pollution problems include uranium tailings and mine waste in southern and western Utah, and pollution of rivers and lakes from agricultural activity as well as acid rainfall apparently resulting from burning of coal.

State of the Art

Awareness of the magnitude of hazards has grown rapidly over the past several years. At the present time, there are no reliable methods for predicting landsliding, earthquakes, dam failures, extended periods of polluted air due to temperature inversions, or many other natural hazards. Technology to map and monitor movement of groundwater pollution is primitive and expensive to apply over broad areas. In addition, there has been little development of laws, regulations and codes to ensure preparation or mitigation of effects of hazards. There appears to be a substantial information gap, that is, education of the public in hazards potential and methods of preparedness is highly inadequate. Although most people would profess to believe that preparing for hazards can save a great deal of money over simply dealing with them after they occur, there has been little actual preparation. State legislators always find it difficult to recommend expenditure of funds for preparedness for an event that may not happen for years.

In short, we lack techniques to assess and mitigate most hazards and we lack the public awareness necessary to implement measures to prepare for the potentially disasterous effects. Much needs to be done.

Concept for the Center

The University of Utah Research Institute proposes to form a Geologic and Environmental Hazards Research Center within the Institute. We would organize and make use of the substantial capability for research, technology development and implementation of mitigation measures for the broad range of hazards that exist in Utah. We would formulate and coordinate a comprehensive program to assess hazards in Utah and would initiate work on the highest priority hazards in terms of potential destruction, economic disruption and/or loss of life. We would work closely with existing Utah state agencies in helping to prioritize activities in the Center and in implementation of results. We would also work closely with Federal agencies doing hazards work such as the U.S. Geological Survey, the Federal Emergency Management Agency and the Environmental Protection Agency.

Assessment and mitigation of both man-induced and natural geologic and environmental hazards require an interdisciplinary effort. A broad range of scientific and engineering studies will be required. Of equal importance will be studies of the social consequences of hazards and mitigation measures, and appropriate means to implement programs to deal with preparedness and emergency measures. Obviously, there must be close coordination between the Center and federal agencies performing pertinent scientific work on the one hand, and between the Center and Utah state agencies charged with administering programs of hazards mitigation, preparedness and emergency management on the other hand.

Utah has a valuable pool of talent available in its several universities and colleges, state agencies and private industry to perform a great deal of the needed scientific, engineering and socio-political studies that are needed. What is lacking is coordination of this talent. No single state agency has a coordination mandate, and, further, state agencies such as the Utah Geological and Mineral Survey and the Division of Comprehensive Emergency Management have no research or technology development functions. The result in Utah has been that such federal agencies as the U.S. Geological Survey and the Environmental Protection Agency have been left with the technology development functions. Although these federal agencies have individual programs covering certain hazards, there is no coordinated program on hazards. Furthermore, when they work in Utah, they tend to bring in staff from their central facilities outside the state as well as outside contractors to supplement their staffs. The result is that little of the experience developed by such federal programs remains in Utah and few of the funds remain in the state. We believe that a hazards research center in Utah would be capable of attracting talent as well as funds, and that more of the experience could remain in Utah as the programs progressed, giving Utah a future capability to deal with its hazards problems.

Initial Projects

We propose to initiate the following projects to begin work at the Center:

Multi-Hazards Assessment. There has been no effort in Utah to assess the broad range of hazards that affect a given geographic area. What little assessment done has been mainly to assess an individual hazard wherever it might occur. Yet Utah's population concentration along the Wasatch Front together with the identification of this area as having many recognized potential hazards indicates that a multi-hazards assessment in this identified geographic area is needed. For instance, larger losses of life and property in an earthquake may result from dam failure and subsequent flooding than from the quake itself. As the initial step, this study would be a broad, reconnaissance identification of hazards, which would then be prioritized for further, more detailed work.

Earthquake Hazards. The U.S. Geological Survey has identified the Wasatch Front in Utah as the highest priority area in the U.S. for a 3-year program to investigate earthquake potential and estimate damage and loss in the event of a major earthquake. We would seek to obtain funding from this program to supplement funds requested herein to carry out geological and geophysical work along the Wasatch Front.

Landslide Hazards. During the winter of 1983-84, the University of Utah and the University of Utah Research Institute designed, built and installed a landslide monitoring system in Rudd Canyon, near Farmington, and in Reynolds Gulch in Big Cottonwood Canyon. We worked closely with the Utah Geological and Mineral Survey and the Division of Comprehensive Emergency Management on this project. Alarms sounded in the Davis County Sheriff's office, where the Rudd Canyon monitoring signals were telemetered, warned of the major debris flow that occurred there on May 16, 1983. This highly successful monitoring and alarm system needs to be improved and deployed more widely on known slide areas in Utah. We would work with UGMS and CEM to do this.

North Salt Lake Groundwater Pollution. We propose to begin work with the EPA to assess the extent of the pollution problem near the refineries and to develop techniques to either remove or stablize the pollutants.

Program Coordination. We would build the infrastructure needed to carry out multi-hazards research and mitigation. Specifically we would assess the talent available in Utah in academia, government and industry. We would initiate contacts with federal and state agencies to ensure input of pertinent information and dissemination of results. The result would be an infrastructure to carry out research and disseminate results.

Budget

We anticipate that the Geologic and Environmental Research Center could be established and become self-supporting in two years. We require funds for the first two years as follows:

Two-Year Budget

	$K
Multi-Hazards Assessment	425
Earthquake Hazards	150
Landslide Hazards	450
North Salt Lake Groundwater Pollution	125
Program Coordination	300
	$1,450K

General Statement About the University of Utah Research Institute. The University of Utah Research Institute (UURI) is a self-supporting corporation organized in December 1972 under the Utah Non-Profit Corporation Association Act. It is owned by the University of Utah, and its President is James J. Bropohy, who is Vice-President for Research of the University of Utah. Under its charter the Institute is separate in its operations and receives no financial support from either the University of Utah or the State of Utah. The charter includes provisions for UURI to conduct both public and proprietary scientific work for governmental agencies, academic institutions, private industry, and individuals. In this work UURI has a close technical association with the University and is able to draw upon the talents of faculty and students. When such activities are proprietary UURI may be taxed on income as determined by IRS codes.

UURI is composed of three laboratories:

The Earth Science Laboratory
The Center for Remote Sensing and Cartography
The Environmental Studies Laboratory

The staff is a balanced group of scientists including 9 Ph.D, 7 M.S., 10 B.S., and 17 Support personnel. Current contract volume is about $3 million per year. UURI occupies laboratory and office space in Research Park, adjacent to the University of Utah campus.

GEOLOGIC AND ENVIRONMENTAL HAZARDS RESEARCH CENTER

Objectives

1. Coordinate expertise available in state.
2. Provide interdisciplinary research and mitigation capabilities.
3. Attract federal research funds.

Components

1. Geologic Hazards
   - Earthquakes
   - Landslides and Mudflows
   - Avalanches and Rock Falls
   - Rising Lakes and Ground Water
   - Poor Foundation Materials
   - Collapse
   - Volcanic Eruption
2. Environmental Hazards
   - Ground Water Pollution
   - Atmospheric Pollution
   - Weather and Climate
   - Urban Development
   - Dam Failures
   - Waste Disposal
   - Mine Tailings and Dumps
   - Flooding
3. Socio-Economic Considerations
   - Hazards Mitigation
   - Federal, State and Local Regulations
   - Public Awareness and Education

Participants

1. University of Utah Research Institute
2. University of Utah
3. Utah State University
4. Brigham Young University

Cooperating Agencies

1. Federal
   - United States Geological Survey (USGS)
   - Environmental Protection Agency (EPA)
   - Federal Emergency Management Agency (FEMA)
   - U.S. Bureau of Land Management (BLM)
   - U.S. Forest Service (USFS)
   - U..S Park Service (USPS)
   - Department of Energy (DOE)

Department of Defense (DOD)

2. State
   Utah Geological and Mineral Survey (UGMS)
   Comprehensive Emergency Management Agency (CEM)
   Planning and Zoning

(3) possibility of a responsible role in other UURI programs

Potential Components of Center for which UURI Presently has Expertise/ Experience

(1) Landslide monitoring and assessment
(2) Hazardous waste monitoring and mitigation
    EPA programs
    IRP programs
(3) Nuclear waste isolation studies
    Battelle
(4) Volcanic hazards
(5) Atmospheric pollution monitoring
(6) Environmental remote sensing programs

Ridd

1. - multi-hazards is a concept that people agree with
2. - make pitch for social + human interest portions, in addition to scientific work -
   How does scientific work get implemented into regulation, etc.
- what should be done w/ hazards mitigation -
   mitigate from the top.
3. must ~~so~~ structure ~~concept~~ so that expertise is used wherever its found -
4. Les [illegible] is going to BYU

UNIVERSITY OF UTAH RESEARCH INSTITUTE
UURI
EARTH SCIENCE LABORATORY
391 CHIPETA WAY, SUITE C
SALT LAKE CITY, UTAH 84108-1295
TELEPHONE 801-524-3422

13 November 1984

GEOLOGIC AND ENVIRONMENTAL HAZARDS RESEARCH CENTER

Mission

Foster Interdisciplinary Hazards Research

Objectives

Provide Interdisciplinary Research Capabilities
Coordinate a Comprehensive Hazards Research and Mitigation Program

Components

Geologic Hazards
- Earthquakes
- Landslides and Mudflows
- Avalanches and Rock Falls
- Rising Lakes and Ground Water
- Poor Foundation Materials
- Collapse
- Volcanic Eruption

Environmental Hazards
- Ground Water Pollution
- Atmospheric Pollution
- Weather and Climate
- Urban Development
- Dam Failures
- Waste Disposal
- Mine Tailings and Dumps
- Flooding

Socioeconomic Considerations
- Hazards Mitigation
- Federal, State and Local Regulations
- Public Awareness and Education

Participants

University of Utah Research Institute
Universities and Colleges in Utah
State Agencies
Industry and Utilities

Cooperating Agencies

Federal Emergency Management Agency
Environmental Protection Agency
U. S. Geological Survey
Bureau of Land Management
Bureau of Reclamation
Bureau of Mines
U.S. Forest Service
Utah Department of Natural Resources
Utah Geological + Mineral Survey
Selected County / City governments

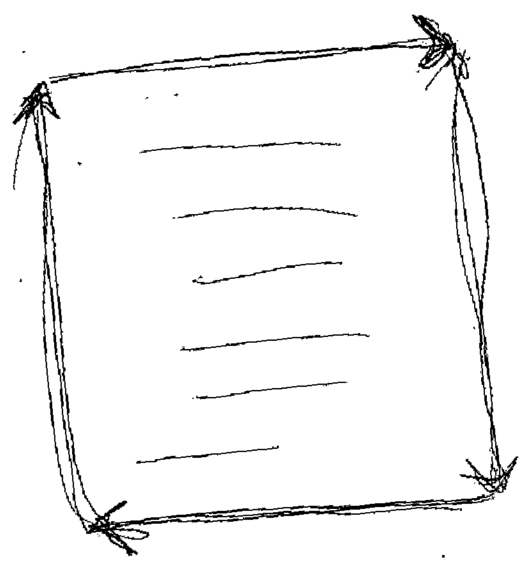
Soil Conservation Service
Department of Energy
Department of Defense
National Science Foundation
National Oceanic and Atmospheric Administration
U.S. Weather ~~Bureau~~ Service
National Aeronautics and Space Administration

notes

Technological Solution in Econ Devlop

1. Talk w/ mothers in WOC
2. Equip devlop for monitoring — DJG
3. Tessa Tek? etc. — because preference is to companies that have strong counterpart.

— — call Sid re possible JV on equip



4. → check WB room for 40 people on 31 May.

5. → George — call him re logging workshop w/ Jeff Daniels approval, etc.

UNIVERSITY OF UTAH RESEARCH INSTITUTE
UURI
EARTH SCIENCE LABORATORY
391 CHIPETA WAY, SUITE C
SALT LAKE CITY, UTAH 84108—1295
TELEPHONE 801-524-3422

13 November 1984

GEOLOGIC AND ENVIRONMENTAL HAZARDS RESEARCH CENTER

Mission

Foster Interdisciplinary Hazards Research

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State Agencies
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Federal Emergency Management Agency
Environmental Protection Agency
U. S. Geological Survey
Bureau of Land Management
Bureau of Reclamation
Bureau of Mines
U.S. Forest Service
Soil Conservation Service
Department of Energy
Department of Defense
National Science Foundation
National Oceanic and Atmospheric Administration
U.S. Weather Bureau
National Aeronautics and Space Administration

TEMPLE A. REYNOLDS
6936 Nye Drive
Salt Lake City, Utah 84121

April ^C, 1985

^F1^
^F2^
^F3^

Dear ^F4^:

Thank you for the opportunity to come by your office on March ^C, 1985 and discuss the concept of a Center for the Study of Geologic and Environmental Hazards. Both ^C and I were encouraged by your comments. ?

For the record, I want also to take this opportunity to briefly recapitulate the major points we addressed regarding a Hazards Center.

As envisioned, the Center would operate as a clearinghouse, business management and contracting office. It would search out available funds to be applied to top priority projects agreed upon by a steering committee and/or act as the bidding and contracting office for advertised research. It would, in turn, subcontract with the best research talent available within the State's Colleges and Universities, state and federal agencies and ~~possibly~~ private firms in order to accomplish the needed research/development work.

If established, the Center would focus on, compete for and engage in, basically, very large, complex and interdisciplinary projects that would normally be considered beyond the scope of individual researchers, state or federal agencies. It is not intended that the Center would become an umbrella for all research and development associated with hazards. Neither is it intended that the Center would compete with individual research activities that have traditionally fallen within the province of individual university [illegible] ag. staff members. It is, however, intended that such a Center would show-case Utah's talent in hazards related research and become a nationally recognized Center of Excellence in this area of growing importance.

The focus of a Center would be on finding solutions to practical problems. This will require the maintenance of close working relationships with governmental agencies at all levels since, considering the nature of the problems, it is only through these agencies and associated legislative funding mechanisms that many of the solutions can be implemented. To assure adherence to the practical, it is anticipated that an advisory committee, with representation from all appropriate governmental agencies, would be established to help guide each research/development project.

While efforts would initially be problem oriented, it is also intended that work be accomplished to explore socio-economic implications associated with hazard areas and/or possible solutions. Where solutions may involve development and marketing of, say, monitoring devices or other technology, there may be opportunity for the Center to become involved with creation of a new business or industry.

As initial steps to explore the establishment of a Hazards Center, the idea was brought before the State Science Council last November where it received ~~a good response~~ encouragement. As a follow-up, we met in early March, 1985 with a number of researchers from Brigham Young University, the University of Utah, Utah State University and the University of Utah Research Institute to further explore concepts and organizational modes. Much of what has been set forth above and what was discussed with you is a result of those meetings.

workshop

The next step will be a ~~seminar~~ workshop to be held at Utah State University within the next several weeks. The purpose of this ~~seminar~~ workshop is to provide those concerned with an opportunity to review the University talent bank and provide an opportunity for all who participate to find out more about each other and what we do. As was remarked when we met, we would be pleased to have you attend this ~~seminar~~ workshop and we will provide you with the specifics of time and place as soon as they become available.

Later this spring we plan a second ~~seminar~~ workshop to gain insight from the public agencies regarding identified hazard problems and problem areas, research or remedial work underway and future work priorities.

We will keep you advised as the concept of a Hazard Studies Center moves along. If you or members of your staff have further questions regarding the concept, please contact me through the University of Utah Research Institute (524-3422) or at my home (942-7725).

Sincerely,

Temple A. Reynolds
Consultant

cc: Stanley H. Ward, UURI

1. management / structure - how will it be organized ?

2. Board of ~~Directors~~ Advisors → representing Research Entities Universities ~~Institutes~~

Advantage - ~~Polit~~ Marketing / Political

Bruce Kaliser - on phone w/ Gordon w/ Sharon Mothers of Hatch's office about getting funding - Gordon ~~&~~ set up Bruce w/ Hatch -

Regional in scope -- bigger than Genesis also broader in topic Than UCRRS -

1. Housed at UURI, but operated independently -
2. Board of Directors comprised of representatives of participating organizations.
3. Small staff
4. marketing a diverse range of talent is primary purpose.
5. Loose agreements w/ profs ? who wants to Support it ?

what can center do that would have helped proposals ?

PMW

M E M O R A N D U M

March 8, 1985

TO: Dr. James Brophy, University of Utah
Dr. Bartell Jensen, Utah State University
Dr. John Lamb, Brigham Young University

FROM: Temple A. Reynolds, Consultant

SUBJECT: Geological and Environmental Hazards Research Center

On Wednesday, March 6, 1985, a group of faculty from Brigham Young University (BYU), Utah State University (USU) and the University of Utah (U OF U) met together with staff from the University of Utah Research Institute (UURI) and this writer in Room 210 of the Energy and Minerals Research Center on the U of U campus. (See attachment no. 1, attendance list.)

Purpose of the meeting was to further explore the concept and possible organization of a Geological and Environmental Hazards Research Center as follow-up to the presentation made before the State Science Advisory Council last November and personal contacts between the University research officers.

To provide a common ground for understanding and discussion, a series of overhead slides with hard copy of each slide for distribution to the participants, had been prepared.

Following introductions, I spent the first few minutes of the session going over the history of the proposal for a Center, together with broad concepts of the envisioned interdisciplinary approach and possible benefits to be derived from a Center. As the morning progressed, we moved into a discussion of possible organizational alternatives. (See copy of my notes, attachment no. 2.)

Following lunch, at the request of the participants from USU and BYU, Stan Ward provided a background briefing on the history, organization and mission of UURI.

Finally, participants refocused their attention on concerns about a Center. This resulted in the following list, which participants believed should provide a discussion/action/resolution agenda for a meeting among the three of you:

- <u>Double Overhead</u>. How to resolve this question in terms of needs of a Center as well as the University researcher?

- <u>Turf Considerations</u>. The USU Water Research Laboratory is already well launched as a Research center. Would its role be eclipsed or obscured in the context of a larger Hazards Research Center?

- Start-up Costs. Source(s) of funding to provide one full time manager-administrator-director, part time stenographic assistance, housing, supplies, phone, travel, etc. for a minimum one year period -- to cover start-up, initial project selection, proposal preparation, contacts with state agencies, contacts with federal agencies (DOE, EPA, Defense, Interior), liaison with Congressional delegation, etc.

- **Leadership.** Where to house a Center? Is there a need for a single focal point such as UURI? Could leadership shift from University to University on a project-by-project or time-share basis?

Subsequent discussion seemed to resolve this issue in favor of a central, legal entity point of focus to provide long term continuity, identity, management and administration, so as to free the primary investigator or investigative team of this responsibility.

- Organizational Structure. Among possible scenarios for discussion was that of UURI being the overall project direction office, with feed-in to Center management from a "Steering Committee", i.e.

```
                     UURI
                       :
Steering Committee----- Center
                       :
                    Projects
```

As suggested, the Steering Committee might be composed of Research Vice Presidents or faculty in comparable position, Deans, Department Heads, etc.

Some concern was expressed over this type of organization and a counter suggestion was made that the Steering Committee be placed on the line between UURI or whatever focal housing point is selected and the Center, so as to provide the Center with direction.

- The Center itself.

Management Control vs. Management Coordination. Concern was expressed that the administrative head of the center have strong interpersonal skills. That he/she exert administrative leadership through coordination and personal relationships rather than through more bureaucratic behavior patterns.

Mission. It was strongly suggested that you reach agreement on a clear statement of goals and objectives, i.e., does a Center start with a State of Utah orientation and move, over time and with experience, to a more regional orientation or should we assume a state and regional thrust at the outset?

There was some sense that the mission statement of a Center might depend on an assessment of funding availability from state agencies or the legislature to provide participation in or implementation of research results.

In addition to the above, several clear recommendations were apparent as follows:

- State agencies must be courted and brought on board at an early stage. Contacts should be made as soon as possible at the Department Director level, i.e. Natural Resources, Public Safety, Health, Transportation, Agriculture, State Adjutant General, etc., to clear the way for development of working level contacts with such agencies as the Division of Water Resources, Comprehensive Emergency Management, Geological and Mineral Survey, and the Division of Environmental Health. The Governor's Administrative Assistant for Natural Resources, Ruth Ann Storey, should also be contacted and briefed as soon as possible.

- The Universities should each prepare a "Capability Document" outlining talent available, specialty areas, etc.

- UURI Staff or consultants should hold themselves available to conduct further campus-specific question/answer sessions regarding a Center, possibly patterned on the March 6 meeting.

- A seminar to show-case geologic and environmental hazards research capabilities/efforts should be scheduled during the next academic quarter. Mid-April seemed to be an agreeable time. A firm time and site needs to be determined.

- State agency representatives should be invited to attend and participate in any seminar so as to insure their continued involvement in development and implementation of the Center concept.

enclosures

CC: All participants listed on Attachment No. 1, w/o Attachment No. 2

ATTENDANCE LIST, ATTACHMENT NO. 1

CENTER FOR GEOLOGICAL & ENVIRONMENTAL HAZARDS RESEARCH

MARCH 6, 1985

NAME	DEPARTMENT	INSTITUTION
Gordon F. Jensen	Utah Engineering Experiment Station	U of U
Kim McCarter	Mining Dept.	U of U
Dennis L. Nielson		UURI
Walter J. Arabasz	Geological & Geophysics Seismograph Stations	U of U
Stanley H. Ward		UURI
Merrill Ridd	Ctr. for Remote Sensing/Geography	UURI
Ronald L. Bruhn	Geology & Geophysics	U of U
Duncan Foley	Earth Science Lab	UURI
Willis Brimhall	Geology	BYU
Mike Wright		UURI
Nolan Mangelson	Chemistry	BYU
John Lamb	Chemistry/Research Administration	BYU
Delbert Eatough	Thermochemical Inst.	BYU
Loren Anderson	Civil Engineering	USU
Clair Batty	Utah Water Research Lab	USU
Roland Jeppson	Civil Engineering	USU
A. Clyde Hill		UURI
Thure E. Cerling	Geology	U of U
David Bowles	Civil Engineering/ Water Research Lab	USU
Kuo-nan Liou	Meteorology	U of U
Temple Reynolds	Consultant	

CENTER FOR GEOLOGICAL AND ENVIRONMENTAL HAZARDS RESEARCH

AGENDA

6 MARCH, 1985

1. INTRODUCTIONS

2. CONCEPT OF HAZARDS RESEARCH CENTER

   OBJECTIVE: TO DETERMINE WHETHER OR NOT THERE IS AGREEMENT THAT A CENTER WOULD BE ADVANTAGEOUS AND WHETHER PARTICIPANTS WOULD SUPPORT IT

3. MODE OF OPERATION

   OBJECTIVE: TO DEVISE A PRELIMINARY MODE OF OPERATION

4. BRAINSTORMING - PROJECTS AND FUNDING SOURCES

   OBJECTIVE: TO LIST AND PRIORITIZE AVENUES OF RESEARCH AND IDENTIFY POTENTIAL FUNDING SOURCES

5. WHERE FROM HERE?

HISTORY

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CENTER FOR GEOLOGICAL AND ENVIRONMENTAL HAZARDS RESEARCH

PURPOSE

- TO ACQUIRE NEW FUNDING FOR LARGE, INTERDISCIPLINARY RESEARCH PROJECTS

ADVANTAGES

1. DISPLAY OF WIDE RANGE OF TALENT FOR MARKETING.
2. SYNERGISTIC EFFECT OF COOPERATION AMONG ACADEMIC/RESEARCH INSTITUTIONS IN OBTAINING POLITICAL SUPPORT.
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7. REAGAN ADMINISTRATION FAVORS MORE UNIVERSITY INVOLVEMENT IN FEDERAL RESEARCH.
8. CAPITALIZE ON RESEARCH RESULTS AT UNIVERSITIES.

CENTER FOR GEOLOGICAL AND ENVIRONMENTAL HAZARDS RESEARCH

OPERATING CONCEPT

1. Coordinate and market State's substantial pool of university research talent.
2. Seek large, complex projects that a single investigator is unlikely to compete successfully for.
3. Bring new research money into State.
4. Form associations with an interdisciplinary research team to handle diverse projects.
5. Work closely with State agencies to be responsive to State needs.
6. Ultimately enlarge to become regional or national center of excellence in hazards research.
7. Incorporate research on social aspects of hazards and mitigation.

WHAT CENTER WOULD NOT DO

1. Compete with individual investigators.
2. Control all hazards research.

UNIVERSITY OF UTAH RESEARCH INSTITUTE

EARTH SCIENCE LABORATORY - 24 EMPLOYEES

- GEOTHERMAL EXPLORATION AND DEVELOPMENT RESEARCH
- MINERALS EXPLORATION AND DEVELOPMENT RESEARCH
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UNIVERSITY OF UTAH RESEARCH INSTITUTE

- Self-supporting, non-profit corporation. No state support.

  President: James J. Brophy

  Secretary/Treasurer: Stanley H. Ward

  Technical Vice President: Phillip M. Wright

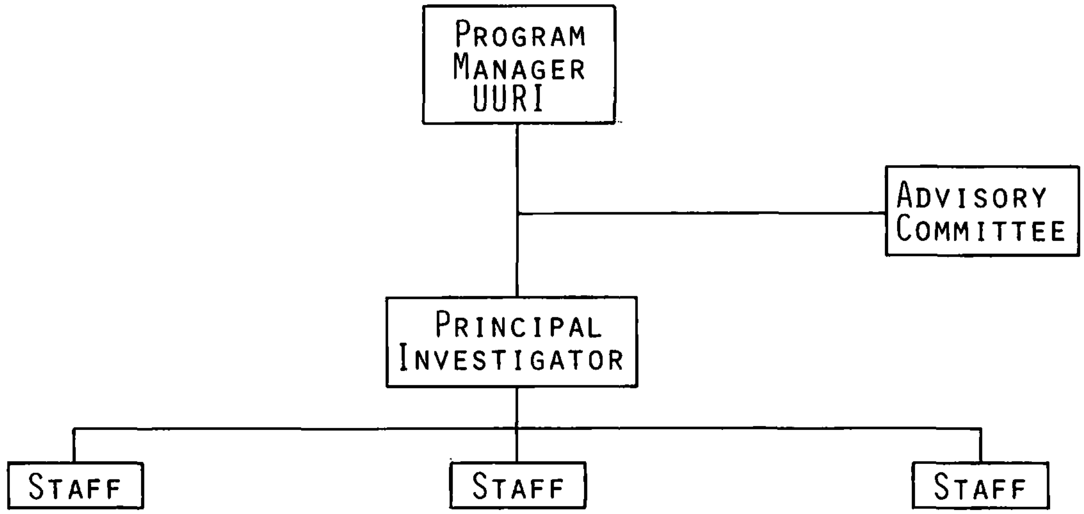
- Seven-member Board of Directors:

  Chase N. Peterson - Chairman
  Irwin Altman
  James J. Brophy - President
  Edward W. Clyde
  John A. Dahlstrom
  Walter P. Gnemi
  Warren E. Pugh
  Roy W. Simmons
  Don E. Detmer

- Mission:
  - to act as an interface between academic research and the community
  - to orginate and perform applied scientific research
  - to stimulate interstate and intrastate cooperative, multidisciplinary research

CENTER FOR GEOLOGICAL AND ENVIRONMENTAL HAZARDS RESEARCH

PROPOSED PROJECT MANAGEMENT



CENTER FOR GEOLOGICAL AND ENVIRONMENTAL HAZARDS RESEARCH

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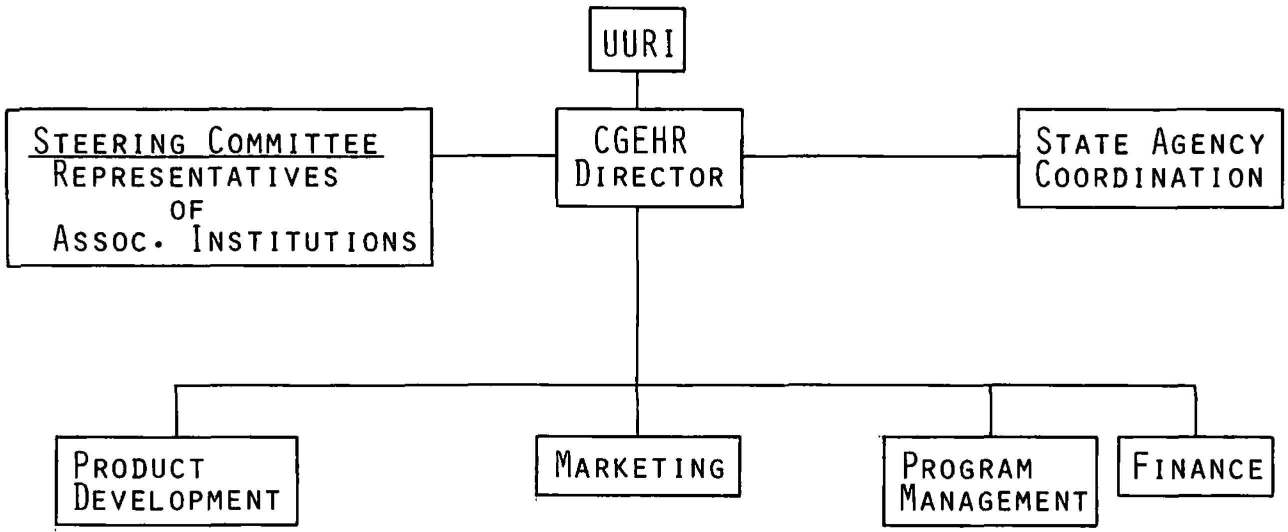

Center
Hazards Meeting

8 March 1985

1. must consider how we could help users —

2. Jim says Sharon Mathews – Hatch – agrees to get something on this.

3. Need cost Estimates ~~fo~~ to get it going →

Hazards Research Center 6 March 85

1. Terry Reynolds -

- Center to begin work on state problems.
  - cited probs in working of state legislature and the general level of apathy
  - idea of integrating research potential in institutions.
  - not to be involved w/ individual research

2. Political support could be obtained for computed center.
   Better opportunity if we work in concert.
   - Reasonable expectation to become regional or national center.
   - indisciplinary nature of hazards problems

3. CBD announcement -

4. went thru slides to "operating concept"
   -- then called for comments -

McCarter - phone call from Colorado re need for monitoring instruments - $300

Batty - recog need for coop up & down state -
- Good concept
- concern about price we might pay for this cooperation -
- have a little paranoia - - will it cut ground from under them?
- is UWRL proper vehicle for center?
- if Governor perceived a threat, it could hurt USU - water lab.

Ward - what can we do to put $ into all of our pockets?
- want to build research bigger -
- will not skim $ off
- Probs w/ ~~Governor~~ - State agencies
→ Governor is apprehensive
- support from CEM.

Anderson - ~~How~~ would you dip into state funds now going to USU?

Ridd - Key to funding = evidence of integration of effort will be synergistic.

Jeppson - Other concerns
- Looks like research falls into public domain
- what is best agency to handle this -
- called for more work w/ legislature for more state $.

Ridd - create a structure that shows cooperative effort -
- have to build in thing that's not one-sided, but access skills where they occur.
- to overcome turf issue -
- Start w/ this concept -
- funding agencies must see no internal strife.

Anderson - agrees w/ what Merrill says
- worries about probs because they still exist
- will there be double overhead

Byrd Caucus -
- more practical than concept
- mechanics of doing

Anderson - Gilbert White's center in Boulder ?
new director is U. Georg prod -
Name from Merrill -
- Merrill says its a ~~communi~~ device for info exchange.

Jeppson - worried about major effort to get together in enough detail to put big proposals together -

Anderson - suggests that a lead institution be appointed for each project -
That

Walter - 1) differences between consortium and center
2) need for flexibility of association -

Questions about [illegible] -

How do we avoid double overhead.

Questions and Concerns - Summary

Betty 1. Question of Double overhead
Betty 2. USU feels they are launched in this area, concerned about turf. Don't want to slip into obscurity under larger organization -
- Heard that idea is not to compete, but swallow larger elephant
Lamb 3. Start-up costs - need for strong leadership to pull things together
Lamb 4. Organizational Structure -
possibility of a [illegible] at top of [illegible] in many sense - doesn't think its feasible to have diffuse institute - feels one of [illegible] to house

Seemed to be group idea that
a location of focus of activities
~~too~~ is needed.

DLN 5. Idea of Prog Manag - PI -
idea is to take adm off PI's back
so he can get on w/ science.

Lamb - draw org chart to show
this

6. The personality of the person in
charge (director) will determine
success -

Berks is familiar w/ Prog Manag - PI
thinks its a good breakdown
- ~~supp~~ clients seem to like it.
- well established agency structure

7. Banks wants to have project
experience of each participant

i.e. what will each group contribute
in expertise, projects, experience, etc -

8. For our in-state efforts, need coop + particip from state agencies -

9. Cards - need to address cost of getting something going -

(a) each institution buck in $15K
(b) ask some charitable institution or company
(c) lobby groups being impacted now

10. Major problem - USU - water Lab's sensitivity to relations w/ Geneva -
WL has to get along & have Geneva's support.

1. USU will host seminar late April
2. VP's will hash out org and find way to contact state agencies -

CENTER FOR GEOLOGICAL & ENVIRONMENTAL HAZARDS RESEARCH

3/6/85

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Temple Reynolds	Consultant	
Gordon F. Jensen	Utah Eng Exp. Station	Univ. of Utah
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Dennis L. Nielson		UURI
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Stanley H. Ward		UURI
Merrill Ridd	Ctr for Remote Sensing/Geogr.	UURI/U of U
Ronald L. Bruhn	Geology & Geophysics	U of U.
Duncan Foley	ESL/UURI	UU
Mike Wright	UURI	—
Willis Brimhall	Geology	BYU
Nolan Mangelson	Chemistry	BYU
John Lamb	Chemistry/Research Admin.	BYU.
Delbert Eatough	Thermochem Inst	BYU.
Loren Anderson	Civil Engineering	USU
Clair Batty	"Water Lab"	USU
Roland Jeppson	Civil Engineering	USU
A. Clyde Hill	UURI	U of U
Thure E. Cerling	Dept Geology	U of U
David Bowles	Civil Engineering & UWRL	USU
21 Kuonan Liou	Meteorology	U of U

CENTER FOR GEOLOGICAL AND ENVIRONMENTAL HAZARDS RESEARCH

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Environmental Protection Agency, Contracts Management Div (MD-33), Office of Administration, Attn: Ralph Kirby (NCCM-S), Research Triangle Park, NC 27711 (919/541-3565).

A – TECHNICAL AND SCIENTIFIC ASSESSSMENTS OF POTENTIALLY HAZARDOUS AIR POLLUTANTS. A term form contract with options is planned for total potential of 45,000 technical labor hours and a potential total three year period of performance. Performance areas include identifying and screening potentially hazardous pollutants (chemicals); characterizing their properties; assessing sources, emission concentrations and trends, human and ecological exposure effects, and control technologies and cost; risk assessments; modeling; and control programs support. RFP to be issued approx Mar 22, 1985. Only written requests for the RFP will be honored. RFP No. DU-85-C110. (057)

45,000 hrs x $40/hr = $1.8M

CENTER FOR GEOLOGICAL AND ENVIRONMENTAL HAZARDS RESEARCH

OPERATING CONCEPT

1. COORDINATE AND MARKET STATE'S SUBSTANTIAL POOL OF UNIVERSITY RESEARCH TALENT.
2. SEEK LARGE, COMPLEX PROJECTS THAT A SINGLE INVESTIGATOR IS UNLIKELY TO COMPETE SUCCESSFULLY FOR.
3. BRING NEW RESEARCH MONEY INTO STATE.
4. FORM ASSOCIATIONS WITH AN INTERDISCIPLINARY RESEARCH TEAM TO HANDLE DIVERSE PROJECTS.
5. WORK CLOSELY WITH STATE AGENCIES TO BE RESPONSIVE TO STATE NEEDS.
6. ULTIMATELY ENLARGE TO BECOME REGIONAL OR NATIONAL CENTER OF EXCELLENCE IN HAZARDS RESEARCH.
7. INCORPORATE RESEARCH ON SOCIAL ASPECTS OF HAZARDS AND MITIGATION.

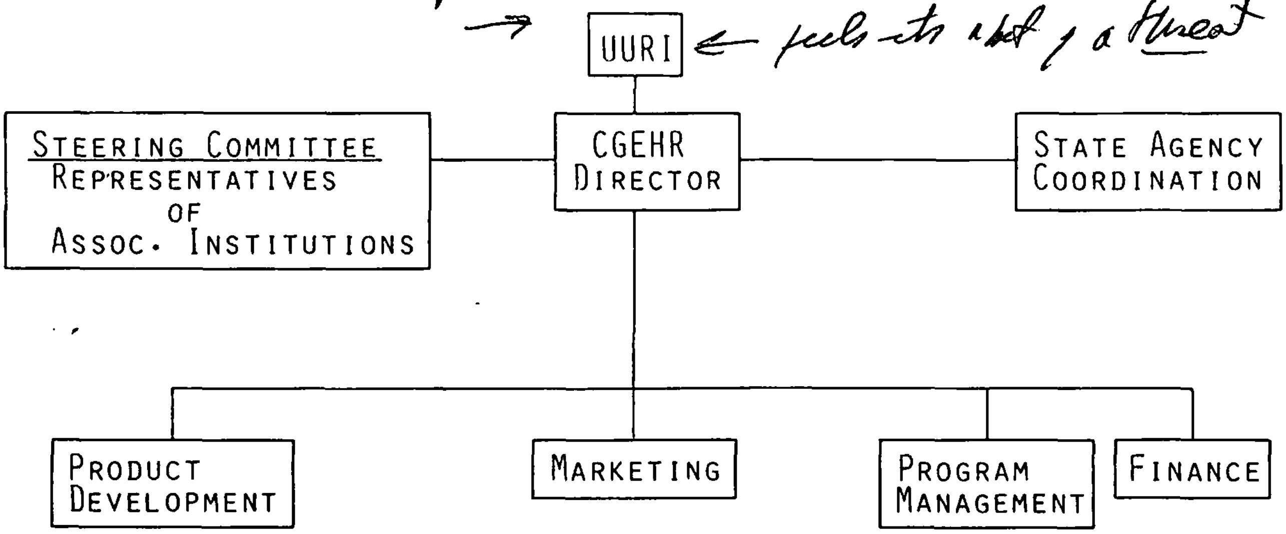
WHAT CENTER WOULD NOT DO

1. COMPETE WITH INDIVIDUAL INVESTIGATORS.
2. CONTROL ALL HAZARDS RESEARCH.

CENTER FOR GEOLOGICAL AND ENVIRONMENTAL HAZARDS RESEARCH

PROPOSED ORGANIZATION

parallel for other schools

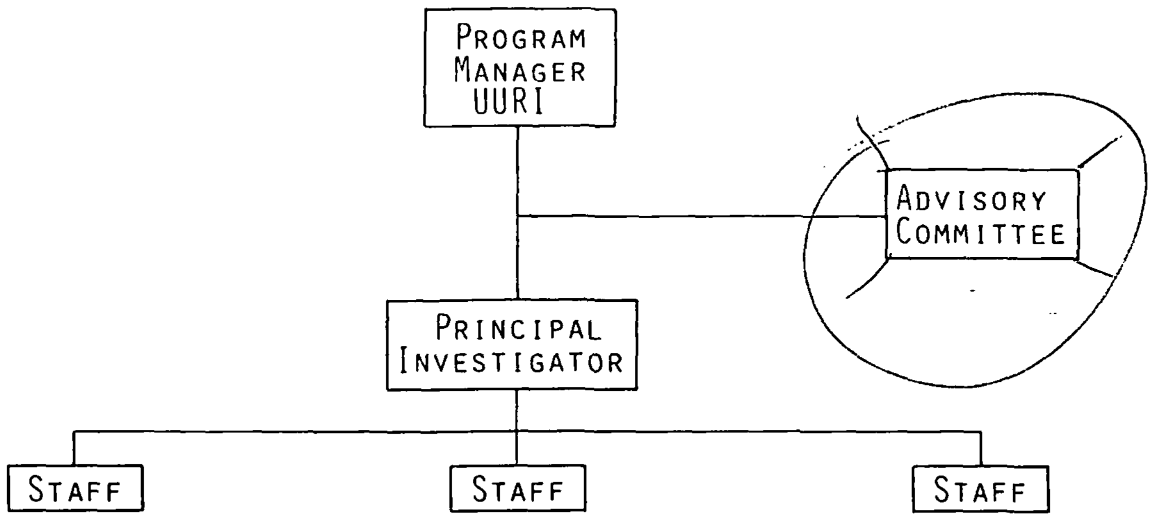


BYU doesn't feel housing @ UURI is a prob —
— but personality of director is what
will make or break the center go

BYU again —
John Lamb — will become director of research
— not have a VP.

CENTER FOR GEOLOGICAL AND ENVIRONMENTAL HAZARDS RESEARCH

PROPOSED PROJECT MANAGEMENT



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- SELF-SUPPORTING, NON-PROFIT CORPORATION. NO STATE SUPPORT.

  PRESIDENT: JAMES J. BROPHY

  SECRETARY/TREASURER: STANLEY H. WARD

  TECHNICAL VICE PRESIDENT: PHILLIP M. WRIGHT

- SEVEN-MEMBER BOARD OF DIRECTORS:

  CHASE N. PETERSON - CHAIRMAN
  IRWIN ALTMAN
  JAMES J. BROPHY - PRESIDENT
  EDWARD W. CLYDE
  JOHN A. DAHLSTROM
  WALTER P. GNEMI
  WARREN E. PUGH
  ROY W. SIMMONS
  DON E. DETMER

- MISSION:
  - TO ACT AS AN INTERFACE BETWEEN ACADEMIC RESEARCH AND THE COMMUNITY
  - TO ORGINATE AND PERFORM APPLIED SCIENTIFIC RESEARCH
  - TO STIMULATE INTERSTATE AND INTRASTATE COOPERATIVE, MULTIDISCIPLINARY RESEARCH

UNIVERSITY OF UTAH RESEARCH INSTITUTE

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UNIVERSITY OF UTAH RESEARCH INSTITUTE
UURI
EARTH SCIENCE LABORATORY
391 CHIPETA WAY, SUITE C
SALT LAKE CITY, UTAH 84108—1295
TELEPHONE 801-524-3422

March 8, 1985

MEMORANDUM

TO: Files

FROM: Mike Wright

SUBJECT: Hazards Research Center Meeting -- USU-BYU-UU-UURI

On Wednesday, 6 March 1985, representatives from the captioned institutions met at the University to discuss the possibility of cooperative research projects under the umbrella of a Center for Geological and Environmental Hazards Research. Discussions were led by Mr. Temple Reynolds. The mood was one of enthusiasm and basic support for the idea, but a number of concerns were voiced that will require solutions so that everyone can feel comfortable with the Center.

USU Concerns

1. The Water Research Lab must work closely with various state agencies and believe that they need Genevieve Atwood's support to succeed in this. They are concerned that their association with the Center could jeopardize their relationship with her.

2. They feel that through the Water Research Lab they are already launched along the directions that we have proposed for the Center. They would not want to see their research group become submerged under another group.

3. They indicated that it would not be wholly acceptable to them to have the Center entirely administered by UURI. Some agreement must be reached regarding the management of the Center that they could feel comfortable with.

4. They are worried about overhead rates and double overhead charges for work administered by the Center.

BYU

1. Their concerns were about how to generate enough start-up capital to actually make it work.

Decisions Taken

The group generally agreed on the following matters:

1. Questions of management of the center should be settled by negotiation at the level of the vice-presidents of the institutions involved.

2. Jim Brophy should arrange a presentation of the concept of the Center to appropriately placed state officials--probably at the Department Director level.

3. USU will host a seminar in late April at which the respective institutions will aim to get to know each other better and will begin to form a list of potential projects.

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1. Questions of management of the center should be settled by negotiation at the level of the vice-presidents of the institutions involved.

2. Jim Brophy should arrange a presentation of the concept of the Center to appropriately placed state officials--probably at the Department Director level.

3. USU will host a seminar in late April at which the respective institutions will aim to get to know each other better and will begin to form a list of potential projects.

Points for Temp to make

1. This meeting is the ~~second step~~ third step in assessing need for a center. The first step consisted of presentation of the concept to the State Scientific Advisory Council. There was an encouraging reception to the idea there. The second step was ~~to~~ taken when Jim Brophy phoned his counterparts at USU and BYU to plan this meeting. VP's of states principal ~~in~~ academic institutions seem to be supportive.

2. Envisage a center to begin working on state problems, but ultimate plans would be to become a regional or national center as experience and expertise grows

3. Senator Hatch is believed to be supportive of concept.

4. Jim Brophy would be here if he could. He is solidly behind the center.

5. Purpose is not to ~~take~~ take away from anyone's research efforts. Purpose is to get bigger projects than one individual or a ~~g~~ smaller group could get.

6. Most work will be contract research with time lines, budgets, deliverables -- not grants.

~~[illegible]~~ diverse

CENTER FOR GEOLOGIC AND ENVIRONMENTAL HAZARDS RESEARCH

WHY A CENTER? handle bigger projects ~~[illegible]~~

- Hazards research is interdisciplinary
- Utah represents an excellent location in terms of problems
- Need for an organization to handle a range of problems
- Need for a mix of full time staff plus academic capabilities
- ~~Elimination of duplicative~~ Coordinate research
- Display of talent for marketing purposes
- Capitalize on the trend toward Centers of Excellence
- Extend work outside state -- i.e. Regional or national
- Capitalize on research results @ Universities, i.e. commercialization

CONCEPT OF CENTER

A Geologic and Environmental Hazards Research Center could:

- Organize and coordinate efforts of the state's substantial pool of University, state agency and private talent to accomplish research, technological development and implementation of hazard mitigation

  - No single state agency has a coordination mandate
  - Most state agencies lack authority, staff and funding to undertake comprehensive research or technology development functions associated with hazards

- Formulate and coordinate a comprehensive program to assess hazards in Utah and regionally as appropriate

- Initiate work on the highest priority hazards

- Work closely with Utah state agencies to prioritize Center activities and to implement results

- Work closely with Federal agencies engaged in hazards work

THE INTERDISCIPLINARY APPROACH

Assessment and mitigation of both man-induced and natural geologic and environmental hazards require an interdisciplinary effort:

- A broad range of scientific and engineering studies will be required

- Studies of social consequences of hazards and mitigation measures will be necessary

- Appropriate means to best implement programs in order to deal with preparedness and emergency response must be explored

A CENTER CAN PROVIDE:

- A management and coordination infrastructure separate and apart from any single University or State Government agency

- A clearinghouse for hazards oriented research

- A training and seminar center for discussion and instruction relative to application/implementation

- A focus from which to solicit funding (e.g. to seek funding from various sources)

POSSIBLE INITIAL PROJECTS:

Multi-Hazards Assessment - A broad, reconnaissance identificvation of hazards by geographical area or region of the state, e.g. Wasatch Front, Southeast Utah, etc.

too late

~~Earthquake Hazards - U.S. Geological Survey has identified Utah's Wasatch Front as the highest priority area in the U.S. for a three-year program to investigate earthquake potential, and estimate damage and loss. We could attempt to obtain funding from and participate in this program.~~

Toxic Wastes - With approximately 150 identified toxic waste sites identified in Utah there is need to assess the extent of potential air/ground water pollution problems, their potential effects on human populations, and to develop techniques to either remove or stabilize the toxicants.

Landslide Hazards - Given continued high levels of ground water saturation, there is potential for further landslides and mudflows. Work originated in 1984 on a landslide monitoring and early warning system (Rudd Canyon, Reynolds Gulch) needs to be improved and deployed more widely on known slide areas.

Program Coordination - Build the infrastructure needed to carry out multi-hazards research and mitigation. Assess the talent available in Utah in academia, government and industry. Initiate contacts with federal and state agencies to insure input of pertinent information and dissemination of results.

- state-wide now, but potential for regional or national status as developing expertise.

Focus on possible dissolution of SCS.

Say this is 2nd step - Science Adv Council ~~and~~ has given approval as well as VPs of Universities.

- state agencies don't have the time or research staff to carry out the size ~~of pro~~ and nature of projects center would handle.

SOME POINTS TO CONSIDER

1. One of the greatest needs in this entire hazards research effort is to INTEGRATE all geotechnical/biophysical data (both known and yet to be found) so that:
   a) The processial interrelationships are demonstrated (slides, floods, groundwater, slopes, seismicity, etc.) and
   b) The existing and continuing data are prepared and synthesized in a comprehensive setting.

   After all, it is the landscape we live on and manage, not a ground shaking phenomenon or slide.

2. Careful MAPPING is essential, so that:
   a) The integrated patterns of the several hazard phenomena are clearly demonstrated.
   b) Common denominator standards of scale, symbology, terminology, etc. will maximize intercommunication

   After all, it is the landscape we live on, buy-and-sell, zone, write ordinances for, etc., and the map is the clearest way to store and present the data to laymen and professionals.

3. Appropriate INVOLVEMENT of local/regional officials is essential, so that
   a) They feel an integral part of the effort,
   b) They will lend their approval rather than resist research efforts and findings,
   c) Model ordinances may be prepared and implemented (I would even recommend that ordinance preparation be a part of the scope of research).
   d) The language of technical findings be presented in maps and documents such that these people understand the basics, and "buy" the results and

recommendations.

In a nutshell, I believe the current sense of potential funding agencies is strongly oriented toward "MULTI-HAZARD" analysis and "MITIGATION" implementation. The above three points will help underscore and assure this objective in the minds of the reviewers.

GEOLOGICAL AND ENVIRONMENTAL HAZARDS RESEARCH CENTER

210 Energy Mineral Research Ctr

Room ~~002 Browning~~ Building

March 6, 1985

AGENDA ITEMS

1. Introductions - 1 min summary of research/position

2. Concept of a Hazard Research Center

   Objective: To determine whether or not there is agreement that a center would be advantageous and participating institutions would support such a center

3. Mode of Operation ~~Organization of a Center~~

   Objective: To devise a preliminary ~~organization and~~ mode of operation

4. Identification of Projects and Funding Sources

   Objective: To list and prioritize approaches and avenues of research for getting a center started

5. ~~Next meeting~~ Where from here?

~~Parlor (B) - Lunch~~
~~Mez. Level~~

8 5 Mar '85

Possible Initial Projects

Ways could help prop. prep. - ident. of talents in Ut (@ start) in other Univs.
e.g. - geophys. + quat. stratigs.

real utility of center - mechanism to get funding that otherwise would not be avail.
- state agency
- fed. budget

communic. link. of univs. to state agencies @ oper. level
method to combine diverse talents from several universities (+ state agencies)
e.g. { - geophys.
- tree rings.

central source of infmn.
" contact for govt. personnel

data support center for prop. writing (link to find various costs, etc.)
seed funding for proposal prep. (not a prob. in Univs., but travel, etc. is...)

what Center is not -
- an interference mechanism to normal researchers contacts and funding mechanisms
- competition for ongoing programs + research

GEOLOGICAL AND ENVIRONMENTAL HAZARDS RESEARCH CENTER

PROPOSED MEETING 28 FEBRUARY 1985

Temp Reynolds
MC. - Intro.

AGENDA ITEMS

1. Concept of Hazards Center — ~~Temp Reynolds~~

   -Objective-to determine whether or not there is agreement that a center would be advantageous and that participating institutions would support such a center — ~~[illegible]~~ Reynolds

2. Organization of Center

   -Objective-to devise a preliminary organization and modus operandi — Wright

3. Identification of Projects/Funding Sources--Brainstorming Session

   -Objective-to list and prioritize approaches and avenues of research for getting center started — Ward.

PARTICULARS OF MEETING

1. Meeting to be held on Campus, University of Utah, at Energy and Minerals Research Center, 201.
2. Times: ~~9:30~~ 10:00 AM to ~~4:30~~ 4:00 PM
3. Lunch: ~~Panaroma Room, UU Student Union~~ Parlor B, Mezz., UU Student Union
4. Attendees:

   Utah State University
   Brigham Young University
   University of Utah

   University of Utah Research Institute

Meteorology
C Eng
Min Eng.
Geol Geoph
Geog.
Biol.

Hydrology
Geotech
Atmosph (?)

Princeton has a

Center for Energy and Environmental Studies

RM 210
EMRC

Bldg 61

Engineering Mineral Research Center

1. Terry Reynolds - 4 March -

everyone is on board -

2. Agenda - like our tentative one -

Ridd + Hill

BYU → 1

USU → 8

UURI → 4

Temp → 1

UU → Jensen, Certing, Arabasz, Brehm, Chapman 5

19 ⇒

20 - 21

Tay: 22 Feb. 85

News Names

Ron Sims - Utah State Nuclear Waste

John Lamb + 2 Assoc

about 20 people

Week 3rd except Thursday -

looks like Wed 6th

Caron Anderson - little reticence
- has talked w/ SHW -

Cayle concerned about length →

Check on Wed 6th 10-4 basis

Allene - ok 6 mar

Bufe → 287-0184
not there any more

Temp. 942-7728 home

12 Feb. 85

1. Possible directions of pursuit for hazards research
2. Problems w/ CIGMS & what can be done about them.
3. In-state items that could possibly be coming up that center could bid on
4. Suggestions for coordinating - who should be in, etc.

Gary Johnson
mr. Moretti - $\boxed{646-2810}$ to get Chuck's # ?

Hazards Center
- Start w/ USU, BYU
- Temp feels Bart Jensen would be supportive
- USU computer/satellite link has potential
  USU good geotech, good hydro.
- Legislature has shot Gen. down 3 times on geol hazards -

1. Proposal to FEMA - turned down -
2. Need to find out what FEMA will buy -
3. meeting of interested parties
   Couple w/ trip by Brophy, Jensen etc.
4. Get cong staffers to go to Utah Cacs -- after FEMA.
5. Brophy to drop in on Chief Geol USGS - Bob Hamilton

— DOE $ possibility
uito-
others @ nuc Hat, etc site characteriz.
⇒ Get contact re this site characteriz.

- Transportation aspects of nuc. waste. Rate safety - pop centers, water pollution - - will be a big problem -

- Act as state subcontractor -
past $ got split up too much
Center could help bring this $ together
Republican adm will be more inclined to contract out.
Pat Spurgeon - in state

Gen not set up to do it. -
Hazards Center ~~is~~ could be set up to train @ County Level -

— OK 'till May
Pull together meeting Thur Feb. 28
brainstorm.

- Prevention and mitigation are more cost-effective than clean-up

- As of August 1984, ONWI lists some 33 reports of project work on the potential waste site in Southern Utah, none of which was done by a corp based or with office in Utah

- Gov's Conference on Geologic Hazards
  - funding should come from Feds
  - State's role
    - research priorities
    - application
    - data collection and dissemination
  - planning and zoning ~~faith~~ is local issue, has failed to enact and enforce codes

DFCM Division of Facilities Construction and Management
DCED Department of Community and Economic Development
DWR Division of Water Resources

- Research
  - Monitoring – best techniques
  - Mitigation – best techniques
  - Prediction of Events

waste depository depts on Utah

USGS 11
Camp Dresser, McKee 1

Texas BEG - 25 reports on their state

PNL - 1
Oak Ridge

ONWI 111
INTERA Environ. Consultants 1
Parsons Brinckerhoff 1
Woodward - Clyde 1111 1111 1111
Bechtel 1111 1111 1

geol
environ

US Geol Survey ~~11~~ 3
ONWI 3
INTERA 1
Parsons - Brinckerhoff 1
Woodward-Clyde 14
Bechtel 11

DF 8 Nov '84

integrated center for research into geol haz in UT
no centralization
lack of research (beyond Univ & USU)
research
monitoring
mitigating
warning

USU - H_2Os, mudslides
Health - toxic wastes
Seis. lab - e.q.
Mech. Eng - slopes
UGMS - Haz. anal., after events, some prediction
USGS - EQ, LS, geol. expertise
Counties - flood control
Emerg. Mgmt. - response
? - dam safety (beyond Ut. Div. H_2O Res.)
? - unstable soils
? - public awareness for central information - UGMS
? - input to county Plng. & Zoning programs - ~~DOT~~
no one - avalanches, as central facility - DOT
? - geol. input to waste disposal

? - geol. input to govt. facility design
i.e. Tooele Army Depot - nerve gas on young fault scarps

Ut. Hazards
floods - hi groundwater
snow melt
lake shore
summer storm
dam failure
volcanoes - local (Cove Fort)
large calderas
earthquakes
landslides - debris flows (into 30s)
thistle (Manti)
avalanches
toxic wastes - water pollution
unstable soils
subsidence - not a problem yet in Ut
wastes - geol. input from state edaq,
on Nuc.

data bases -
Sugarhouse quadrangles

questions -
Genevives plans (can't be research)
Bangater's feelings

Mike

I took the liberty to look over your outline and slides. I think it is well conceived and organized.

I do have a feeling that three points need to be emphasized. I've taken the liberty to write out a couple of thoughts. I believe they can be inserted into your outline.

UURI
31 October 1984

GEOLOGIC AND ENVIRONMENTAL HAZARDS RESEARCH CENTER

Objectives

1. Coordinate expertise available in state.

2. Provide interdisciplinary research and mitigation capabilities.

3. Attract federal research funds.

Components

1. Geologic Hazards
   - Earthquakes
   - Landslides and Mudflows
   - Avalanches and Rock Falls
   - Rising Lakes and Ground Water
   - Poor Foundation Materials
   - Collapse
   - Volcanic Eruption

2. Environmental Hazards
   - Ground Water Pollution
   - Atmospheric Pollution
   - Weather and Climate
   - Urban Development
   - Dam Failures
   - Waste Disposal
   - Mine Tailings and Dumps
   - Flooding

3. Socio-Economic Considerations
   - Hazards Mitigation
   - Federal, State and Local Regulations
   - Public Awareness and Education

Participants

1. University of Utah Research Institute
2. University of Utah
3. Utah State University
4. Brigham Young University

Cooperating Agencies

1. Federal
   - United States Geological Survey (USGS)
   - Environmental Protection Agency (EPA)
   - Federal Emergency Management Agency (FEMA)
   - U.S. Bureau of Land Management (BLM)
   - U.S. Forest Service (USFS)
   - U..S Park Service (USPS)
   - Department of Energy (DOE)

Department of Defense (DOD)

2. State
   Utah Geological and Mineral Survey (UGMS)
   Comprehensive Emergency Management Agency (CEM)
   Planning and Zoning

1. Slides of hazards in Utah
   - view of Thistle slide
   - view of Farmington debris flows
   - view of recent damaging storm
   - view of Mt. St. Helens blast
   - view of Great Salt Lake flooding
   - view of earthquake damage
   - view of SL valley during poor air quality day
   - view of Teton dam failure
   - view of industrial pollution

2. Concept of Hazards Research Center
   (a) Need exists in state - Utah one of highest cost in U.S.
   (b) Talent exists in state - state agencies, universities, engineering and consulting firms
   (c) There is currently no coordination of effort and no coherent program for:
      - assessment of hazards
      - research into mitigation measures
      - public awareness and education
      - instituting public safety measures

3. Objective of Center

4. Potential Hazards
   geologic
   environmental

5. Proposed Structure of Center

6. Steps in Creating Center

HAZARDS RESEARCH CENTER

NEED

- Utah one of Higest Cost States for Disaster cleanup

- No Coherent State or Federal Program
  - assessment of all types of hazards
  - research ~~tst~~ on mitigation
  - public awareness
  - safety measures

- Current Major Efforts by Out-of-State Groups
  - Woodward-Clyde
  - U.S. Geological Survey

HAZARDS RESEARCH CENTER

PARTICIPANTS

STATE

University of Utah Research Institute
University of Utah
Utah State University
Brigham Young University
Other State colleges

REGION

Idaho National Engineering Laboratory

HAZARDS RESEARCH CENTER

COMPONENTS

~~- Geologic Hazards~~

~~- Environmental Hazards~~

~~- Socio-Economic Considerations~~

- HAZARDS RESEARCH
  assessment
  mitigation techniques

- SOCIO-ECONOMIC CONSIDERATIONS
  public awareness and education
  instituting safety measures

HAZARDS RESEARCH CENTER

COOPERATING AGENCIES

FEDERAL

Federal Emergency Management Agency
U.S. Geological Survey
Environmental Protection Agency
Department of Defence
U.S. Bureau of Mines
U.S. Bureau of Land Management
National Science Foundation

STATE

Comprehensive Emergency Management
Utah Geological and Mineral Survey
Planning and Zoning Commissions

HAZARDS RESEARCH CENTER

ENVIRONMENTAL HAZARDS

Weather and Climate
Rising Lakes and Groundwater
Flooding
Groundwater Pollution
Atmospheric Pollution
Urban Development
Dam Failures
Waste Disposal - radioactive, toxic, industrial
Mine Dumps and Tailings

HAZARDS RESEARCH CENTER

GEOLOGIC HAZARDS

Earthquakes
Landslides and Mudflows
Avalanches and Rock Falls
Volcanic Eruption
Poor Foundation Materials
Ground Collapse

HAZARDS RESEARCH CENTER

MISSION

- FOSTER INTERDICIPLINARY HAZARDS RESEARCH

OBJECTIVES

1 - PROVIDE INTERDICIPLINARY RESEARCH CAPABILITIES
- ADMINISTER A COMPREHENSIVE HAZARDS RESEARCH AND MITIGATION PROGRAM

title slide

GEOLOGIC AND ENVIRONMENTAL HAZARDS

RESEARCH CENTER

ENVIRONMENTAL AND GEOLOGIC HAZARDS RESEARCH CENTER

Concept for Center

Assessment and mitigation of both man-induced and natural environmental and geologic hazards requires an interdisciplinary effort. UURI and the University of Utah, as well as the other universities in the state, could serve as a pool of talent available to programs administered by the Center. State agencies involved in hazards programs, such as the UGMS and CEM, do not have a research and development mandate to help deal with hazards--R&D components are the proper role of universities and related research entities.

There are several Federal programs that deal with environmental and geologic hazards from which funding could be solicited, and there is potential for project support from the State of Utah. We recognize the following types of hazards to be present in Utah and to be of sufficient potential to merit research and technology development.

- Earthquakes
- Landslides
- Dam failures
- Rising lake and groundwater levels
- Floods
- Shrinking or swelling soils
- Ground collapse
- Volcanic eruption
- Air pollution
- Groundwater pollution
- Disposal of toxic waters
- Disposal of low-level radioactive wastes
- Disposal of high-level radioactive wastes
- Weather hazards

Position Available - Administrator

Principal duties

(1) organize the Center
(2) identify a mission that meets one or more national and/or state needs, i.e. an ecological niche
(3) secure funding for one or more projects
(4) open new lines of communication between UURI and one or more Washington level and/or State offices/programs

Conditions

(1) no salary until first project is funded
(2) UURI would provide office space, telephone, secretary, etc. and some travel money

(3) possibility of a responsible role in other UURI programs

<u>Potential Components of Center for which UURI Presently has Expertise/Experience</u>

(1) Landslide monitoring and assessment
(2) Hazardous waste monitoring and mitigation
    EPA programs
    IRP programs
(3) Nuclear waste isolation studies
    Battelle
(4) Volcanic hazards
(5) Atmospheric pollution monitoring
(6) Environmental remote sensing programs

<u>Ribb</u>

1. – multi-hazards is a concept that people agree with
2. – make <u>pitch</u> for social + human interest portions, in addition to scientific work –
   How does scientific work get implemented into regulation, etc.
   – what should be done w/ hazards mitigation – mitigate from the <u>top</u>.
3. must ~~so~~ structure ~~concept~~ so that expertise is used wherever its found –
4. Les Youd is going to <u>BYU</u>

23 Aug 84

met w/ Temp Reynolds and Jim Bagley re taking ~~Howard's~~ Center director position

Another view of quantitative values (these are from the real world) can be taken from the experienced costs of damages from Utah's 1983 and 1984 flooding and landslide disasters.

1983	Damage Costs	$478,098,555
1984	Damage Costs	41,413,479
		$519,512,034

In these two illustrations, we've talked about economic impact----dollars.

Drawing from the USGS Open-File Report 76-89, A Study of Earthquake Losses In The Salt Lake City, Utah Area, we view a subject much more serious than economics, or dollars, that of potential lives lost.

Written in 1976, this report estimates the impact of an earthquake of a Richter magnitude 7.5 along the Wasatch Fault, considering damages in Weber, Davis, Salt Lake and Utah counties.

Deaths	2,266
Seriously Injured	9,064
Homeless	29,569

With the added impact of a secondary threat from a dam break, such as Deer Creek, the estimates rise to:

Deaths	11,900
Homeless	44,369

Not belaboring the potential economic impact of such an earthquake, but going on to an interesting comparison of a Richter 7.5 earthquake along the Wasatch Fault with the 1983 Lake Thistle mountainslide. When the mountain began slipping, around April 12th, there were 22 persons living in the area which was eventually displaced by the 70,000 acre foot lake.

Fortunately, with this catastrophic natural event, along with the flooding and debris flows along the Wasatch Front, no lives were lost, no hospitals were disabled, and no major metropolitan lifelines were disrupted.

If the Thistle mountainslide had suddenly occurred without warning; if the total movement of the land mass, the formation of the dam, and the filling of the lake, had all occurred in less than three minutes (longer than the time of damaging earthquake shocks); if all 22 residents of the area had lost their lives,----though tragic, that would yet have been only 22, not 2,266----as estimated for a Richter 7.5 earthquake along the Wasatch Fault.

Putting it in perspective, to deal with a natural hazard of the magnitude threatened by a Wasatch Fault major earthquake is a very serious and worthwhile endeavor. If we plan, prepare, and as a result reduce and prevent losses, whatever meager funds and efforts we expend to achieve it will reap pay-off benefits beyond many other things for which we could spend out time and money.

What is Utah doing in the way of preparedness and planning along the Wasatch Front for earthquakes and other natural hazards?

We are well on the way to completing a joint-use State/Four County Earthquake Response Plan. This plan is to be an operational management tool to be used whenever a damaging earthquake occurs along the Wasatch Fault. It will integrate all available response resources and capabilities and employ them with coherent control and management throughout Weber, Davis, Salt Lake, and Utah counties. The State/Four County Plan will be used as a common reference guide at community, county, and state levels by officials, emergency response forces, and volunteer organizations. It will be backed up by mutual aid agreements sufficient to support unencumbered employment of appropriate resources where needed most.

Much effort has gone into making it site specific and in telling users readily:

What to do.

Who will do it.

How to do it.

and

What resources will be used.

This operational plan is developed under the mandate and authorities of Utah's Disaster Response and Recovery Act of 1981 and Utah's Emergency Management Act of 1981. It's development is supported by funding through the Federal Emergency Management Agency.

Special activation procedures are established to be applied at state level if notifications arise from the seismograph station system of the University of Utah or from the National Earthquake Information Service at Golden, Colorado. County or community level activation can also be done to respond to damages or threats of damage.

Provisions are made for:

Emergency Communications, which emphasize the use of radio links from on-scene locations of damage or response to the all-important control and management centers. An all-inclusive radio frequency list is developed to provide a common reference tieing together the government emergency use frequencies with state agencies and counties frequencies, and including the expanded resources of private sector volunteer radio communications resources.

Reconnaissance Operations, which establishes mechanisms and resources for immediate evaluation of damages and hazards. Pre-disaster contacts and reporting formats are established. Precise facilities and pin-pointed inspections will be initiated by local emergency inspection teams. Specific areas or objectives will be covered by aerial surveillance from the Utah National Guard, Civil Air Patrol, etc.. Broad area aerial reconnaissance with pre-designated essential elements of information has been set up with the U.S. Sixth Army and the Idaho Air Guard. This is a tactical reconnaissance organization equipped with high level-high speed remote sensing aircraft, imagery production and interpretation laboratories.

Monitoring and Warning: Emphasis is placed on the responses needed to evacuate, or take safety measures in advance of secondary threats, such as deluges from dam breaks. Precisely, Pineview, Mountain Dell, and Deer Creek Dams and their downstream metropolitan areas are given unique procedures. To the extent possible, existing 24-hour alert centers are used, such as the Sheriff's Dispatch Centers and Utah Highway Partol Dispatch Centers. Procedures cover conditions with telephone or without telephone capabilities. Other life-saving warning provisions relate to the hazard areas surrounding the four oil refineries in Davis County, which have a combined storage capacity of over 5 million barrels of petroleum products.

Emergency Public Information procedures are pre-planned to broadcast emergency guidance for specific hazard areas or general instructions to populations affected by power outages, gas main failures, water system failures or route blockage isolations. Means for activating the Emergency Broadcast System at state, county or community levels are given. County Emergency Operations Centers, as well as the State Emergency Operations Center, have remote radio pick-up linkages to designated Primary Common Program Control Stations in their county areas.

Fire Fighting and Search and Rescue are life-saving demands where pre-planning and training pay off. In addition to the combined utiliza- tion of all available municipal and county fire fighting resources, mutual support agreements have been adopted for all of the oil refineries. They have their own foamer trucks and trained fire suppres- sion crews. They have established quick response procedures from the nearest municipal fire stations. Response resources for use throughout the four-county area include the foamer and special equipment from Hill Air Force Base and Salt Lake City International Airport (above the airport needs at the time), and aerial fire retardant units managed by the Inter-Agency Fire Control Center, based at the Salt Lake International and Ogden Airports. When not involved with fire suppression, fire fighting crews provide one of the best resources for searches in damaged buildings and the rescue of entrapped victims. Primary responsibility for search and rescue rests with the Sheriff's Departments. They will be augmented with Rocky Mountain Rescue Dogs, a unit on 24-hour alert with access to 20 dog teams throughout the four counties; Sheriffs' Jeep Posses having over 160 four-wheel drive and radio equipped vehicles; and the Civil Air Patrol with 8 squadrons of trained search and rescue resources.

Evacuation, Sheltering, and Feeding are established as responsibilities at local community and county levels, supported by the state agencies. First demands will be evacuations from areas threatened by a dam failure. The inundation areas, evacuation procedures, routes, and shelters are pre-designated in the plan. Unique transportation resources will be coordinated by the State Emergency Operations Center to provide helicopters and ambulances. Evacuations from heavily damaged building areas and high rise buildings, hospitals, nursing homes, and schools are treated. Shelters are to be quickly inspected by local inspection teams. The most likely shelters within the four counties are listed. Large volume public and commercial shelters in contiguous areas, such as Park City and the ski resorts are considered. Mass feeding and shelter management will be coordinated by local and state agencies and supported by the American Red Cross.

Health, Medical, and Sanitation: Managing and employing the undamaged and uninjured medical resources will be one of the most crucial factors of earthquake response. As summarized from the USGS Open File Report, 76-89, there could be over 12,000 persons with injuries serious enough to require hospitalization. A compilation of hospital/medical facility resources in 1984 carried 4,668 bed spaces within the four counties. In their emergency medical plan, the State Department of Health considered that they could accept an augmented capacity of 150% normal for emergencies. This would equate to an augmented figure of 7,000 bed spaces. The above quoted USGS Open File Report, 76-89, estimated that earthquake damages would result in a bed loss of 2,937, or almost half of the available spaces. Priorities for emergency treatment and physician/nurse care will no doubt be more critically short than bed spaces. Massive adjustments and coordination will require state-level management. Unique resources, such as helicopters and ambulances will need to be pooled and allocated by priorities. Emergency Medical Collection Points will need to be established. Massive patient evacuations to regional hospitals outside the area will need to be considered. The aspects of health, medical care, and sanitation are planned to the depth of detail permissable. They will be expanded and refined as exercises and experience give us more knowledge.

Response To Lifeline Systems Damages will be crucial to support relief operations and to sustain the disrupted and recovering populations. Each of the lifeline systems are vast and unique. To a certain extent, the private sector or utility agencies who operate the systems will manage the restoration of services. For example, in the USGS Open-File Report, it was estimated that following a 7.5 earthquake, Mountain Fuel Supply could repair most natural gas line damages within 24 hours. Yet lifeline disruptions will probably be massive, widespread in their impacts, and may last days or longer. To the greatest detail allowable, and within proprietary rights, this section establishes the processes for restoring the lifelines. Direct links with the lifeline operators and the State and County EOC's are best covered by having respresentatives from the lifeline agency in the appropriate emergency operations centers.

Debris and Wreckage Removal take on a more critical importance then in normal disasters because of the likelihood of entrapped victims. Controlled demolition could be required, in some cases. Procedures and authorizations are guided by the life-saving demands and in accordance with provisions given in Utah's Disaster Response and Recovery Act of 1981.

Military Support will be a major contribution. Resources from the Utah National Guard have proven their responsiveness and sizable scope during the 1983 and 1984 flood and landslide disasters. Other nearby military resources from Hill Air Force Base and Tooele Army Depot will consititute vital flexible capabilities. In the event the State's Emergency Operations Center is disabled, the Alternate EOC will be located in facilities on Hill Air Force Base. Sixth US Army at Presidio has established a specific Earthquake Response Plan for the Great Salt Lake City Area. It provides for the deployment of Disaster Control Elements at the outset of a damaging earthquake from the Ogden Air Logistics Command, from Fort Carson, Colorado, and other military resources. The Tactical Air Command has an Operations Plan "Sea Nature" which provides Tactical Air Reconnaissance in support of natural disasters. For the Wasatch Front earthquake, reconnaissance objectives have been specified, essential elements of information listed, and required reports formats coordinated to facilitate automatic operational response to the earthquake event.

<u>Volunteer Support</u> is an extraordinary resource in Utah. It coalesces and brings in the specialized, trained, and organized capabilities of the American Red Cross, Salvation Army, Civil Air Patrol, Rocky Mountain Rescue Dogs, Sheriffs' Jeep Posses, Amateur Radio organizations, and the churches, especilly the L.D.S. Church. Putting to work their responsive structure, during the 1983 flood and landslide disaster, 139,537 members of the L.D.S. Church (in organized and managed groups) performed 1,271,443 hours of volunteer labor. They have developed neighborhood resource lists of response specialists, such as doctors, nurses, etc..

Mutual Aid Agreements are being negotiated to facilitate flexible application of resources. Though negotiations are sometimes fraught with protective reluctance, progress is being made in many areas. As mentioned above, the four oil refineries, AMOCO, Chevron, Husky, and Phillips, have mutual aid agreements with themselves and nearby Fire Departments in Davis County wherein they will combine to handle a massive emergency at one or more of the refineries. The Military Assistance To Traffic support agreement for life-threatening emergencies negotiated with the Helicopter Rescue Detachment of the 40th Air Rescue and Recovery Service at Hill Air Force Base, is another example of achieved mutual aid. Three of the four counties in the above mentioned response plan have concluded Mutual Aid Agreements.

Training of Emergency Response Forces, such as Fire Departments, emergency Medical Teams and volunteer organizations will take on a more meaningful scope as the Earthquake Response Plan is exercised and used as hub around which to focus and vector the training and drills.

The Division of Comprehensive Emergency Mangement's Training and Education Section has annually sponsored an Earthquake Preparedness Month throughout all channels of the media. The recent formation of the Public Awareness/Education Resource Committee is intended to generate classroom quality instruction on earthquake preparedness and inject it into homes and businesses through PBS television and other media outlets.

Utah's Multi-Hazards Mitigation Project goes beyond the threshold of earthquake preparedness and includes the hazards of dam failures, deluging floods, and landslides. More than one of these events could occur simultaneously or in triggered sequence. The Multi-Hazard approach was adopted to enable planners and mitigation authorities to treat all four hazards in a parallel, formal manner, with equal cognizance of all risks.

The Multi-Hazard Mitigation Project is supported by funding from the Federal Emergency Management Agency. However, since the Project evolves long-haul mitigation measures which will actually implement life saving and property loss reductions within jurisdictional areas, the objective is to develop a partnership relationship between FEMA and the local jurisdictions. Hazard analyses and mitigation strategies evolve from the Multi-Hazard Project developments. Application of the mitigation measures and bringing to culmination the hazard reduction benefits will depend upon efforts contributed by the affected jurisdictions in the way of funding, legislation, preparedness, zoning, structural modifications, etc..

Certain catalysts which will clarify the view of mitigation authorities are the Probabilistic Risk Analysis, Economic Impact Analysis, and Demographic Risk Analysis. The Probabilistic Risk Analysis applied by Jack R. Benjamin, Associates, Inc., (who developed the Stanford University's Engineering risk assessment techniques for dams) precisely quantifies the risks from the four hazards within a designated project area. From the three analyses mentioned, jurisdictional authorities are able to assess the impacts of the hazard events and grasp the scope or urgency of mitigation requirements.

As has been shown in the costs mentioned above, and from the 1983 and 1984 floods and landslides damages, potential savings from responsible mitigation efforts can be immense, both in terms of dollars as well as in lives saved.

To initiate the Multi-Hazards Mitigation Project and focus the implementable hazard reduction results, the Pineview Dam and the Ogden Metroplitan area were selected for the pilot effort.

Pineview Dam is an earthfill structure located six miles up Ogden Canyon and 600 feet in elevation above the Ogden City area. It was first constructed in 1935 to a height of 65 feet with an impoundment volume of 44,000 acre feet. In 1957, the height of this earthfill dam was increased to 94 feet, giving it a reservoir capacity of 110,000 acre feet.

The initial project in the Multi-Hazards Program has dealt with a Richter magnitude 7.5 earthquake or maximum credible earthquake along the Wasatch Fault in Ogden; a partial or complete failure of the Pineview Dam; the hydrologic event of a maximum credible storm of 10 inches within 6 hours over the 298 square mile watershed draining into Pineview Reservoir; and the risks of hazardous landslides.

As the probabilities are annunciated, as the risks are assessed, and as the impacts are evaluated, the Ogden Area Administrative Review Committee (made up of Weber County/Ogden City officials, memebers of private industry, the banking community, and academic community) will develop and pursue the myriad hazard reduction measures.

The Multi-Hazard Mitigation model will then be applied to other areas which urgently need similar hazard reduction implementations. These areas are: Salt Lake City and Mountain Dell Dam, Provo/Orem communities and Deer Creek Dam, and other specific sites of major populations in Utah.

LIFELINES IN A URBAN POST-EARTHQUAKE ENVIRONMENT

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INTRODUCTION

Lifelines, as used in this paper, refer to those facilities which are required to transport people, things, energy, and information. They are a necessity for a community in a modern industrial society to survive and prosper. They include power, communication, water, sewage, oil, gas, and transportation systems. Many of the lifeline systems have associated with them what are called critical facilities such as dams and gas storage facilities. They are also indispensable elements to other facilities and services that are critical in a disaster setting such as hospitals, fire fighting, and emergency operation centers.

The disruption associated with the loss of any of the lifelines would constitute a disaster in its own right. When this occurs in conjunction with a generally disruptive event such as an earthquake and several lifelines are disrupted concurrently, their loss of function can greatly exacerbate the situation and can seriously compound the loss of life and property.

In this paper the following topic are discussed: characteristics of lifelines; lifeline damage experience and expectations; the relation between disaster preparedness, response, and lifelines; the role of utilities in mitigation and preparedness; assessing societal needs and establishing acceptable risks; translating performance criteria into design specifications. The discussion of the above topics will be in general terms without making qualifications when a specific comment may not be applicable to some of the systems referred to. There also has been an attempt to put the discussion in a context of the situation in Utah. Since earthquake experience has been obtained from other regions, certain aspects of these experiences may not be applicable to the local situation.

CHARACTERISTICS OF LIFELINES RELATED TO EARTHQUAKES

Several characteristics of lifelines are of particular significance when considering the earthquake problem. Most lifelines have a moderate to high degree of redundancy. This has the effect of significantly improving system reliability since the system can experience some damage without effecting system performance.

Lifelines represent a significant part of the total capital investment within a community. Thus, damage to their facilities can have a significant direct economic impact on the community. More important, however, are the secondary effects that the loss of lifeline function can have. Their impact is more keenly felt by the society rather than the utility. While there are numerous anecdotal examples of secondary effects in the post-earthquake environment, little has been done to thoroughly document secondary effects associated with lifeline damage.

LIFELINE DAMAGE EXPERIENCE AND WHAT CAN BE EXPECTED

The discussion of lifeline damage from past earthquakes must start by noting that no major metropolitan area of a modern industrial society has been subjected to a great earthquake since that advent of modern lifeline systems. Given this limitation, the experience to date has shown that system performance has generally been good. However, there are numerous examples of specific facilities being severely damaged by both moderate and strong seismic excitations. This suggests that a great earthquake could damage enough facilities so that system performance would be unacceptable and a bad situation could be made significantly worse as a result of the poor performance of lifelines.

EARTHQUAKE DISASTER RESPONSE AND LIFELINES

Several lifelines play a crucial role during the disaster response phase following a earthquake. Effective communications is probably the most important factor that will determine how disaster response works. As the telephone system can become saturated with calls for even a small earthquake, dependence on this vital function for emergency response is highly risky.

Power systems are also of particular importance since so many things in the community is dependent on power. Unfortunately, power systems have been proved to be very vulnerable to earthquake damage.

The lack of warning, the rapid onset, the creation of numerous large impact secondary hazards, and the fact that most lifelines are adversely effected by earthquakes creates a negative synergism that makes coping with earthquakes much worse that most other disasters. Utilities often respond to disasters that befall them, however, the unique way in which earthquakes effect utilities and the lack of experience in dealing with them highlights the need for disaster mitigation and preparedness.

THE ROLE OF UTILITIES IN EARTHQUAKE MITIGATION AND PREPAREDEDNESS

Because the physical plant of most utilities is so large, any wholesale effort to implement massive mitigations measures will be beyond the resources of most utilities and the communities that they serve. Since the cost of mitigation is low for new construction, sound earthquake practice should be exercised for new facilities.

Experience has shown that in regions of low seismic awareness, utility personnel often under estimate the vulnerability of their systems to earthquakes. Thus, it is important to not only get the attention of utilities that there is earthquake risk, but to make sure that the required expertise is brought in to assess the risk. It should be noted that most utilities do not use formal cost-benefit analysis in determining what mitigation measures should be implemented. As secondary effects primarily impact the society and they are difficult to quantify they play little if any role in the decision process. This suggests the need for a public policy that will address societal needs.

As noted earlier, utilities deal with disasters on a regular basis. Even for an earthquake standard response plans will be activated and will attack the problem. Utilities will normally prioritize critical facilities and attempts to restore service to the most customers in the shortest time. In the post earthquake environment this practice may not be the best from the community perspective so that it is vital that major utilities have a representative familiar with utility operations present at emergency operation centers so that they can be informed of the communities needs and these can be transmitted to the utility in an appropriate manner.

ACCEPTABLE RISK AND SOCIETAL NEEDS

At the present time, where earthquakes are given any consideration, the approach is to use sound installation practices and have equipment meet seismic specifications. System response is given little consideration as it is both difficult and costly to assess. Thus, to the extent that societal needs are addressed, they are a byproduct not a direct objective. Of course, it is inappropriate for societal needs to be specified by engineers in utilities. What is needed is for public officials with the assistance of emergency planners and utility personnel to establish levels of acceptable risks keeping in mind that it is probably not prudent or possible to have a disruption free system. If acceptable risk can be stated in terms of performance criteria, such as the duration and extent of disruption, then meeting the requirements can be left to the engineers to meet. It should be emphasized that the detailed, highly technical decisions are best left to utility personnel.

TRANSLATING PERFORMANCE CRITERIA IN TO DESIGN SPECIFICATIONS

Because of the complexity introduced by system redundance and the difficulty in designing some equipment to withstand earthquakes, the problem of translating performance criteria into system and equipment specifications is still an unsolved problem. Given the mandate and public support there is little doubt that utilities will continue to meet societies needs.

WHERE DO THINGS STAND AND WHAT SHOULD BE DONE

The items discussed below while closely related to lifelines also form part of the general approach to earthquake mitigation and preparedness.

1. A clear signal should be given by government that it recognizes earthquakes as a hazard to the community and that earthquake effects should be an integral part of lifeline plans, construction, and operations.

2. An earthquake scenario should be developed which is based on a uniform description of a specific earthquake. The description should consist of seismic hazard maps showing intensity, ground shaking parameters, and soil stability. It should be emphasised that this material is to only be used for initial emergency planning purposes so that accuracy is not as crucial were they to be used for administrative purposes.

   The description of the seismic environment that is developed would then be distributed to each concerned organization so that it can estimate how it will perform. For lifelines these estimates would include the extent and duration of disruption and the assumptions as to the availability of other lifelines and emergency services used in developing the scenario. Two types of estimates should be provided; a) a centered best estimate of the system response, and b) a reasonable worse case situation. This should be an iterative process which incorporates external expert review at some point. This scenario provides the basis for implementing lifeline mitigation and preparedness measures and community emergency response planning.

3. Emergency governments at various levels should develop their own response plans which should include lines of communications (both organizational and physical) to community lifelines.

This provides some initial steps in the process of addressing the problems of earthquake mitigation and planning as they relate to lifelines.

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Mission

Foster Interdisciplinary Hazards Research

Objectives

Provide Interdisciplinary Research Capabilities
Coordinate a Comprehensive Hazards Research and Mitigation Program

Components

Geologic Hazards
- Earthquakes
- Landslides and Mudflows
- Avalanches and Rock Falls
- Rising Lakes and Ground Water
- Poor Foundation Materials
- Collapse
- Volcanic Eruption

Environmental Hazards
- Ground Water Pollution
- Atmospheric Pollution
- Weather and Climate
- Urban Development
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Mission

Foster Interdisciplinary Hazards Research

Objectives

Provide Interdisciplinary Research Capabilities
Coordinate a Comprehensive Hazards Research and Mitigation Program

Components

Geologic Hazards
- Earthquakes
- Landslides and Mudflows
- Avalanches and Rock Falls
- Rising Lakes and Ground Water
- Poor Foundation Materials
- Collapse
- Volcanic Eruption

Environmental Hazards
- Ground Water Pollution
- Atmospheric Pollution
- Weather and Climate
- Urban Development
- Dam Failures
- Waste Disposal
- Mine Tailings and Dumps
- Flooding

Socioeconomic Considerations
- Hazards Mitigation
- Federal, State and Local Regulations
- Public Awareness and Education

Participants

University of Utah Research Institute
Universities and Colleges in Utah
State Agencies
Industry and Utilities

Cooperating Agencies

Federal Emergency Management Agency
Environmental Protection Agency
U. S. Geological Survey
Bureau of Land Management
Bureau of Reclamation
Bureau of Mines
U.S. Forest Service
Soil Conservation Service
Department of Energy
Department of Defense
National Science Foundation
National Oceanic and Atmospheric Administration
U.S. Weather Bureau
National Aeronautics and Space Administration

UNIVERSITY OF UTAH RESEARCH INSTITUTE
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TELEPHONE 801-524-3422

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Jim Ehleringer 7623 18 June 85
136 Biology

Utah State - Ecology Center - state line item.
ecosystem research
strip mining, water ecology, revegetation

- plant ecologist / environ interactions -
- plant response to stresses
- water stress
- stable isotopes under water stress -
- works of native pl...
- year in Germany -
- response to acid rain

- to China fall 22

- wants brochure un...

USU - Biology Dept.
Neal Van Alfen
Plant pathologist / biochemist.
Has contact for
K environ. monitoring.

DRI - Hess -
702-798-8882 Reno

- are setting up stable isotope lab
will have excess capacity
no S : C, H, N, O

1. Lawsuit

2. ~~Hazards~~ Institute
   (a) Friday, 21 June meeting USU ←
   (b) Visit to Ada, OK
   (c) Water Research Foundation

3. Contract Negotiations
   This week

4. JPTA program

Biology Jim Erlinger → 8^{30} 5 Biology 135
Med Center Ed Renn → Turn off Unseen –
Wren 5 Biology

THE
UNIVERSITY
OF UTAH

CHASE N. PETERSON
PRESIDENT

203 PARK BUILDING
SALT LAKE CITY, UTAH 84112
801-581-5701

June 13, 1985

MEMORANDUM

TO: VICE PRESIDENTS, DEANS AND DIRECTORS

FROM: Chase N. Peterson

SUBJECT: Budget Process

The timing on decisions for 1985-86 allocations and on requests for 1986-87 has been a problem for many of you. I want to apologize for delays on the part of the central administration and for the fact that many detailed budgets were sent out prior to what should have been accompanying vice presidential letters of explanation, to offer some note of explanation, and to outline in a very preliminary way steps I propose to correct the situation.

The legislature left an unusually large number of high priority program needs unfunded this year. These programs ranged from the University Writing Program to several Nursing programs to the American Indian Services Training Program. We had the difficult task of determining which of these important programs to continue funding on a temporary basis, finding the funds to sustain them at some minimal level, and at the same time finding funds for other serious areas neglected by the legislature.

Each of you is to be commended for your diligent and timely efforts in submitting the necessary budget materials. The delays encountered arose from the above issues, from other pressing matters in my office, and from some salary and job classification analyses that resulted in my recent letter on selected salary increase caps.

Traditionally we have delayed the preparation and submission of budget requests for the next fiscal year until such time as final budget allocations for the immediate fiscal year have been made. In some years, and this year is a good case in point, this has resulted in deadlines that preclude thoughtful planning and consultation. Next year, I propose we do two things to correct this problem. First, we in the central administration will make budget decisions on a more timely basis. Second, budget requests for the 1987-88 fiscal year will be made in advance of 1986-87 fiscal year final allocations. Any amendments to the requests occasioned by these final allocations can be made in a fine tuning effort rather than in building anew.

I appreciate your patience and understanding of these matters. I would also welcome, either directly or through Leon Robertson or Tony Morgan, suggestions you may have that would improve this important process.

Chase Peterson

RESEARCH INSTITUTE
DIRECTOR
391 CHIPETA WAY 99101
4-13

Curriculum Vitae May, 1985

Biographical Data
on
James R. Ehleringer

Address: Department of Biology
University of Utah
Salt Lake City, Utah 84112

Phone Number: 801-581-7623 Social Security Number: 553-80-6483
Date and Place of Birth: 2 July 1949, Portland, Oregon
Marital Status: Married, 2 children

Areas of Interest: plant ecology and ecophysiology, mechanisms of adaptation in plants to contrasting environments, photosynthesis, plant productivity, leaf energy balance, and water relations.

Education:

B. S.	San Diego State University	June, 1972
M. S.	San Diego State University	June, 1973
Ph.D.	Stanford University	September, 1977

Honors and Distinctions:

Alexander von Humboldt Fellowship, 1984; Murray Buell Award, Ecological Society of America, 1978; NSF National Needs Postdoctoral Fellowship, 1977; Carnegie Predoctoral Fellow, Carnegie Institution of Washington, Department of Plant Biology, Stanford, 1974-1977; Achievement Rewards for College Scientists (ARCS) Scholarship, 1974; Outstanding Graduating Senior, College of Sciences, San Diego State Univ., 1971; Golden Scholarship, San Diego State University, 1969-1971; Systems Ecology Program (Ford Foundation), San Diego State University, 1969-1973.

Academic Positions:

1984-date Professor, Department of Biology, University of Utah.
1980-1984 Associate Professor, Department of Biology, University of Utah.
1977-1980 Assistant Professor, Department of Biology, University of Utah.

Professional Service

Editorial Board, Oecologia, 1982-date
Awards Committee, Botanical Society of America, 1982-1983
Photosynthesis Panel, USDA-CRGO, 1983
Physiological Ecology and Population Biology Panel, NSF, 1983-date
Co-organizer, NSF Workshop on Future Needs in Physiological Ecology, 1984

Field Experience:

Chaparral ecosystems of California and Chile
Alpine tundra ecosystems of Colorado
Mangrove ecosystems of Florida and Mexico
Desert ecosystems of Arizona, California, Nevada, Utah, Australia, Chile, Mexico and Peru
Tropical ecosystems of Costa Rica and People's Republic of China
Montane ecosystems of Utah
Agricultural systems - amaranth, cotton, sunflower

Membership:

Agronomy Society of America
American Association for Advancement of Science
American Institute of Biological Scientists
American Society of Plant Physiologists
Botanical Society of America
British Ecological Society
California Botanical Society
Crop Science Society of America
Ecological Society of America

Publications (last five years):

29. Ehleringer, J. 1980. Leaf morphology and reflectance in relation to water and temperature stress, pp. 295-308. In N. Turner and P. Kramer (eds.), Adaptations of Plants to Water and High Temperature Stress. Wiley-Interscience, New York.

30. Mooney, H. A., S. L. Gulmon, P. Rundel, and J. Ehleringer. 1980. Further observations on the water relations of *Prosopis tamarugo* of the northern Atacama Desert. Oecologia 44:177-180.

31. Forseth, I., and J. Ehleringer. 1980. Solar tracking response to drought in a desert annual. Oecologia 44:159-163.

32. Ehleringer, J., H. A. Mooney, S. L. Gulmon, and P. Rundel. 1980. Orientation and its consequences for *Copiapoa* (Cactaceae) in the Atacama Desert. Oecologia 46:63-67.

33. Mooney, H. A., S. L. Gulmon, J. Ehleringer, and P. Rundel. 1980. Atmospheric water uptake by an Atacama Desert shrub. Science 209:693-694.

34. Rundel, P., J. Ehleringer, H. A. Mooney, and S. L. Gulmon. 1980. Patterns of drought response in leaf-succulent shrubs of the coastal Atacama Desert in northern Chile. Oecologia 46:196-200.

35. Ehleringer, J., and C. S. Cook. 1980. Measurements of photosynthesis in the field: utility of the CO_2 depletion technique. Plant Cell Environ. 3:479-482.

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38. Ehleringer, J. 1981. Leaf absorptances of Mohave and Sonoran Desert plants. Oecologia 49:366-370.

39. Ehleringer, J. 1982. The influence of water stress and temperature on leaf pubescence development in Encelia farinosa. Amer. J. Bot. 69:670-675.

40. Forseth, I., and J. Ehleringer. 1982. Ecophysiology of two solar tracking desert winter annuals. I. Photosynthetic acclimation to growth temperature. Austr. J. Plant. Physiol. 9:321-332.

41. Forseth, I. N., and J. Ehleringer. 1982. Ecophysiology of two solar tracking desert winter annuals. II. Leaf movements, water relations, and microclimate. Oecologia 54:41-49.

42. Lin, Z. F., and J. Ehleringer. 1982. Studies of photosynthesis in papaya. I. The effects of light, temperature, water vapor pressure deficit and carbon dioxide. Acta Phytophysiol. Sinica 8:363-372.

43. Lin, Z. F., and J. Ehleringer. 1982. Studies of the effects of leaf age on photosynthesis and water use efficiency of papaya. Photosynthetica 16:514-519.

44. Lin, Z. F., and J. Ehleringer. 1982. Changes in spectral properties of leaves as related to chlorophyll and age in papaya. Photosynthetica 16:520-525.

45. Mooney, H. A., J. Berry, O. Björkman, and J. Ehleringer. 1982. Comparative photosynthetic characteristics of coastal and desert plants of California. Bol. Soc. Bot. Mex. 42:19-33.

46. Ehleringer, J. 1983. Ecophysiology of Amaranthus palmeri, a Sonoran Desert summer annual. Oecologia 57:107-112.

47. Ehleringer, J. 1983. Characterization of a glabrate Encelia farinosa mutant: morphology, ecophysiology, and field observations. Oecologia 57:303-310.

48. Forseth, I. N., and J. Ehleringer. 1983. Ecophysiology of two solar tracking desert winter annuals. III. Gas exchange responses to light, CO_2, and VPD in relation to long term drought. Oecologia 57:340-351.

49. Werk, K. S., and J. Ehleringer. 1983. Photosynthesis by flowers of two shrubs Encelia farinosa and Encelia californica. Oecologia 57:311-315.

50. Forseth, I. N., and J. Ehleringer. 1983. Ecophysiology of two solar tracking desert winter annuals. IV. Effects of leaf orientation on calculated daily carbon gain and water use efficiency. Oecologia 58:10-18.

51. Lin, Z. F., and J. Ehleringer. 1983. Photosynthetic characteristics of Amaranthus tricolor, a tropical leafy vegetable. Photosynthetic Res. 4:171-178.

52. Ehleringer, J., and H. A. Mooney. 1983. Photosynthesis and productivity of desert and Mediterranean climate plants. Encyclopedia of Plant Physiology (New Series) Vol. 12D:205-231, Springer-Verlag, New York.

53. Werk, K. S., J. Ehleringer, I. N. Forseth, and C. S. Cook. 1983. Photosynthetic characteristics of Sonoran Desert winter annuals. Oecologia 59:101-105.

54. Lin, Z. F., and J. Ehleringer. 1983. Epidermal effects on spectral properties of leaves of four herbaceous species. Physiol. Plant. 59:91-94.

55. Ehleringer, J., and R. W. Pearcy. 1983. Variation in quantum yields for CO_2 uptake in C_3 and C_4 plants. Plant Physiol. 73:555-559.

56. Ehleringer, J. 1984. Ecology and ecophysiology of leaf pubescence in North American desert plants, p. 113-132. In E. Rodriguez, P. Healey, and I. Mehta (eds.), Biology and Chemistry of Plant Trichomes. Plenum Press, New York.

57. Pearcy, R. W., and J. Ehleringer. 1984. Ecophysiology of C_3 and C_4 plants. Plant Cell Environ. 7:1-13.

58. Comstock, J., and J. Ehleringer. 1984. Photosynthetic responses to slowly decreasing leaf water potentials in Encelia frutescens. Oecologia 61:241-248.

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60. Ehleringer, J., and D. House. 1984. Orientation and slope preference in barrel cactus (Ferocactus acanthodes) at its northern distribution limit. Great Basin Naturalist 44:133-139.

61. Ehleringer, J., and C. S. Cook. 1984. Photosynthesis in Encelia farinosa Gray in response to decreasing leaf water potential. Plant Physiol. 75:688-693.

62. Ehleringer, J. 1984. Intraspecific competitive effects on water relations, growth, and reproduction in Encelia farinosa. Oecologia 63:153-158.

63. Forseth, I. N., J. Ehleringer, K. S. Werk, and C. S. Cook. 1984. Field water relations of Sonoran Desert annuals. Ecology 65:1436-1444.

64. Schulze, E.-D., and J. Ehleringer. 1984. The effect of nitrogen supply on growth and water use efficiency of xylem mistletoes. Planta 162:268-275.

65. Ehleringer, J. 1985. Comparative microclimatology and plant responses in Encelia species from contrasting habitats. J. Arid Environ. 8:45-56.

66. Ehleringer, J. 1985. Adaptations of annuals and perennials to warm deserts, p. 162-180. In B. Chabot and H. A. Mooney (eds.), Physiological Ecology of North American Plant Communities. Chapman and Hall Ltd., London.

67. Ehleringer, J., and E.-D. Schulze. 1985. Mineral concentrations in an autoparasitic Phoradendron californicum growing on a parasitic P. californicum and its host, Cercidium floridum. Amer. J. Bot. 72:568-571.

68. Ehleringer, J., E.-D. Schulze, H. Ziegler, O. L. Lange, G. D. Farquhar, and I. R. Cowan. 1985. Xylem mistletoes: water or nutrient parasites? Science 227:1479-1481.

Manuscripts in Press or in Review:

Ehleringer, J., and K. S. Werk. Modifications of solar radiation absorption patterns and the implications for carbon gain at the leaf level. In T. Givnish (ed.), On the Economy of Plant Form and Function. Cambridge Univ. Press, London (in press).

Ehleringer, J., and S. D. Hammond. Solar tracking and photosynthesis in cotton leaves. Crop Science (in review).

Werk, K. S., and J. Ehleringer. Photosynthetic characteristics of Lactuca serriola L. Plant Cell Environ. (in press).

Comstock, J., and J. Ehleringer. Canopy dynamics and carbon gain in response to soil water availability in Encelia frutescens Gray, a drought-deciduous shrub. Oecologia (in review).

Ullman, I., O. L. Lange, H. Ziegler, J. R. Ehleringer, E.-D. Schulze, and I. R. Cowan. Diurnal courses of leaf conductance and transpiration of mistletoes and their hosts in central Australia. Oecologia (in review).

Comstock, J., and J. R. Ehleringer. Photoperiod and photosynthetic capacity in Lotus scoparius Nutt., a Mediterranean climate drought-deciduous shrub. Science (in review).

Ehleringer, J. R., C. S. Cook, and L. L. Tieszen. Comparative water use and nitrogen relationships in a mistletoe and its host. Oecologia (to be submitted 6/85).

THE
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VICE PRESIDENT
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4 September 1984

Refer to: 84-378

Ms. Kris Iverson
Office of Senator Orrin G. Hatch
135 Russell Senate Office Building
Washington, D.C. 20510

Dear Ms. ~~Iverson~~: Kris

Here is the description of our proposed Geologic and Environmental Hazards Research Center I spoke to you about. Since the activities encompass responsibilities of several agencies, we wonder how best to proceed, and if a $1.5M two-year initial budget is appropriate.

Sincerely,

Jim

James J. Brophy
Vice President for Research

JJB:mh

Attachment

bcc: R. J. Snow
~~P.~~ M. Wright
S. H. Ward

GEOLOGIC AND ENVIRONMENTAL HAZARDS RESEARCH CENTER

Summary

During 1983 and 1984, a number of natural events occurred in Utah and elsewhere in the West that have focused attention on the substantial destructive power of geologic hazards. These events included among others, the large Thistle landslide, which severed a railway and main highway and caused an estimated $200 million in economic loss, and the dramatic rise of the Great Salt Lake, which has caused tens of millions of dollars in flood damage. Attention has also been called to a number of hazards resulting from man-caused pollution of the environment. One of the largest problems is the contamination by hydrocarbons of shallow groundwaters in the vicinity of the refinery complex at North Salt Lake.

There is a clear need for applied research and development of technologies to monitor, predict and mitigate a wide range of geologic and environmental hazards. The University of Utah Research Institute is proposing to coordinate such efforts in Utah by forming a Geologic and Environmental Hazards Research Center. The Center would initiate a program of applied research and technology development using the large array of talent available in the State's universities and colleges, state agencies and private industry. The Center would also include a capability to evaluate the social aspects of hazards, and to implement measures to ensure preparedness. Once established, the Center would attract both federal and state funds.

Hazards in Utah

Precipitation in Utah during the past two years has broken records. It has directly caused floods, rise in lake levels and has triggered landslides and mud flows. Moreover, the geologic record makes it clear that such phenomena have occurred regularly in the past. Former shorelines of the Great Salt Lake have been identified that are nearly 10 feet above the present lake level, and we know that the level of the Great Salt Lake was nearly what it is now in the late 1800s. Scars of landslides, both large and small, are to be seen in all of Utah's mountains and foothills. Some historic slides, including the Manti slide of the mid-1970s, have occurred in dry years.

A potential natural hazard with perhaps the most capability for destruction and death in Utah would be a major earthquake. The Wasatch Front, where the majority of Utah's population is located, is a known area of historic and prehistoric faulting and earthquakes. Evidence from large fault scarps indicates that some of the prehistoric earthquakes were very large and probably as destructive as the 1906 San Francisco earthquake. A major earthquake would cause collapse of buildings, disruption of electrical, gas, telephone and water supplies and could initiate failure in one or more of the dams in the canyons above large population centers in Utah.

These and other geologic hazards have been identified in the Governor's Conference on Geologic Hazards (Circular 74, Utah Geological and Mineral Survey, 1983), a report on a conference brought together by the UGMS and the Division of Comprehensive Emergency Management. This report makes recommendations of technical and social scope to deal with geologic hazards. It correctly identifies the broad range of talents that will require coordination in order for a hazards mitigation program to be successfully implemented in Utah.

Environmental hazards, both natural and man-caused in nature, also exist in Utah. Each year storms cause damage from flash flooding, hail and lightning. There is considerable potential for health problems from the temperature inversions that trap stagnant air in many of the populated valleys along the Wasatch Front during winter months. Man-caused hazards include the apparently substantial groundwater pollution problem in the vicinity of the petroleum refinery complex at North Salt Lake. We understand that the EPA has identified this site as one of the top priority areas in the U.S. for clean-up. Other pollution problems include uranium tailings and mine waste in southern and western Utah, and pollution of rivers and lakes from agricultural activity as well as acid rainfall apparently resulting from burning of coal.

State of the Art

Awareness of the magnitude of hazards has grown rapidly over the past several years. At the present time, there are no reliable methods for predicting landsliding, earthquakes, dam failures, extended periods of polluted air due to temperature inversions, or many other natural hazards. Technology to map and monitor movement of groundwater pollution is primitive and expensive to apply over broad areas. In addition, there has been little development of laws, regulations and codes to ensure preparation or mitigation of effects of hazards. There appears to be a substantial information gap, that is, education of the public in hazards potential and methods of preparedness is highly inadequate. Although most people would profess to believe that preparing for hazards can save a great deal of money over simply dealing with them after they occur, there has been little actual preparation. State legislators always find it difficult to recommend expenditure of funds for preparedness for an event that may not happen for years.

In short, we lack techniques to assess and mitigate most hazards and we lack the public awareness necessary to implement measures to prepare for the potentially disasterous effects. Much needs to be done.

Concept for the Center

The University of Utah Research Institute proposes to form a Geologic and Environmental Hazards Research Center within the Institute. We would organize and make use of the substantial capability for research, technology development and implementation of mitigation measures for the broad range of hazards that exist in Utah. We would formulate and coordinate a comprehensive program to assess hazards in Utah and would initiate work on the highest priority hazards in terms of potential destruction, economic disruption and/or loss of life. We would work closely with existing Utah state agencies in helping to prioritize activities in the Center and in implementation of results. We would also work closely with Federal agencies doing hazards work such as the U.S. Geological Survey, the Federal Emergency Management Agency and the Environmental Protection Agency.

Assessment and mitigation of both man-induced and natural geologic and environmental hazards require an interdisciplinary effort. A broad range of scientific and engineering studies will be required. Of equal importance will be studies of the social consequences of hazards and mitigation measures, and appropriate means to implement programs to deal with preparedness and emergency measures. Obviously, there must be close coordination between the Center and federal agencies performing pertinent scientific work on the one hand, and between the Center and Utah state agencies charged with administering programs of hazards mitigation, preparedness and emergency management on the other hand.

Utah has a valuable pool of talent available in its several universities and colleges, state agencies and private industry to perform a great deal of the needed scientific, engineering and socio-political studies that are needed. What is lacking is coordination of this talent. No single state agency has a coordination mandate, and, further, state agencies such as the Utah Geological and Mineral Survey and the Division of Comprehensive Emergency Management have no research or technology development functions. The result in Utah has been that such federal agencies as the U.S. Geological Survey and the Environmental Protection Agency have been left with the technology development functions. Although these federal agencies have individual programs covering certain hazards, there is no coordinated program on hazards. Furthermore, when they work in Utah, they tend to bring in staff from their central facilities outside the state as well as outside contractors to supplement their staffs. The result is that little of the experience developed by such federal programs remains in Utah and few of the funds remain in the state. We believe that a hazards research center in Utah would be capable of attracting talent as well as funds, and that more of the experience could remain in Utah as the programs progressed, giving Utah a future capability to deal with its hazards problems.

Initial Projects

We propose to initiate the following projects to begin work at the Center:

Multi-Hazards Assessment. There has been no effort in Utah to assess the broad range of hazards that affect a given geographic area. What little assessment done has been mainly to assess an individual hazard wherever it might occur. Yet Utah's population concentration along the Wasatch Front together with the identification of this area as having many recognized potential hazards indicates that a multi-hazards assessment in this identified geographic area is needed. For instance, larger losses of life and property in an earthquake may result from dam failure and subsequent flooding than from the quake itself. As the initial step, this study would be a broad, reconnaissance identification of hazards, which would then be prioritized for further, more detailed work.

Earthquake Hazards. The U.S. Geological Survey has identified the Wasatch Front in Utah as the highest priority area in the U.S. for a 3-year program to investigate earthquake potential and estimate damage and loss in the event of a major earthquake. We would seek to obtain funding from this program to supplement funds requested herein to carry out geological and geophysical work along the Wasatch Front.

Landslide Hazards. During the winter of 1983-84, the University of Utah and the University of Utah Research Institute designed, built and installed a landslide monitoring system in Rudd Canyon, near Farmington, and in Reynolds Gulch in Big Cottonwood Canyon. We worked closely with the Utah Geological and Mineral Survey and the Division of Comprehensive Emergency Management on this project. Alarms sounded in the Davis County Sheriff's office, where the Rudd Canyon monitoring signals were telemetered, warned of the major debris flow that occurred there on May 16, 1983. This highly successful monitoring and alarm system needs to be improved and deployed more widely on known slide areas in Utah. We would work with UGMS and CEM to do this.

North Salt Lake Groundwater Pollution. We propose to begin work with the EPA to assess the extent of the pollution problem near the refineries and to develop techniques to either remove or stablize the pollutants.

Program Coordination. We would build the infrastructure needed to carry out multi-hazards research and mitigation. Specifically we would assess the talent available in Utah in academia, government and industry. We would initiate contacts with federal and state agencies to ensure input of pertinent information and dissemination of results. The result would be an infrastructure to carry out research and disseminate results.

Budget

We anticipate that the Geologic and Environmental Research Center could be established and become self-supporting in two years. We require funds for the first two years as follows:

Two-Year Budget

	$K
Multi-Hazards Assessment	425
Earthquake Hazards	150
Landslide Hazards	450
North Salt Lake Groundwater Pollution	125
Program Coordination	300
	$1,450K

General Statement About the University of Utah Research Institute. The University of Utah Research Institute (UURI) is a self-supporting corporation organized in December 1972 under the Utah Non-Profit Corporation Association Act. It is owned by the University of Utah, and its President is James J. Bropohy, who is Vice-President for Research of the University of Utah. Under its charter the Institute is separate in its operations and receives no financial support from either the University of Utah or the State of Utah. The charter includes provisions for UURI to conduct both public and proprietary scientific work for governmental agencies, academic institutions, private industry, and individuals. In this work UURI has a close technical association with the University and is able to draw upon the talents of faculty and students. When such activities are proprietary UURI may be taxed on income as determined by IRS codes.

UURI is composed of three laboratories:

The Earth Science Laboratory
The Center for Remote Sensing and Cartography
The Environmental Studies Laboratory

The staff is a balanced group of scientists including 9 Ph.D, 7 M.S., 10 B.S., and 17 Support personnel. Current contract volume is about $3 million per year. UURI occupies laboratory and office space in Research Park, adjacent to the University of Utah campus.

Wright

GEOSCIENCES

I. Introduction

The Geosciences Division supports research in the atmospheric and terrestrial sciences, that is, the physical sciences of planet earth excluding ocean media. The continental environments involved cover the entire range from polar to mid-latitude to tropical and the spectrum of natural and man-modified surfaces, perpetual snow or ice, tundra, deserts, rivers and lakes, forests, etc., and under all weather conditions, favorable and adverse, clean air and polluted air. The atmospheric sciences and terrestrial sciences are by nature highly interdisciplinary. Atmospheric and terrestrial problems that are of concern to the Army have increasing need for attack by interdisciplinary research teams. For more specific information on the program of the Geosciences Division, contact Dr. Walter A. Flood (atmospheric sciences) or Dr. Steven J. Mock (terrestrial sciences).

II. Terrestrial Sciences

The terrestrial sciences program addresses Army problems arising from the variable characteristics of the terrain. This is admittedly an extremely broad and diverse subject area ranging as it does from seismic propagation in soils to techniques for automated mapping. Three major research categories or thrust areas are delineated with examples of major problems.

1. Properties of Earth Materials

a. Soil and rock mechanics and dynamics (including snow and ice): This is an area of extreme importance to all phases of military construction from expedient field fortification to permanent facilities. Of particular interest are:

(1) Constitutive relationships under static and dynamic loading including 2- and 3-phase systems.

(2) Methods for testing and measuring properties in situ.

(3) Relationships between laboratory measured properties and those in situ.

(4) Stress wave propagation in unconsolidated, anisotropic media.

b. Novel techniques and instrumentation: Remote (non-contact) and emplanted sensors or systems which can measure properties in-situ are highly desirable. Particularly of interest are methods for determining the complex dielectric constant as a function of depth in the near surface (down to 100 meters), for detecting small scale anomalies, such as tunnels or caverns and for measurement of seismic and electromagnetic anisotropy.

2. Earth-Fluid Dynamic Processes

A continuous dynamic interaction between solid earth materials and the most abundant fluids, water and air, takes place at the earth surface and below the surface. Military problems arising from these processes include localized flooding on the battlefield, wave and tidal action on amphibious operations and port and harbor installations, natural or battlefield-induced dust as a function of soil properties and vehicle-induced susceptibility to erosion of terrain. Specific areas of interest include:

a. Soil Moisture: Questions remain as to whether the physics of time-dependent water movement in soils having sporadic surface inputs is well enough understood to successfully develop adequate soil moisture predictive models. Research is desired in the following areas:

(1) Experimental and theoretical studies of time-dependent vertical movement of moisture with variable inputs.

(2) Methods to measure/monitor soil moisture (a) by remote means, (b) with emplanted sensors or (c) combinations to these.

(3) Spatial variation in soil moisture as a function of terrain, soil types and microclimate.

b. Rainfall-Runoff Modelling: Streamflow modelling has reached an advanced state in civilian use for flood forecasting and routing. The military addresses a more difficult problem, namely forecasting runoff in small to medium sized ungaged basins. Specific research areas are:

(1) Parameterization of stage frequency as a function of basin characteristic and antecedent conditions.

(2) Adaptive hydrologic models for sparse data areas; i.e., which of the available hydrologic models are best used in areas having variable topography, vegetation and amounts of data.

3. Remote Sensing and Mapping

Research interests in these areas of the terrestrial sciences include:

a. Novel concepts and techniques for remote measurements and interpretation of surface and subsurface properties and anomalies.

b. Theoretical and experimental studies leading to terrain modelling, sensor modelling and feature signatures in frequencies from microwave to ultraviolet in relation to feature extraction, reference scene generation and simulation.

c. Image (and other) sensor interpretation and processing research directed toward automation of the mapping processes from image acquisition to data base preparation, map and other terrain display products.

III. Atmospheric Sciences

The atmospheric sciences program is subdivided into four major research categories: (1) Atmospheric Effects on Propagation, (2) Atmospheric Sensing and Probing, (3) Small Scale Atmospheric Processes and (4) Aerosol Research.

1. Atmospheric Effects on Propagation

Active and passive electromagnetic systems operating at wavelengths ranging from the centimeter through the ultra-violet as well as acoustic systems are performance limited by weather and battlefield conditions. Examples of propagation effects of interest to this Division include absorption by gasses, absorption and scattering by natural and battlefield aerosols and as a consequence of adverse weather, turbulence and battlefield turbidity, the degradation of the mutual coherence function and the contrast of images and targets.

The effects of realistic atmospheres and realistic terrain on the long range propagation of sound waves is another area of interest to this office. Modelling efforts, backed up by complete path characterization, are required to predict, with high accuracy, among other things, noise level contours around Army training centers.

Whether investigating EO system performance or acoustic wave propagation, it should be clear that experiments should be accompanied by extensive micro-meteorological measurements as well as a complete description of the particulates suspended along the propagation path. Furthermore, the relationship among the micro-meteorological parameters, the larger mesoscale weather conditions and the local terrain features should be established.

Research is also required in the reflection/scatter and backscatter from vegetation and snow-covered terrain at near millimeter wavelengths (0.85 to 3.2 millimeters). Particular attention should be paid to the physical consequences of the small antenna "footprint" and its effects on the statistics of the forward scattered and backscattered return; the effects of antenna polarization should be carefully investigated.

2. Atmospheric Sensing and Probing

Potentials exist for advances in remote and in situ atmospheric sensing and probing, for real-time surveillance of atmospheric conditions and parameters. There are indications that this can be accomplished economically, and with spatial and temporal resolution and precision not attainable with traditional techniques. Further development of these techniques applicable to problems in the preceding thrust areas is needed. Of special interest are:

a. Techniques for remotely measuring the optical properties of the atmosphere including natural and man-made aerosols.

b. Techniques for automated, remote measurement of meteorological parameters; e.g., precipitation, temperature, humidity, cloud height, horizontal and slant range visibility, pressure, wind, windshear and turbulence.

c. Techniques for remote and real time sensing of chemical and biological agents in the atmosphere.

3. Small Scale Atmospheric Processes

Primary interests in the meteorology of small scales of space and time are in developing techniques and mesoscale models of the atmosphere for depiction and prediction of meteorological conditions over the battlefield. Research efforts will be concentrated on:

a. Processes controlling formation and dissipation of fogs, clouds and precipitation.

b. Terrain effects on the planetary boundary layer and meteorological conditions.

c. Horizontal, slant and vertical variability of atmospheric elements.

d. Models capable of predicting transport, diffusion, scavenging and interaction of natural; e.g., dust and smoke, and man-made materials (including chemical and biological agents) released into the atmosphere in complex terrains and/or under adverse weather conditions.

4. Aerosol Research

The Army requires increased knowledge of the atmosphere as an aerosol system: characteristics of the aerosols, their involvement in meteorological processes and the effects of natural and manmade aerosols on visibility, obscuration and the transmission of electromagnetic energy. Research will emphasize:

a. New concepts for determining, analyzing and characterizing natural and man-made solid and liquid particles in the atmosphere including the origin, size, concentration, shape, orientation, composition, source and sinks, frequency of occurrence, temporal and spatial variations and deposition and scavenging.

b. Processes of formation, growth and dissipation of natural (fog, cloud, precipitation) and man-made aerosols (smoke, dust).

c. Improved methods for characterizing the aerosol environment of the battlefield.

15. EARTHQUAKE HAZARD RESEARCH NEEDS AND DISSEMINATION OF INFORMATION

Chairperson: Walter Arabasz, University of Utah Seismograph Stations

Topic a: Centralized earthquake information source and dissemination program

Problem: Some mechanism is needed to provide a centralized source of information relating to earthquake hazards in Utah and to facilitate the dissemination of results of on-going earthquake hazard research. The general public needs a readily identifiable source of information and assistance. Further, a host of technical users need the assistance of a modern information/resource office - particularly for access to up-to-date information not readily available in standard libraries.

Action: An information/resource office (distinct from a publication sales office) should be established within State government and operated by an information specialist (the Utah Geological and Mineral Survey appears to be a logical agency). Functions should include: (1) aggressive acquisition and library maintenance of at least one file copy of publications, reports, newsclippings, newletters, etc. relevant to earthquake hazards in Utah and bordering regions; (2) on-site availability of library materials and photo-copying service to meet needs of out-of-town users; (3) provision of reference services to meet telephone and on-site requests; (4) establishment of computerized data base to facilitate information retrieval of holdings; (5) interaction with diverse researchers and officials to provide informed assistance, in their stead, to general public.

Res Org: Governor for action by his office or a State agency

Cost: $35,000 to $40,000 per year.

Topic b: Detailed mapping and studies

Problem: There is a need for detailed mapping and studies of: (1) the Wasatch fault; (2) other active faults throughout the State; (3) liquefaction potential; (4) engineering properties and 3-D distribution of foundation materials; and (5) site response.

Action: Establish a State seismic risk assessment program to compile existing studies and systematically obtain additional data to provide seismic risk information at scales and in formats usable by county and local officials. Such a program should focus on items listed above.

Res Org: Utah State Legislature

Cost: Greater than $100,000 per year

Topic c: Strong motion instrumentation

Problem: There is a lack of adequate strong motion instrumentation within the State of Utah which is needed for earthquake resistant engineering design.

Action: A State program of strong motion instrumentation should be established to carry out the recommendation of the report of the Seismic Safety Advisory Council. Implementation of such a strong motion program may be achieved, in part, by a requirement for instrumentation in major State construction projects.

Res Org: Utah State Legislature

Cost: See SSAC report for cost estimate

Topic d: Strong ground motion information

Problem: There is need for information relevant to strong ground motion associated with earthquakes in the Utah region. Such information is essential for earthquake-resistant design and construction practices and for seismic risk assessment.

Action: Development within the State of the capacity to conduct research in strong motion estimation, to analyze stong motion data, and to provide information on strong ground shaking to the engineering community.

Res Org: Governor for action by his office or a State agency

Cost: $100,000 to $150,000 per year

Topic e: Policy advisory group

Problem: Lack of a policy advisory group at the State level on geological hazards

Action: An advisory policy group should be formed with representatives from the following groups: (1) earth scientists; (2) engineers; (3) public officials; (4) business and industry; (5) general public.

Res Org: Governor for action by his office of a State agency

Cost: $10,000

Topic f: Transfer of information

Problem: Some mechanism is needed to facilitate transfer of information from earthquake-hazards researchers to individuals responsible for public education and public policy.

Action: Periodic workshops should be organized

Res Org: Governor for action by his office or a State agency.

Cost: $10,000

review issues relating to mudflow hazards and to develop recommendations for developing uniform Mudflow Damage Prevention Ordinances within the County that meet local conditions.

c. Make available technical publications and case studies on mudflow hazards and Mudflow Damage Prevention Ordinance Programs.

d. Provide information on the administrative aspects and procedures for implementing Mudflow Damage Prevention Ordinances.

2. Require communities receiving State financial assistance for flood and mudflow damage to enact a Mudflow Damage Prevention Ordinance as a condition for receiving State mitigation and other State disaster recovery funds.

3. Establish a program at the State level for certifying professional engineers responsible for soil analyses, grading plans, drainage plans, and other site development plans.

4. Initiate, in coordination with FEMA through the National Flood Insurance Program (NFIP) and other Federal agencies, a program for identifying mudflow hazard areas, particularly those affected by rapid growth. These detailed engineering studies are necessary to serve as the technical basis for Mudflow Damage Prevention Ordinances. However, until such studies are completed local governments should utilize the best available data such as the maps of recent mudflow events and/or those developed by approximate engineering methods.

Res Org: The responsibility for establishing an effective Mudflow Damage Prevention Ordinance Program with the State is the joint responsibility of the Governor, the State Legislature, State Agencies and local public officials.

Cost: The cost of a modest program to address the mudflow hazard through Mudflow Damage Prevention Ordinances would involve \$100,000 per year for funding a technical assistance and a mudflow study program. The funding to establish the necessary certification program is dependent upon existing mechanisms for certifying professional engineers within the State.

28. RESEARCH NEEDS FOR LANDSLIDES/MUDFLOWS
Chairperson: Robert W. Fleming, U.S. Geological Survey

Topic a: Studies to protect life and property from landslide hazards

Problem: (1) During the disaster of 1983, much of the concern and damage was associated with failure of reservoirs. One reservoir failed, two others (Gunnison and Huntington) caused great concern, one (Twin Lake in 12-Mile Canyon) was partially drained to prevent a potential disaster, and several others including Joe's Valley and two reservoirs in American Fork were involved in landsliding.

Action: A reconnaissance investigation of reservoirs should be completed during 1983-84 to identify those with potential problems from landslides and other defects. An evaluation of hazards should be made together with notification to owners of these reservoirs that could fail during a continuation of the present weather cycle.

Res Org: Study should be done by the Utah Geological and Mineral Survey or through contract with an engineering geologic consulting firm.

Problem: (2) The landslide at Thistle demonstrated how vulnerable our commerce is to disruption by landslides. The landslide at Thistle was a reactivation of a large, old landslide that has moved small amounts through much of this century. The reactivation of large, old landslides is related to rising subsurface water levels in response to abnormally high precipitation. A continuation of even normal precipitation will undoubtedly trigger more landslides of the same type.

Action: In conjunction with land-use planners, identify areas which are critical for maintenance of essential transport of energy and commodities. Conduct a reconnaissance of these areas to identify areas of past landsliding and visit particularly critical sites to evaluate likelihood of reactivation of landslide movements.

Res Org: Utah Geological and Mineral Survey or contract with engineering geologic consulting firm.

Problem: (3) One of the overlooked, but important hazards in the metropolitan areas along the Wasatch Front is the failure of the "benches." These small failures are probably caused by high ground-water levels and imprudent construction practices and result in large damage to property.

Action: A basic study of past failures is needed to determine habitat, materials, influence of construction and drainage changes, and intensity of events. From this could come an evaluation of where problems are most likely to occur in future years and lead to public acceptance of grading codes and avoidance zoning as mitigation methods.

Res Org: Utah Geological and Mineral Survey or a private consulting firm.

Problem: (4) Other studies to protect life and property from landslide hazards. Several other studies were recommended to protect life and property from landslides. I think the group felt that they were generally of lower priority than the three listed above. The type of problem and recommended action are evident from the title of the suggested study.

a. Evaluation of different hazard warning system for debris flow events.
b. Demonstration project of different debris flow control measures including channelization, catchment basins, and diversion structures.
c. Prepare for a rapid response to initial indications of a disaster in much the same way as in 1983. However, in this case, attempt to mobilize more people to obtain information of research value in addition to producing more conficent assessments of hour-by-hour hazards.

Topic b: Studies to learn more about landslides and associated hazards

Problem: (1) The loss of information from removal of stream gages in the canyons north of Salt Lake City was an unfortunate result of austerity in water and hazards studies nationwide. The snowpack and stream gage data would have been of great value in assessing the probability of future events of the same type in the same areas.

Action: In at least a few areas, re-establish the stream gages and snowpack measuring system. Priorities for areas should be determined from an evaluation of risk to property and lives.

Res Org: USGS Water Resources Division or perhaps local university.

Problem: (2) The most damaging failures of 1983 were classic soil slip/debris flows. We have learned a great deal about these failures in the past twenty years but many of the critical studies leading to reduction of damages have not been completed.

Action: Several studies were proposed which apply to this problem. They are:

a. model studies of flow processes;
b. characterization of susceptible source areas, materials, and deposits.
c. effects of microstructure on the distribution of soil slips/debris flows;
d. comprehensive instrumentation of a selected watershed to measure pore water pressures, precipitation, runoff, and deformations;
e. conduct research to establish recurrence intervals for such events.

Res Org: These studies are open and will not be pursued without strong pressure. They could be conducted by any of the competent research organizations including the Utah Geological and Mineral Survey, universities, consulting firms, and the USGS.

Problem: (3) The landslide at Thistle was the most costly in the history of the United States to date. The repercussions will be felt for years in the future.

Action: Conduct a comprehensive autopsy of the landslide to determine costs and alternative actions for response to the crisis. This could result in millions of dollars in savings in future landslides of the same type.

Res Org: The study should be conducted by an independent board or group of scientists and lay people without direct involvement in the event.

Problem: (4) The disaster of 1983 was largely a flood and landslide disaster. It has pushed the earthquake issue into the background for the moment but the issue should not be ignored.

Action: Techniques are being developed for assessment of relative seismic slope stability and the more promising of these should be applied along the urban corridor of the Wasatch Front. This should include a continuation of studies of liquefaction of poorly consolidated debris.

Res Org: Early studies have been done by the USGS and continuations should be initiated by the USGS.

29. LAND CONDEMNATION TO REDUCE RISK TO LIFE FROM GEOLOGIC HAZARDS

Chairperson: Bruce Kaliser, Utah Geological and Mineral Survey

Topic a: Homeowners' protection

Problem: Protection of prospective homeowners from geologic hazards.

Action: Local government building inspection departments may accept waivers from liability for single dwelling lots at their option. Such waivers would be recorded and would appear on deed and on title insurance policy for subsequent buyers.

Res Org: Local government

more local participation (twice the original amount).

Action: (1) Pressure put on our congressional delegates to try and have congress fund the project. (2) The State of Utah fund the project either partially or completely. (3) Eliminate the Corp of Engineers and let State and local interests build the project.

Res Org: Metropolitan Water District of Salt Lake City; Salt Lake County Flood Control; State and County Parks and Recreation.

Cost: $85,000,000

37. BANKING AND GEOLOGIC HAZARDS
Chairperson: Richard Kopp, Valley Bank and Trust

Topic a: Lending policy

Problem: Bankers and other lenders need to be made aware of the importance of considering the presence of geologic hazards as part of their lending policy. They also need to be made aware of the engineering and planning options which can be used to "work around" a potential hazard situation.

Action: (1) Governor's conference for bankers and lenders to achieve awareness and possible actions. (2) Outreach program to educate. (3) Geologic hazards handbook for laymen. (4) Multi-hazard mapping program to identify hazards. (5) Consideration of immediate action to prevent possible 1984 disaster.

38. EARTHQUAKE MONITORING AND PREDICTION
Chairperson: Robert Smith, Department of Geology and Geophysics, University of Utah

Topic a: Coordination of evaluations and warnings

Problem: There is a need for identification of the lead State agency to coordinate evaluations and warnings of earthquake hazards.

Action: Designate the Utah Geological and Mineral Survey as the lead agency.

Res Org: Governor for action by his office or a State agency

Topic b: Seismic monitoring

Problem: There is a need for long-term support for seismic monitoring as part of the State-Federal partnership.

Action: There should be an analysis of State commitments both to the operational support and upgrading of earhtquake-monitoring facilities in Utah.

Res Org: Governor by his office or a State agency

Topic c: Wasatch Front earthquake deformation assessment

Problem: There is considerable uncertainty in assessing the level of pre-earthquake deformation along populated segments of the Wasatch Front and other active areas in the State.

Action: Avenues should be explored for Federal-State cooperation to expand current geodetic monitoring.

Res Org: Governor for action from his office or a State agency

Topic d: Agency cooperation

Problem: There is a need for cooperation of State, Federal and private agencies (including utilities) who can provide communication services to research institutions involved in geophysical monitoring.

Action: Conduct workshop

Res Org: Governor for action by his office or a State agency

39. GRADING AND HILLSIDE ORDINANCES
Chairperson: William J. Kockelman, U.S. Geological Survey

Topic a: Adoption of ordinances

Problem: Only a few cities and counties have regulated development in hazardous geologic areas.

Action: State Legislature should require every city and county to adopt a grading, building, subdivision, or other development ordinance that regulates development in hazardous geologic areas.

Res Org: State Legislature, cities, counties.

WORKSHOP ON "EVALUATION OF REGIONAL AND URBAN EARTHQUAKE HAZARDS AND RISK IN UTAH"

State Capitol Building
Salt Lake City, Utah
August 14-16, 1984

Final Program

Note: Sessions are in the State Capitol Building unless otherwise noted in the program.

TUESDAY, AUGUST 14, 1984

08:00 a.m.	*Registration*
	Moderator: Paula Gori
08:30	*Welcome* *--Honorable Scott M. Matheson, Governor of Utah* *--Genevieve Atwood, Director, Utah Geological and Mineral Survey*
	Introductions, objectives, and procedures of workshop *--Paula Gori, U.S. Geological Survey*
09:00	***PLENARY SESSION 1: EVALUATION OF EARTHQUAKE HAZARDS AND RISK ALONG THE WASATCH FRONT, UTAH***
	Objective: To review an integrated series of overview-type presentations identifying important research results obtained in the past several years which are now being used to evaluate the hazards of ground shaking, earthquake-induced ground failure, surface fault rupture, and tectonic deformation in Utah and their associated risk. These results provide a technical basis for answering the general questions about each hazard: WHERE? WHY? HOW BIG? HOW OFTEN? WHAT ARE THE PHYSICAL EFFECTS AND POTENTIAL LOSSES? and WHAT ARE THE OPTIONS FOR REDUCING LOSSES?
20 minutes	*Review of Regional Geology and Tectonics* *--Ronald Bruhn, University of Utah*
40 minutes	*Seismicity and Earthquakes of Utah and the Wasatch Front: Paradigm and Paradox (includes presentation of a film).* *--Robert Smith, University of Utah*
10:00	*Break*
10:30	***PLENARY SESSION I (CONTINUED): EVALUATION OF EARTHQUAKE HAZARDS AND RISK ALONG THE WASATCH FRONT, UTAH***
30 minutes	*Review of Earthquake Recurrence and Fault Behavior, Wasatch Fault Zone* *--David Schwartz, Woodward Clyde Consultants*

30 minutes — *Review of Liquefaction Potential and Slope Stability, Wasatch Front Area*
—Loren Anderson, Utah State University

30 minutes — *Review of Soil Response, the Ground Shaking Hazard, and Loss Estimation, Wasatch Front Area*
—Ted Algermissen, U.S. Geological Survey
—Walter Hays, U.S. Geological Survey

12:00 noon — *Lunch (Cafeteria located between Capitol Building and State Office Building will be available for lunch.)*

01:30 p.m. — ***FORMATION OF DISCUSSION GROUPS TO CONSIDER TOPICS INTRODUCED IN OVERVIEW PRESENTATIONS AND TO ADDRESS IMPORTANT QUESTIONS***

Moderator: Walter Hays

Objective: Four discussion groups will meet simultaneously, considering topics introduced in the overview presentations and addressing the following questions:

1. *What technical problems are unresolved and require more focused or additional research?*

2. *Is the current research properly focused on the correct physical parameters (i.e. will current research studies solve important unresolved technical problems)?*

3. *What additional research should be undertaken to achieve research and implementation goals?*

Each group will have a moderator, recorder, and one or more stimulators. The stimulator's role is not to give a lengthy dissertation, but in a 10-minute presentation, to take a stand on one or more technical issues, to recommend specific research to resolve these issues, and to provoke discussion. The recorder will prepare an oral report, giving the range of views and the consensus of the group. The moderator will make certain that all participants have a chance to state their views, but not give papers. The report will be given orally and incorporated in the proceedings.

GROUP 1—Synthesis of regional geologic and geophysical studies for evaluation of earthquake hazards and risk in Utah.

Moderator:	*Ernest Anderson, U.S. Geological Survey*
Recorder:	*Bruce Kaliser, Utah Geological and Mineral Survey*
Stimulators:	*David Schwartz, Woodward Clyde Consultants and Walter Arabasz, University of Utah*

Unresolved technical issues relevant to Utah will be identified from the following topical subjects: historical seismicity versus tectonics, seismic cycle, segmentation of faults, characteristic earthquakes, seismic gaps, time-dependent earthquake recurrence, mechanics of the Wasatch fault zone, (normal fault, strike-slip fault, listic fault), mini-Sosie reflection data, etc.

GROUP 2—Synthesis of geologic, geophysical, and engineering data for evaluating the ground-failure hazard and risk in Utah.

Moderator:	*Don Mabey, Utah Geological and Mineral Survey*
Recorder:	*Darrell Herd, U.S. Geological Survey*
Stimulators:	*Jeffrey Keaton, Dames and Moore and Leslie Youd, U.S. Geological Survey*

Unresolved technical issues relevant to Utah will be identified from the following topical subjects: Regional and site-specific prediction of liquefaction potential, regional and site-specific prediction of debris flows, reactivation of landslides, variation in seasonal risk, influence of material properties on triggering and runout of debris flows, etc.

GROUP 3—Synthesis of geologic, geophysical, engineering data, and vulnerability studies for evaluating the ground-shaking hazard and risk in Utah.

Moderator:	*Edgar Leyendecker, National Bureau of Standards*
Recorder:	*Stan Crawley, University of Utah*
Stimulators:	*Albert Rogers, U.S. Geological Survey and Richard Hughes, R.S. Hughes Company, Inc.*

Unresolved technical issues relevant to Utah will be identified from the following topical subjects: local ground response, inventories of buildings and lifeline systems, vulnerability studies, acceptable risk, building codes, architectural practices, construction practices, etc.

GROUP 4—Special session on legal issues related to hazard mitigation policies in Utah.

Moderator:	*Susan Tubbesing, Natural Hazards Research & Applications Information Center*
Recorder:	*Lynne Barnhard, U.S.Geological Survey*
Stimulators:	*James Slosson, Slosson and Associates and Mike Richman, Vancott, Bagley, Hornwall, & McCarthy*

03:00	*Break*
03:30	***PLENARY SESSION 1 (CONTINUED): EVALUATION OF EARTHQUAKE HAZARDS AND RISK ALONG THE WASATCH FRONT, UTAH***
45 minutes	*Reports of discussion groups and interactive discussion.*

45 minutes	*Wasatch front hazards information system. (One of the five interrelated components of the current draft work plan.)*

Objective: A presentation describing a directory ("yellow pages") of the researchers, the hazards information (data, maps, reports, and bibliographic references) being produced by this research, and the procedure for obtaining information from the researchers.
—Arthur Tarr, U.S. Geological Survey
—Don Mabey, Utah Geological and Mineral Survey

5:00 — *Adjourn and reconvene at Hotel Utah*

06:00 — *Dinner at Hotel Utah, Empire Room (a ticket for dinner is provided for all registrants). Technical session follows dinner in Bonneville I.*

TECHNICAL SESSION ON EVALUATION OF EARTHQUAKE HAZARDS AND RISK ALONG THE WASATCH FRONT, UTAH

Objective: To give details about individual research studies.

Organized and moderated by Walter Arabasz, University of Utah, Robert Bucknam, U.S. Geological Survey, and Lawrence Reaveley, Lawrence Reaveley and Associates.

WEDNESDAY AUGUST 15, 1984

08:30 a.m. — ***PLENARY SESSION 2: RESPONDING TO THE EARTHQUAKE HAZARDS IN UTAH***

Moderator: Walter Hays

Note: This session is designed to present information to the Utah legislature which will be meeting on this day. The schedules of the workshop and the legislature will be synchronized.

Objective: Presentations describing continuing actions to improve the state-of-earthquake-hazard-awareness- and preparedness in Utah, building on past experiences.

30 minutes — *The potential vulnerability of city lifeline systems to earthquake hazards.*
—Anshel Schiff, Purdue University

30 minutes — *A hypothetical scenario of a damaging earthquake on the Wasatch front, portraying the resultant crisis environment and real-time pressures for solutions to critical problems.*
—Charles Thiel, Telesis Inc.

Formation of Governor's Commission and Special Action Groups. (Special Action Groups will reconvene in auditorium of State Office Building.)

09:30 — ***TWO CONCURRENT SESSIONS (Session 1 in State Capitol and Session 2 in State Office Building.)***

30 minutes	*Session 1: Special presentations to the Utah legislature suggesting actions in the context of existing buildings, lifeline systems, and preparedness planning that can be initiated now to mitigate hazards in Utah.* *--Christopher Arnold, Building Systems Development, Inc.* *--Anshel Schiff, Purdue University* *--Jerry Olson, Federal Emergency Management Agency, Region VIII* *--Lorayne Tempest, Utah Divison of Comprehensive Emergency Management* *Following these presentations speakers will join special action groups in auditorium of State Office Building.*
90 minutes	*Session 2: Special action groups* *Objective: Three discussion groups will meet simultaneously and address specific scientific-legal-political-social issues identified in the hypothetical scenario. Each special action group will receive an assignment for discussion and quick resolution. A moderator and recorder will be assigned for each group. The recorder will prepare a report which will be incorporated in the proceedings. The moderator will insure that participants have a chance to express their views. In the report to the Governor's Commission, some role playing will be necessary.* *Note: A working break will be taken between 10:00 and 10:30.*
11:00	***PLENARY SESSION 2 (CONTINUED): RESPONDING TO THE EARTHQUAKE HAZARDS IN UTAH (Plenary session will convene in auditorium of State Office Building.)***
40 minutes	*Report of special action groups to Governor's Commission.*
20 minutes	*Preparedness planning along the Wasatch front for earthquakes and other natural hazards.* *--Jerry Olson, Federal Emergency Management Agency, Region VIII* *--Lorayne Tempest, Utah Division of Comprehensive Emergency Management*
12:00	*Lunch (Cafeteria located between Capitol Building and State Office Building will be available for lunch.)* *Moderator: Don Mabey, Utah Geological and Mineral Survey*
01:30 p.m.	***PLENARY SESSION 3: IMPLEMENTATION OF SPECIFIC ACTIONS TO REDUCE POTENTIAL LOSSES FROM EARTHQUAKE HAZARDS IN UTAH*** *Objective: To review a series of integrated presentations describing actions that can be taken to reduce potential losses from earthquake hazards in Utah.*

20 minutes	*Review of recommendations of the 1983 Governor's Conference on Geologic Hazards.* *—Genevieve Atwood, Utah Geological and Mineral Survey*
30 minutes	*Review of accomplishments and recommendations of Utah Seismic Safety Advisory Council, 1977-1980.* *—Delbert Ward, Structural Facilities, Inc.* *—Richard Olson, Arizona State University, Tempe, Arizona*
40 minutes	*Architectural and engineering actions to improve earthquake resistance of new and existing buildings.* *—Christopher Arnold, Building Systems Development, Inc.* *—Edgar Leyendecker, National Bureau of Standards*
15 minutes	*Reducing losses from earthquake hazards through land-use planning, zoning, and subdivision ordinances.* *—Jerold Barnes, Salt Lake County Planning Department*
15 minutes	*Reducing losses from earthquakes through personal preparedness actions.* *—William Kockelman, U.S. Geological Survey*
03:30	*Break*
04:00	***PLENARY SESSION 4: REVIEW OF DRAFT WORK PLAN "REGIONAL AND URBAN EARTHQUAKE HAZARDS EVALUATION: WASATCH FRONT, UTAH"***
	Objective: To review the five interrelated components of the draft work plan: 1) information systems, 2) synthesis of geologic, geophysical, and engineering data for evaluation of earthquake hazards, 3) ground motion modeling, 4) loss estimation modeling, and 5) implementations. The goal is to recommend priorities, program options, and program plans and strategies for FY 85-86.
60 minutes	***DISCUSSION GROUPS***
	Three discussion groups will meet simultaneously to discuss the fifth component, implementation. Each group will identify achievable actions that can be taken within the next 2 years to foster an environment for implementation of loss reduction measures in Utah. The three groups will use the information presented earlier in the day (i.e. recommendations of the 1983 Governor's conference on geologic hazards, architectural and engineering actions, land-use planning, and personal preparedness) in their discussions, identifying possible actions that are relevant for Utah (for example, information centers; professional registration and training; business, civic, and volunteer preparedness; building codes; land-use regulations; insurance, etc.). Each group will have a moderator and a recorder. The recorder will prepare a report which will be incorprated into the proceedings. The moderator will insure that participants have a chance to express their views.
05:00	*Adjourn and reconvene at Hotel Utah*

06:00 *Dinner at Hotel Utah, Empire Room (a ticket for dinner is provided for all registrants). Technical session follows dinner in Bonneville I.*

TECHNICAL SESSION ON EVALUATION OF EARTHQUAKE HAZARDS AND RISK ALONG THE WASATCH FRONT, UTAH

Objective: To give details about individual research studies.

Organized and moderated by Walter Arabasz, University of Utah, Robert Bucknam, U.S. Geological Survey, and Lawrence Reaveley, Lawrence Reaveley and Associates.

THURSDAY, AUGUST 16, 1984

08:30 a.m. ***DISCUSSION GROUPS (CONTINUED) All participants meet in State Capitol Building for formation of three new discussion groups.***

Moderator: Walter Hays

Objective: To review the five components of the draft work plan for research along the Wasatch front, modifying the work plan as appropriate to focus on priority goals, to take advantage of research opportunities, and to enhance synergism.

90 minutes *Three new discussion groups will meet simultaneously to discuss: 1) synthesis of geological, geophysical, and engineering data for evaluation of earthquake hazards, 2) ground motion and loss estimation modeling, and 3) earthquake hazards information systems. Using the draft work plan as a guide, each discussion group will identify priorities, program options, and program plans and strategies for one of the three discussion topics listed above, considering the other two topics if time permits. Each group will have a moderator and a recorder (different from those of the prior discussion groups). The recorder will prepare a report which will be incorporated into the proceedings. The moderator will be prepared to initiate the discussion on the topic, asking the group to identify priorities, program options, and program plans and strategies, and will insure that all participants have an opportunity to express their views. Timeframe under consideration is FY 85-86.*

"Synthesis" Discussion Group
Moderator: Walter Arabasz, University of Utah
Recorder: Russ Wheeler, U.S. Geological Survey

"Ground Motion--Loss Estimation" Discussion Group
Moderator: Maurice Power, Woodward Clyde Consultants
Recorder: Martin McCann, J. R. Benjamin Associates

"Information Systems" Discussion Group
Moderator: Robert Alexander, U.S. Geological Survey
Recorder: Terry Feldman, Federal Emergency Management Agency

10:00	*Break*
10:30	***PLENARY SESSION 4 (CONTINUED): REVIEW OF DRAFT WO PLAN "REGIONAL AND URBAN EARTHQUAKE HAZARDS EVALUATION: WASATCH FRONT, UTAH"***
60 minutes	*Recommendations of discussion groups and interactive discussion.*
30 minutes	*Closure*
12:00	*Adjournment of workshop*

SPECIAL SESSION AT HOTEL UTAH, EMPIRE ROOM

THURSDAY, AUGUST 16, 1984

01:30 p.m. **DETERMINATION OF NEEDS OF POLICYMAKERS IN UTAH**

A special session will be convened for planners and decisionmakers following the workshop. The purpose of this session is to identify the special needs for earthquake hazards information and any obstacles to the use of such information when it is available.

MODERATORS:

Genevieve Atwood, Utah State Geologist
William Kockelman, U.S. Geological Survey

PANELISTS

Mr. Jerold Barnes, Salt Lake County Planner
Mr. Don Bennett, Vice President, Mountain Fuel Company
Mr. G. Allen Fawcett, Director, Richfield Community Plannning
Honorable Don LeBaron, Utah State House of Representatives
Mr. George Shaw, Sandy City Planner
Honorable Harold Tippetts, Davis County Commissioner

SPEAKERS:

Patricia Bolton, Research Scientist, Battelle
Wesley Dewsnup, Utah State Multi-Hazards Project Manager
Merrill Ridd, Utah State Information Provider
Jeanne Perkins, San Francisco Bay Regional Planner-Geologist
Clark Meek, Idaho State Disaster Mitigator
Robert Alexander, U.S. Geological Survey, Research Geographer
Stephen French, Earthquake Planning Needs Researcher

01:30	Introduction of moderators and panelists and explanation of purpose and agenda by Genevieve Atwood
01:50	Presentation by each speaker after their introduction by William Kockelman
03:00	Break
03:15	Questions of speakers by panelists and audience
04:00	Statements of needs or obstacles by audience
04:30	Adjourn
05:00	Dinner meeting
06:30	Reconvene to prepare statements of n speakers, panelists, and others.
07:30	Adjourn

GLOSSARY

This glossery of technical terms is provided to facilitate their use in a standard manner. These terms are encountered frequently in the literature and in discussion of earthquake hazards and risk.

Accelerogram. The record from an accelerometer showing acceleration as a function of time. The peak acceleration is the largest value of acceleration on the accelerogram.

Acceptable Risk. A probability of occurrences of social or economic consequences due to earthquakes that is sufficiently low (for example in comparison to other natural or manmade risks) as to be judged by authorities to represent a realistic basis for determining design requirements for engineered structures, or for taking certain social or economic actions.

Active fault. A fault is active if, because of its present tectonic setting, it can undergo movement from time to time in the immediate geologic future. This active state exists independently of the geologists' ability to recognize it. Geologists have used a number of characteristics to identify active faults, such as historic seismicity or surface faulting, geologically recent displacement inferred from topography or stratigraphy, or physical connection with an active fault. However, not enough is known of the behavior of faults to assure identification of all active faults by such characteristics. Selection of the criteria used to identify active faults for a particular purpose must be influenced by the consequences of fault movement on the engineering structures involved.

Attenuation. A decrease in seismic signal strength with distance which depends on geometrical spreading and the physical characteristics of the transmitting medium that cause absorption and scattering.

Attenuation law. A description of the average behavior of one or more characteristics of earthquake ground motion as a function of distance from the source of energy.

b-value. A parameter indicating the relative frequency of earthquakes of different sizes derived from historical seismicity data.

Capable fault. A capable fault is a fault whose geological history is taken into account in evaluating the fault's potential for causing vibratory ground motion and/or surface faulting.

Design earthquake. A specification of the ground motion at a site based on integrated studies of historic seismicity and structural geology and used for the earthquake-resistant design of a structure.

Design spectra. S ectra used in earthquake-resistant design which correlate with design earthquake ground motion values. A design spectrum is typically a broad band specturm having broad frequency content. The design spectrum can be either site-independent or site-dependent. The site-dependent spectrum tends to be less broad band as it depends at least in part on local site conditions.

Design time history. One of a family of time histories used in earthquake-resistant design which produces a response spectrum enveloping the smooth design spectrum, for a selected value of damping.

Duration. A description of the length of time during which ground motion at a site exhibits certain characteristics such as being equal to or exceeding a specified level of acceleration such as 0.05g.

Earthquake hazards. Natural events accompanying an earthquake such as ground shaking, ground failure, surface faulting, tectonic deformation, and inundation which may cause damage and loss of life during a specified exposure time. See earthquake risk.

Earthquake risk. The probability that social or economic consequences of earthquakes, expressed in dollars or casualties, will equal or exceed specified values at a site during a specified exposure time.

Earthquake waves. Elastic waves (P, S, Love, Rayleigh) propagating in the Earth, set in motion by faulting of a portion of the Earth.

Effective peak acceleration. The value of peak ground acceleration considered to be of engineering significance. It can be used to scale design spectra and is often determined by filterng the ground-motion record to remove the very high frequencies that may have little or no influence upon structural response.

Epicenter. The point on the Earth's surface vertically above the point where the first fault rupture and the first earthquake motion occur.

Exceedence probability. The probability (for example, 10 percent) over some exposure time that an earthquake will generate a level of ground shaking greater than some specified level.

Exposure time. The period of time (for example, 50 years) that a structure or facility is exposed to earthquake hazards. The exposure time is sometimes related to the design lifetime of the structure and is used in seismic risk calculations.

Fault. A fracture or fracture zone in the Earth along which displacement of the two sides relative to one another has occurred parallel to the fracture. See Active and Capable faults.

Focal depth. The vertical distance between the earthquake hypocenter and the Earth's surface.

Ground motion. A general term including all aspects of motion; for example, particle acceleration, velocity, or displacement; stress and strain; duration; and spectral content generated by an earthquake, a nuclear explosion, or another energy source.

Intensity. A numerical index describing the effects of an earthquake on the Earth's surface, on man, and on structures built by him. The scale in common use in the United States today is the Modified Mercalli scale of 1931 with intensity values indicated by Roman numerals from I to XII. The narrative descriptions of each intensity value are summarized below.

I. Not felt--or, except rarely under specially favorable circumstances. Under certain conditions, at and outside the boundary of the area in which a great shock is felt: sometimes birds and animals reported uneasy or disturbed; sometimes dizziness or nausea experienced; sometimes trees, structures, liquids, bodies of water, may sway--doors may swing, very slowly.

II. Felt indoors by few, especially on upper floors, or by sensitive, or nervous persons. Also, as in grade I, but often more noticeably: sometimes hanging objects may swing, especially when delicately suspended; sometimes trees, structures, liquids, bodies of water, may sway, doors may swing, very slowly; sometimes birds and animals reported uneasy or disturbed; sometimes dizziness or nausea experienced.

III. Felt indoors by several, motion usually rapid vibration. Sometimes not recognized to be an earthquake at first. Duration estimated in some cases. Vibration like that due to passing of light, or lightly loaded trucks, or heavy trucks some distance away. Hanging objects may swing slightly. Movements may be appreciable on upper levels of tall structures. Rocked standing motor cars slightly.

IV. Felt indoors by many, outdoors by few. Awakened few, especially light sleepers. Frightened no one, unless apprehensive from previous experience. Vibration like that due to passing of heavy or heavily loaded trucks. Sensation like heavy body of striking building or falling of heavy objects inside. Rattling of dishes, windows, doors; glassware and crockery clink or clash. Creaking of walls, frame, especially in the upper range of this grade. Hanging objects swung, in numerous instances. Disturbed liquids in open vessels slightly. Rocked standing motor cars noticeably.

V. Felt indoors by practially all, outdoors by many or most; outdoors direction estimated. Awakened many or most. Frightened few--slight excitement, a few ran outdoors. Buildings trembled throughout. Broke dishes and glassware to some extent. Cracked windows--in some cases, but not generally. Overturned vases, small or unstable objects, in many instances, with occasional fall. Hanging objects, doors, swing generally or considerably. Knocked pictures against walls, or swung them out of place. Opened, or closed, doors and shutters abruptly. Pendulum clocks stopped, started or ran fast, or slow. Move small objects, furnishings, the latter to slight extent. Spilled liquids in small amounts from well-filled open containers. Trees and bushes shaken slightly.

VI. Felt by all, indoors and outdoors. Frightened many, excitement general, some alarm, many ran outdoors. Awakened all. Persons made to move unsteadily. Trees and bushes shaken slightly to moderately. Liquid set in strong motion. Small bells rang--church, chapel, school, etc. Damage slight in poorly built buildings. Fall of plaster in small amount. Cracked plaster somewhat, especially fine cracks chimneys in some instances. Broke dishes, glassware, in considerable quantity, also some windows. Fall of knickknacks, books, pictures. Overturned furniture in many instances. Move furnishings of moderately heavy kind.

VII. Frightened all--general alarm, all ran outdoors. Some, or many, found it difficult to stand. Noticed by persons driving motor cars. Trees and bushes shaken moderately to strongly. Waves on ponds, lakes, and running water. Water turbid from mud stirred up. Incaving to some extent of sand or gravel stream banks. Rang large church bells, etc. Suspended objects made to quiver. Damage negligible in buildings of good design and construction, slight to moderate in well-built ordinary buildings, considerable in poorly built or badly designed buildings, adobe houses, old walls (especially where laid up without mortar), spires, etc. Cracked chimneys to considerable extent, walls to some extent. Fall of plaster in considerable to large amount, also some stucco. Broke numerous windows and furniture to some extent. Shook down loosened brickwork and tiles. Broke weak chimneys at the roof-line (sometimes damaging roofs). Fall of cornices from towers and high buildings. Dislodged bricks and stones. Overturned heavy furniture, with damage from breaking. Damage considerable to concrete irrigation ditches.

VIII. Fright general--alarm approaches panic. Disturbed persons driving motor cars. Trees shaken strongly--branches and trunks broken off, especially palm trees. Ejected sand and mud in small amounts. Changes: temporary, permanent; in flow of springs and wells; dry wells renewed flow; in temperature of spring and well waters. Damage slight in structures (brick) built especially to withstand earthquakes. Considerable in ordinary substantial buildings, partial collapse, racked, tumbled down, wooden houses in some cases; threw out panel walls in frame structures, broke off decayed piling. Fall of walls, cracked, broke, solid stone walls seriously. Wet ground to some extent, also ground on steep slopes. Twisting, fall, of chimneys, columns, monuments, also factory stacks, towers. Moved conspicuously, overturned, very heavy furniture.

IX. Panic general. Cracked ground conspicuously. Damage considerable in (masonry) buildings, some collapse in large part; or wholly shifted frame buildings off foundations, racked frames; serious to reservoirs; underground pipes sometimes broken.

X. Cracked ground, especially when loose and wet, up to widths of several inches; fissures up to a yard in width ran parallel to canal and stream banks. Landslides considerable from river banks and steep coasts. Shifted sand and mud horizontally on beaches and flat land. Changes level of water in wells. Threw water on banks of canals, lakes, rivers, etc. Damage serious to dams, dikes, embankments. Severe to well-built wooden structures and bridges, some destroyed. Developed dangerous cracks in excellent brick walls. Destroyed most masonry and frame structures, also their foundations. Bent railroad rails slightly. Tore apart, or crushed endwise, pipelines buried in earth. Open cracks and broad wavy folds in cement pavements and asphalt road surfaces.

XI. Disturbances in ground many and widespread, varying with ground material. Broad fissures, earth slumps, and land slips in soft, wet ground. Ejected water in large amounts charged with sand and mud. Caused sea-waves ("tidal" waves) of significant magnitude. Damage severe to wood-frame structures, especially near shock centers. Great to dams, dikes, embankments often for long distances. Few, if any (masonry) structures, remained standing. Destroyed large well-built bridges by the wrecking of supporting piers or pillars. Affected yielding wooden bridges less. Bent railroad rails greatly, and thrust them endwise. Put pipelines buried in each completely out of service.

XII. Damage total--practically all works of construction damaged greatly or destroyed. Disturbances in ground great and varied, numerous shearing cracks. Landslides, falls of rock of significant character, slumping of river banks, etc., numerous and extensive. Wrenched loose, tore off, large rock masses. Fault slips in firm rock, with notable horizontal and vertical offset displacements. Water channels, surface and underground, disturbed and modified greatly. Dammed lakes, produced waterfalls, deflected rivers, etc. Waves seen on ground surfaces (actually seen, probably, in some cases). Distorted lines of sight and level. Threw objects upward into the air.

Liquefaction. The primary factors used to judge the potential for liquefaction, the tranformation of unconsolidated materials into a fluid mass, are: grain size, soil density, soil structure, age of soil deposit, and depth to ground water. Fine sands tend to be more susceptible to liquefaction than silts and gravel. Behavior of soil deposits during historic earthquakes in many parts of the world show that, in general, liquefaction susceptibility of sandy soils decreases with increasing age of the soil deposit and increasing depth to ground water. Liquefaction has the potential of occurring when seismic shear waves having high acceleration and long duration pass through a saturated sandy soil, distorting its granular structure and causing some of the void spaces to collapse. The pressure of the pore water between and around the grains increases until it equals or exceeds the confining pressure. At this point, the water moves upward and may emerge at the surface. The liquefied soil then behaves like a fluid for a short time rather than as a soild.

Magnitude. A quantity characteristic of the total energy released by an earthquake, as contrasted to intensity that describes its effects at a particular place. Professor C. F. Richter devised the logarithmic scale for local magnitude (M_L) in 1935. Magnitude is expressed in terms of the motion that would be measured by a standard type of seismograph located 100 km from the epicenter of an earthquake. Several other magnitude scales in addition to M_L are in use; for example, body-wave magnitude (m_b) and surface-wave magnitude (M_S), which utilize body waves and surface waves, and local magnitude (M_L). The scale is theoretically open ended, but the largest known earthquakes have had M_S magnitudes near 8.9.

Region. A geographical area, surrounding and including the construction site, which is sufficiently large to contain all the geologic features related to the evaluation of earthquake hazards at the site.

Response spectrum. The peak response of a series of simple harmonic oscillators having different natural periods when subjected mathematically to a particular earthquake ground motion. The response spectrum may be plotted as a curve on tripartite logarithmic graph paper showing the variations of the peak spectral acceleration, displacement, and velocity of the oscillators as a function of vibration period and damping.

Return period. For ground shaking, return period denotes the average period of time or recurrence interval between events causing ground shaking that exceeds a particular level at a site; the reciprocal of annual probability of exceedance. A return period of 475 years means that, on the average, a particular level of ground motion will be exceeded once in 475 years.

Risk. See earthquake risk.

Rock. Any solid naturally occurring, hard, consolidated material, located either at the surface or underlying soil. Rocks have a shear-wave velocity of at least 2,500 ft/sec (765 m/s) at small (0.0001 percent) levels of strain.

Seismic Microzoning. The division of a region into geographic areas having a similar relative response to a particular earthquake hazard (for example, ground shaking, surface fault rupture, etc.). Microzoning requires an integrated study of: 1) the frequency of earthquake occurrence in the region, 2) the source parameters and mechanics of faulting for historical and recent earthquakes affecting the region, 3) the filtering characteristics of the crust and mantle along the regional paths along which the seismic waves travel, and 4) the filtering characteristics of the near-surface column of rock and soil.

Seismic zone. A generally large area within which seismic design requirements for structures are uniform.

Seismotectonic province. A geographic area characterized by similarity of geological structure and earthquake characteristics. The tectonic processes causing earthquakes are believed to be similar in a given seismotectonic province.

Source. The source of energy release causing an earthquake. The source is characterized by one or more variables, for example, magnitude, stress drop, seismic moment. Regions can be divided into areas having spatially homogeneous source characteristics.

Strong motion. Ground motion of sufficient amplitude to be of engineering interest in the evaluation of damage due to earthquakes or in earthquake-resistant design of structures.

group iso

Ray Bronson

14 Aug 84

1. Ron Bruhn – (a) Parry believes on basis of geochem that uplift of Little Cottonwood block is 7–9 km, whereas rest of Wasatch Fault averages about 3–4 km.
(b) evidence that earthq along Wasatch nucleate ≤ 9–10 km depth –
from cataclastic rock, seismic binding } above
foliated rock, aseismic slip } below
(c) Wasatch F may be divided into segments that rupture independently
(d) Mesozoic thrust sheets
– called attn to large ramp anticlines in upper plates of thrusts
(e) E–W boundaries between segments of WF correlate w/ present seismicity

3-yr, $7.5M Wasatch Front study spoken about frequently

2. Bob Smith –
(a) Borah Peak, Id
– Main shock + aftershocks were all 10–15 km W & SW of the surface rupture. Plots of depth indicate 45° dip on events, going up to surface rupture.
49° dip, planar fault depth map (12–20 km

Hebgen Lake, Borah Peak, Dixie Valley
- all 7.5 ±
- nucleated @ ± 15 km
- all had upward propag of events
@ 45–60° --
- mid-crustal ductile ~~zone~~ @ ± 15 km
seems to be ~~are~~ region of generation
of large eqs

(4) Recommends
(a) more info on 3rd term
(b) drill faults
(c) more geodetic leveling
(d) statistics of earthquake occurrence
(e) normal fault mechanisms
(f) stable funding for monitoring
(g) increased engineering research
(h) expand seismograph networks —

David Schwartz – Woody Clyde
(a) work sponsored by USGS

Has had a landslide assessment study
of Davis County funded by USGS
Rudd Canyon – 1983 ~~Bountiful eq~~ → Farmington
Ward Canyon – 1983 → mud flood in Bountiful
→ Centerville

Regional Assess of Liquefaction Potential
Youd © 2 things
1. liquefaction susceptibility - types of soils
2. " opportunity - located in same zone
i.e. critical acceleration to give liq.
Youd - cases drawn

Things that affect liq suscept also respond
to standard penetration resistance

CPT - cone penetrometer
SPT -

To get into hazards map - thoughts
(1) get in with team, so can get support
-- Utah State / Dames & Moore
UGMS
UU / Seismic
Woodward Clyde
(2) Get new idea of how to contribute

Jeff Keaton - AGM 3
Multiple Hazard Planning

Research needs
1. Synthesize hazards mapping
2. Risk-based analyses
3. Work all hazards at once
4. Continue hazards evaluation
5. Better understanding of liq mech
6. " " " liq assess methods

Ted Algermissen -
(a) USGS has just installed 8 strong-motion accelograph instruments in SL valley -- in conjunction w/ UGMS -
(b) did economic loss studies
1. inventory of what is at risk - bldgs, etc
2. loss - ground shaking relationship
3. earthquake simulators

uses MM Intensity scales for loss assessment

Tuesday Afternoon -- Ground Failure

(Hydrocompaction & expansive soils --)

Jeff Keaton - types of failure

primary effects
1. tectonic disruption
2. Creep deformation

secondary EQ effects
3. EQ induced landslides - Barnes 1978 paper
4. Loss bearing capacity

not EQ induced
5. Static Spreads
6. Landslides
7. Hydrocompaction, expansive soils
8. Passage of debris

(1) Dave Keifer "Landslides Caused by Earthquakes"
-- few EQ induce reactivated landslides -- most are new landslide blocks
-- need to focus on slopes that have not failed in context of future research
(2) If we recognize slope failure, do we have engineering capabilities to deal w/ this ?
what do we do to upgrade existing facilities after development -

Les Youd, USGS
- need research in how far lateral spreads will move based on soil eng data
- need research in all types mitigation

Bob Rock - Utah State - will be assessing landslide hazard -- non lying induced
need - do need additional mapping in landslide & rock fall areas

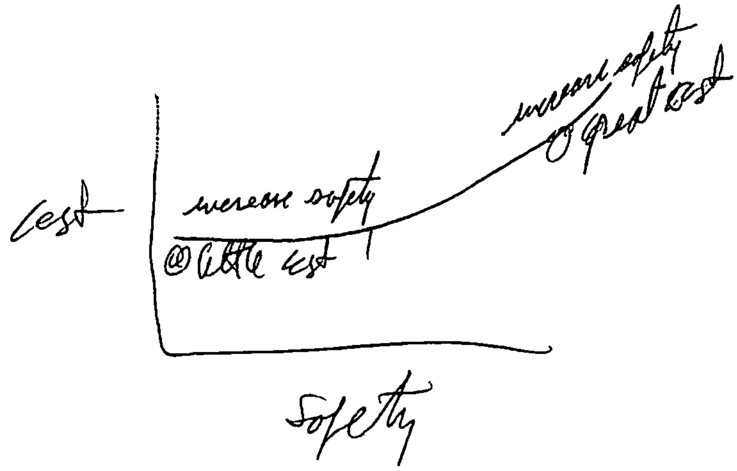
–

– How are we going to apply these hazard maps?

1) is there active mechanism to feed back info from occurrences into models?
2)

High liquefaction potential is west of a line about midway between Stansbury & [illegible] Wells of Bonneville –

– One of hazards is daming of streams by landslides then failure of dam –
– this kind of hazard is not being assessed at present



Johnson Hollow - Emigration Canyon - home owners have applied for tax relief

mechanisms of failure of earth dams — Loren Anderson - Utah State has looked @ this —
feels that can spend lots $ to increase safety dams we live a bit, but there may be another hazard that could overshadow the one we are spending $ to mitigate —

- One point: Rudd Canyon debris basin cost $1M. Cost of this $ is ≅ $80K/yr. Cost to insure ± 15 homes per year is $300 × 15. So maybe insurance is best answer. —

- In Texas: owner sets value of his house. He is taxed on this amt. If its destroyed, he is paid by state this amt, and no other develop is allowed there again bec its state $. —
Trouble w/ federal bailout is that develop is allowed again and resets the clock for ~~an~~ another bailout later —

Group Reports -

1. Bruce Kaliser

1. Need for microseismic networks to identify swarm areas
2. Increased understanding of layering ½ -- 3rd dim. -
3. Refinement of characteristics of seismic gaps -
4. Trenching across youngest faulted materials for determination lapse periods — periodicity
5. More sampling points along each W fault segment - — more trenching -
6. Deep seismic profiling + drilling downdip in situ stress, fluids, materials, etc. -
7. Adequacy of Quat fault map for Utah - can it be improved ?: Eastern portion of State lower in quality than Great Basin -

2. Craig Taylor -

Research Needs

1. How much lateral displacement will occur — landslides techniques for thin layered deposits
2. Models of bldg responses to various EQs
3. Need for study of damming of canyons -- disruptions
4. Syst method for making data as public as possible -
5. Critic accel + peak accel need to be determined in terms of EQ magnitude
6. Landslide hazards ~~not~~ assoc w/ liquefaction need to be studied
7. Need for loss/risk models re costs -
8. Must evaluate all hazards together
9. Need for application of findings

3. Del Ward

1. Geotech research is ok
2. Users of info became polarized -
3. Data may not be transferable between regions
4. Research needed into attenuation of shaking away from quake area
5. Need pred. ~~on~~ EQ motion to be used in design - instru needed <u>in</u> <u>bldgs</u> -- measure motion in bldgs -

---

Earth Sci, too? ⟹ NSF is a USGS partner in EQ Hazards - would welcome proposals from architectural points of <u>view</u> -

4. <u>Lynn Bamberd</u> -

1. Courts are moving toward more liberal interp of liabilities of developers, etc. In Calif "act of God" clause is out -
   - we know how to mitigate, but don't
   - we drop to min standards -- state agencies may be <u>liable</u> if they don't require what's known
   - Utah - 2 dam inspect for 1400 dams, neither of which are trained -

Purpose of workshop is to refine workplan for 2nd year, if needed -
Planning; Info System; Synthesis of geol, geoph, eng data for evaluation of EQ Hazards; Ground motion modeling; Loss Estimation modeling; Implementation -

Spenser Wood

Using Geodetic Leveling,
Can resolve 1 mm over 1 Km

In Weber Canyon, 1958-1983, 120 mm
moved across fault -- most occurred
before 1974. = 10 μrad tilt

Proposed Items

(2) Subsurface structure group
- integrated data collection and interpretation
  - geologic ~~do~~ mapping and structural studies
  - seismic studies - ~~select~~
  - gravity
  - magnetic -
  - electrical - probably MT and dipole-dipole

- objective - define subsurface structure on Wasatch and other selected faults to depths of 10 km
  - new data - geol mapping selected areas
    - detailed magnetic
    - supplemental gravity
    - electrical
- one objective - select sites for deep drilling
  - seismic studies - swarms
    - reflection

(1) ~~2a~~. Earth motion -

suggest that the horizontal components of strain would also be measurable through precise surveying. Could be very important in studying styles of faulting. With vertical strain rates of 120 mm in 25 yrs = 5 mm/yr, vertical and horizontal surveys may be repeatable on a time scale of 5 years, giving very valuable data on rate of strain buildup for selected Wasatch Front areas.

Seems to me that data on actual earth movements are core, fundamental data. (1) ~~E~~ Episodic, sudden movements -- seismic monitoring (2) Continuous strain surveying -- both are very important.

3. Concentration of so much effort along Wasatch Fault Z might be a mistake -

- ~~Z~~ in Provo - SLC - Ogden - Brigham area, historic seismicity is much greater on other segments
- suggest that one way to learn about style of faulting in Utah would be to study presently active faults more thoroughly -- correlate structure w/ observed seismicity - to study segmentation of area into blocks and what they mean

4. See nothing in plan re monitoring of seismic zones for purposes of prediction

- realize this is a controversial topic, haven't had much success
- style of faulting here is different from Calif, where most of US studies have been done
- suggest picking an area of reasonably active seismic activity, prob not the WFZ, and installing monitoring instrumentation
  - microearthquake array
  - electrical resistivity
  - magnetic field
- try to ~~[illegible]~~ determine any precursors -
- the ultimate goal of the earthquake science must be prediction in advance -- ~~[illegible]~~ best way by far to save lives -- little ~~[illegible]~~ in the way of mitigation can be done for ~~[illegible]~~ developed areas -

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Location of Fault -

no program to consider where Wasatch Fault actually exists?

Strip mapping - USGS not committed to strip mapping - only doing selected segments new critic info in Quat. -- but no plans to deliver before 1986 -

There is a need for strip maps along faults for engineering purpose

Mike Machette doing this only in areas for major input in fault behavior -

People doing mapping are experts, using whole generation of new techniques / glacial, fluvial, etc. -

Suggest
- workshop
- identify a subsurface group
- what can each see bring to bear -?

July SGR - Characteristic EQ

NGS –
need a proposal for expanded geodetic –
horizontal studies –

~~Implemen~~

Recommendations of Groups

I. Implementation
1. Technology transfer – need for an organization to transfer info from scientists to city/state planners
– need to identify a group – maybe non-profit
– need a proposal to USGS by 1 Dec.
2. need for technical data by planners
3. need for geologists in counties –
support for this program –

II. Synthesis – Russ Wheeler — Smiths + Synthesis
– see separate notes
Accel Fault Deep Study
Geodetic Subsurface

III. Ground Motion / Attenuation – Loss
1. Put together best avail info on motion / Loss –
2. Collecting data / modeling –
EPRI – FEMA, etc have data
3. Instrumentation –
site response; small earthquakes; strong motion
4. need for smaller featured metrics

IV Information Systems

1. Process of small group meetings

1. There will be a December RFP cycle for external grants & contracts
2. One week after Labor day, USGS internal program review — in light of this conference — conference will have affect on USGS program —

FEMA will fund jointly w/ USGS the Implementation phase of program —

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Earthquake Hazards Of The Wasatch Front

Basic Conditions:

1. Earthquake risk and hazard assessement are long-term committments and will not stop at the end of the current three-year program--an assessment can be made at any time with current, thus it represents a progress report that must be continuously updated as new information is availiable.

2. Current tectonic models for a large earthquake on the Wasatch Front would place a normal fault event on a westward dipping (45°-65°), nucleating at about 15km depth.

3. We should consider the Wasatch Front as a three-dimensional volume, extending across the valley (and encompassing adjacent areas) and to depths of 20km. We need to assess the entire volume, not just the currently obvious faults.

4. Scientific investigations (generally long-term) will drive the applied -science/engineering assessments.

Suggested Recomendations

1. **Accelerated investigations of major faults emphasizing mechanics, timing, geometry, stress, etc. including the depth dimension.**

High

2. **Expanded trenching of major faults with at least three sites per segment to assess: displacement history, segment definition, statistical uncertainties, etc.**

3. **Deep-penetration, seismic reflection profiles to map faults with depth.** - 3D imaging proposal to IRIS - NSF deep DOSECC drill hole

Long-term

4. **Deep holes drilled through the inferred fault zones to assess stress, mechanical properties, pore properties, etc.**

High

5. **Expanded vertical and horizontal geodetic networks across major fault zones to assess long-term strain and vertical deformation.**

6. **Deterministic and probabilistic evaluations of earthquake occurrence integrating geological and geophysical data.**

7. <u>Accelerated seismological research into the dynamics of normal faulting</u> supported by modern digital seismometry and a committment to long-term stable funding for the Intermountain seismograph network.

8. <u>Increased research in engineering seismology</u> to emphasize conditions on the Wasatch Front.

9. <u>Theoretical modeling of strong-ground motion and implementation of an expanded accelerograph network in Utah.</u>

REGIONAL AND URBAN EARTHQUAKE HAZARDS EVALUATION

WASATCH FRONT, UTAH

DRAFT WORK PLAN: FY 84-86

FOREWARD

This draft work plan describes the integrated goals, plans, and activities of the U.S. Geological Survey (USGS) and the Utah Geological and Mineral Survey (UGMS) for the program element, "Regional and Urban Earthquake Hazards Evalaution: Wasatch front, Utah," a part of the Geological Survey's National Earthquake Hazards Reduction Program (NEHRP). The purpose of the work plan is to define research **GUIDELINES** and general **RESPONSIBILITIES** for 3-years, FY 84-86, the first phase of a focused effort on the Wasatch front. The work plan will be reviewed each year and revised, as appropriate, to reflect progress, new goals, opportunities for synergism, and more effective use of resources. The following persons participated in at least one of the two planning meetings held in Salt Lake City, Utah, on October 27-28, 1983, and January 26-27, 1984, and contributed to this formulation of the work plan:

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HISTORICAL BACKGROUND

The concept of the Regional and Urban Earthquake Hazards Evaluation program element evolved out of discussions held at Asilomar Conference Center, Pacific Grove, California, in April 1982. At this meeting, 54 participants (27 USGS and 27 non-Survey) in the NEHRP were asked to debate the question "are changes in the NEHRP, now 5-years old, needed and if so what are they?" From these discussions, the 5 interrelated program elements constituting the current NEHRP were defined:

1) Regional Monitoring and Earthquake Potential--Perform geologic and seismological analyses of current earthquake activity, the seismic cycle of active faults and estimates of earthquake potential in earthquake-prone regions of the United States (23% of budget).

2) Earthquake Prediction Research--Conduct, field laboratory, and theoretical studies of earthquake phenomena with the goal of reliable prediction of the time, place, and magnitude of damaging earthquakes (44% of budget).

3) Data and Information Services--Provide data on earthquake occurrence to the public, other Federal agencies, State and local governments, emergency response organizations, and the scientific community (12% of budget).

4) Engineering Seismology--Operate a national network of strong motion instruments, disseminate the basic ground-motion information, and conduct research on the data (9% of budget).

5) Regional and Urban Earthquakes Hazards Evaluation--Compile and synthesize geologic and geophysical data needed for evaluating the earthquake hazards of ground-shaking, ground failure, surface fault rupture, and tectonic deformation and for assessing the risk in broad geographic regions containing important urban areas. Foster an environment for implementation, creating partnerships and providing high quality scientific information that can be used by local

governments to devise and implement loss-reduction measures (such as building codes, zoning ordinances, personal prepardness, etc.) (12% of budget).

COMPONENTS OF THE REGIONAL AND URBAN EARTHQUAKE HAZARDS PROGRAM ELEMENT

The Regional and Urban Earthquake Hazards program element has 5 **INTERRELATED** components:

1) Information Systems--The goal is to produce **QUALITY** data along with a comprehensive information system, available to both internal and external users for use in earthquake hazards evaluations, risk assessment, and implementation of loss-reduction measures.

2) Synthesis of Geological and Geophysical Data for Evaluation of Earthquake Hazards--The goal is to produce synthesis reports describing the state-of-knowledge about earthquake hazards (ground shaking, surface faulting, earthquake-induced ground failure, and tectonic deformation) in the region and to recommend future research to increase the state-of-knowledge required for the creation and implementation of loss-reduction measures.

3) Ground Motion Modeling--The goal is to produce deterministic and probabilistic ground-motion models and maps of the ground-shaking hazard with commentaries on their use.

4) Loss Estimation Models--The goal is to devise economical methods for acquiring inventories of structures and lifeline systems in urban areas, to create a standard model and commentary for loss estimation, and to produce loss and casualty estimates for urban areas.

5) Implementation--The goal is to foster the creation and implementation of hazard-reduction measures in urban areas, providing high-quality scientific information that can be used by local government decisionmakers as a basis for "calling for change."

Research focusing on one or more of the above components is presently being conducted in the following urban areas, ranked according to their respective priority:

1) Wasatch front, Utah,
2) Southern California,
3) Northern California,
4) Anchorage, Alaska,
5) Mississippi Valley,
6) Puget Sound, Washington,
7) Charleston, South Carolina, and
8) Buffalo-Rochester area, New York.

The Wasatch front is the only region where all 5 components are being conducted. In each region, the research is performed using the resources of the USGS's internal and external program (the external program is implemented through grants and contracts awarded annually following a request for proposals in cooperation with the resources of their "partners"). The goal is to achieve maximum synergism of State and Federal resources.

STRATEGIES FOR CONDUCTING RESEARCH IN THE WASATCH FRONT AREA

The strategies for the Wasatch front study are:

1) Foster Partnerships--USGS and UGMS will seek to foster strong partnerships with the universities, private sector, units of local government, and other State and Federal agencies. Existing partnerships will be strengthened.

2) Take advantage of past research studies and other activities--Results of past research studies will be utilized to the fullest extent possible. Achievements of the Utah Seismic Safety Advisory Council and, the USGS sponsored earthquake hazards workshop of 1980, and the Governor's Conference on Natural Hazards of 1983 will be used as building blocks for future activities.

3) Study 10 Counties Along the Wasatch Front--Although Salt Lake, Davis, Weber, and Utah Counties will receive the primary attention because of their population density, potential risk, and the availability of information from prior and ongoing research studies, Cache, Box Elder,

Summit, Wasatch, and Juab Counties will also be studied. The goal is to acquire a uniform, **HIGH QUALITY** data base on earthquake hazards.

4) Convene Annual Meetings to Review Progress and Recommend New Research--Each year, a workshop will be held in Salt Lake City to review: **WHAT HAS BEEN ACCOMPLISHED** and **WHAT IS STILL NEEDED TO ACCOMPLISH THE GOALS.** Participants from many different disciplines at in the workshop will be asked to address the question "what changes, if any, are needed to accomplish the goals of the program element "Regional and Urban Earthquake Hazards Evaluation: Wasatch front, Utah."

5) Publish Annual Reports and Communicate Findings--Proceedings of the workshops, which will include papers documenting results from all research projects in the Wasatch front, will be published as USGS Open-File Reports approximately 3- or 4-months after each meeting. In FY 86, the third year of the program, a USGS Professional Paper will be published. The workshops, their products, and the findings in the professional paper will be **COMMUNICATED** to policymakers whose task is to implement hazard-reduction policy.

6) Take Advantage of Earthquakes--Use knowledge gained from earthquakes such as the Borah Peak, Idaho, earthquake of October 1983 to improve the methodology that is currently used in the evaluation of earthquake hazards and the assessment of risk in the Wasatch front area. Many scientists consider the 1983 Borah Peak earthquake as representative of the type of earthquake that can occur along the Wasatch front. In addition, other parts of the World have a similar tectonic setting as the Wasatch front; earthquakes in these areas should be investigated to provide insight into the characteristics of ground-shaking and the physical effects that might occur in a major earthquake along the Wasatch front.

RESEARCH GOALS, OBJECTIVES, AND TASKS OF THE PROGRAM ELEMENT "REGIONAL AND URBAN EARTHQUAKE HAZARDS EVALUATION: WASATCH FRONT, UTAH"

INTRODUCTION

The 5 **INTERRELATED** components comprising the program element "Regional and Urban Earthquake Hazards Evaluation: Wasatch front, Utah" are described below to provide **GUIDELINES** for researchers who are either working now or planning to work in the Wasatch front area. The work plan each component will be reviewed annually and revised as apprropriate, to meet the research goals of the program element. UGMS (and their partners) will focus primarily on tasks described in components 1, 2, and 5. USGS (and their partners) will focus on tasks described in components 1-5.

COMPONENT 1: INFORMATION SYSTEMS

Every research study will generate basic data which needs to be organized. A large but unorganized amount of data relating to the earthquake hazards along the Wasatch front already exists in published maps, reports, and computerized data sets. If these data were organized, the resultant data base would be an extremely valuable resource for a wide variety of user groups, including the participants in the NEHRP. In addition, the data base is expected to grow as research studies mature.

The objectives of this component are: 1) to make quality data readily available to meet the needs of researchers and policymakers, 2) to create a system that assures that new data will be available in the form most useful to meeting program objectives, 3) to devise a system whereby potential users will have easy access to data in media, scales, and formats that will be most useful to them, and 4) to provide continuing information on objectives and progress of the program element. Accomplishing these objectives will require: 1) inventorying existing data sets, 2) developing data standards for critical data sets, 3) identifying user groups and thier needs, 4) developing strategies for data management and data dissemination, and 5) assuring that pertinent hazards data are available to the user community.

Priorities--The first priority is the creation of a directory of hazards information by the time of the 1984 annual workshop. Second priority is an inventory of existing data sets, perhaps using a standard questionnaire or form. Third priority is to test the capability for data interchange and communications.

Implementation--The objectives listed above will be accomplished primarily by USGS and UGMS. Tarr (USGS) and Mabey (UGMS) will provide leadership; however, others will be involved in the implementation of the tasks. To accomplish the above objectives, a leadership role is suggested for USGS and UGMS, as noted below in the task statements:

1) Inventory of Existing Data--UGMS lead. The UGMS is compiling a computerized bibliography of Utah geology that provides for keyword searches, including terms that are pertinent to the evaluation of earthquake hazards and the assessment of risk. The bibliography will be upgraded by the UGMS to meet the needs of the program element.

   USGS lead. USGS will compile a directory of hazards information to determine what data exists, what form the data are in, and the availability of the data. A determination will be made of each data set as to its adequacy for the needs of the research program.

2) Standardization--USGS lead. To the extent possible, the catalog of Utah earthquakes (especially the preinstrumental data) will be standardized because it is important, if not crucial, to several of the research studies. The catalogs of the University of Utah Seismograph Station and the USGS (National Earthquake Information Service, Algermissen) are the best starting point. Standards may need to be established for other major data sets, such as computer files of digitized geological data.

   UGMS lead. Part of this effort will be the selection of standard base maps and mapping scales for data compilation and publication by all participants in the program. Reproducible base materials must be available for rapid production of greenlines, paper copies, and film composites of maps. In addition, standards for computer storage of point data and line data will have to be established if automated computer mapping is to be realized.

3) Data Set Management--UGMS lead. A complete library of publications, reports, and a hard copy of data sets related to the Wasatch front studies are needed. These could be established as a part of the existing UGMS library.

USGS lead. The successful management of computerized data should expedite many research studies. Existing computer resources are the USGS VAX/VMS system in Golden, the Multics system in Lakewood, USGS PIO in Salt Lake City, and the Utah Department of Natural Resources Automatic Geographic Reference System in Salt Lake City. The University of Utah Computer Center and the NOAA data center in Boulder are other systems that may have to be accessed. Documented software to access and utilize the major data sets must also be available.

4) Information Transfer--UGMS lead. An earthquake information office is needed in Salt Lake City. Such an office would be concerned primarily with the dissemination of earth science information (e.g., in a quarterly newsletter) related to the earthquake hazards of ground-shaking, surface fupture, ground failure, and tectonic deformation, as well as earthquake preparedness. The office would provide, to a wide variety of users: historic and current data on Utah earthquakes, information on current research, and advice on obtaining access to earthquake-related literature and data. The new earthquake information office could be established at the UGMS, with a close working relationship with the USGS Public Inquiries Office in Salt Lake City.

COMPONENT 2: SYNTHESIS OF GEOLOGIC AND GEOPHYSICAL DATA FOR EVALUATION OF EARTHQUAKE HAZARDS

Geologic and geophysical research aimed at a better understanding of the potential for the occurrence of large, damaging earthquakes in the Wasatch front region have been carried out since as early as 1970. These studies have provided a critical perspective on the level of the potential hazard for the region and have contributed, in large part, to the high priority given to this area in the Regional and Urban Earthquake Hazards program element. The geologic and geophysical data collected in these studies are essential in the evaluation of earthquake hazards and the assessment of risk from earthquakes occurring in the region. However, the results of these studies have been released primarily as discrete scientific papers in research journals or in the "gray" literature of USGS Open-File Reports and other publications. They have not been synthesized or integrated into a comprehensive evaluation of the potential for the occurrence of damaging earthquakes and the associated hazards of ground-shaking, ground failure, surface fault rupture, and tectonic deformation in the Wasatch front region.

Priorities--First priority will be given to collecting and synthesizing basic geologic and geophysical data required for evaluation of earthquake hazards. The second priority is to conduct additional research needed to achieve the goals of the program element.

Implementation--USGS and UGMS scientists (identified below) will provide leadership and perform the research tasks identified below. In addition, other researchers in universities and the private sector (e.g. University of Utah, Utah State University, and others) will participate under the auspices of the USGS's grants and contracts program.

1) Collection and Synthesis--Research initiated in prior years will be continued as well as new research, focusing on the collection and synthesis of those data needed for realistic deterministic and probabilistic calculations of hazard and risk for the region, as well as carrying out essential additional research. This effort will be integrated to provide: a) a broader understanding of the setting and effects of active tectonic processes and rates of tectonic activity producing earthquakes in the region, and b) definition and study of specific geologic hazards of special significance to the Wasatch front area.

The objective of the above task is to develop synthesis reports and maps on four main topics. Project chiefs in USGS and UGMS are listed below for each topic:

a) Geologic/tectonic setting of current seismicity of the Wasatch front region:

Project Chief/Investigator	Project Topic
Anderson	Seismotectonic Studies, Eastern Great Basin
Wheeler	Structural controls of segmentation, Wasatch front
Pakiser	Review and evaluation of crustal models Basin and Range Province
Diment	Geophysics of eastern Great basin Transition Zone
Mabey (UGMS)	Interpretation of subsurface and geophysical data (Utah Valley to Ogden area)

b) Late-Quaternary tectonic activity of the Wasatch front region:

Project Chief/Investigator	Project Topic
Crone	Subsurface geometry of late-Quaternary faults, Wasatch front region
Machette/Rehis	Late Quaternary history of the Wasatch fault in the Santaquin-Nephi region
Wood	Tectonic deformation, Wasatch front region
Kaliser (UGMS)	Documentation of evidence of Late-Quaternary faulting in Wasatch front urban area

c) Timing and character of Late-Quaternary ground failure events:

Project Chief/Investigator	Project Topic
Madole	Timing of ground failure events, Wasatch front region
Not assigned	Liquefaction potential mapping
Not assigned	Surface faulting
Not assigned	Slope stability mapping
Bucknam	Seismic source zone mapping

d) Information for local and regional use in hazard reduction:

Project Chief/Investigator	Project Topic
Not assigned (UGMS)	Compilation of hazards information for local and regional use

COMPONENT 3: GROUND MOTION MODELING

This component is concerned primarily with the prediction of the effects of local geologic site conditions on ground shaking in the Salt Lake City region, although the effects of the source and the travel path will also be considered. Knowledge of the nature and severity of ground motion induced at a site is fundamental to sound earthquake-resistant design. Although the importance of local geologic conditions has been recognized for many years, the quantitative prediction of their influence on ground shaking using either empirical or theoretical models is still evolving. In this component, the application, extension, and validation of relevant research techniques will be continued in the Salt Lake City area and along the Wasatch front.

Priorities--The first priority is to install strong motion accelerographs in the Salt Lake City area and to acquire and use the mini-Sosie portable reflection system in ground-response research. (Utah only has one strong motion accelerogram from past earthquakes.) The second priority is to prepare a synthesis report of the ground shaking data available from prior studies in Utah. The third priority is to extend the results of these studies, performing deterministic and probabilistic hazard analysis and utilizing new equipment (mini-Sosie, strong motion accelerographs, etc.) to acquire basic data.

Implementation--The research will be conducted primarily by Algermissen, Campbell, Hays, Rogers, and King (USGS). Non-USGS researchers will be invited to participate through the Survey's external grants and contract program. The tasks are described below:

1) Synthesis Report--The research by Hays, King, and Miller, which used nuclear-explosion ground-motion data to derive ground response in the Salt Lake City-Ogden-Provo-Logan-Cedar City area, has been published in several journals (e.g., Proceedings of Third International Conference on Seismic Microzonation), but has not been synthesized and published in a reference that is more readily available. Such a report will be produced in FY 84. A USGS Open-File report describing the nuclear-explosion ground-motion data will also be produced.

2) <u>Deterministic and Probabilistic Hazard Analysis</u>--Research on deterministic and probabalistic hazard analysis, applied in 1982 on a national scale by Algermissen and others, will be applied in the Wasatch front urban areas, and extended by using time-dependent models of earthquake occurence. A regional seismic wave attenuation function for Utah will be derived. These analyses, combined with the inventory and vulnerability studies discussed below in the loss estimation component, will form the basis for estimates of economic loss (risk) and casualties.

3) <u>Research on Attenuation and Ground Response</u>--Begining in late FY 84, the methodology developed by Rogers and others to zone the ground-shaking hazard in Los Angeles will be applied to the Wasatch front. This empirical technique uses several generally available geotechnical factors to predict how site conditions will influence ground motion during an earthquake. Sites are classified into site types or clusters according to their geotechnical factors, and a mean ground shaking factor (dependent on the site's cluster type) is assigned to the site in three separate period bands. The classification scheme developed for Los Angeles will be applied to Salt Lake City. Validation of this technique for Salt Lake City will be accomplished by comparing ground motions recorded by Hays and others in Salt Lake City with the predictions. By combining and comparing the cluster results at selected sites throughout the city with mapped near-surface geology, maps of the ground-shaking response relative to rock can be constructed for each of the three period bands on a regional basis. These results will also be used to construct intensity maps for a maximum-magnitude earthquake. Ground-response research is still in the early stages, and as noted by Rogers and others, some sites outside of Los Angeles can not be classified using the scheme developed for that city. Additional site types may have to be developed in this study; these clusters might possibly be based on the data of Hays and others. Additional ground motion data, however, may have to be collected, as well as the development of new correlation techniques and the collection of new site properties.

Regional seismic-wave attenuation functions for the Wasatch front will be derived using the best available data.

4) Zoning Research--Beginning in FY 85, research with high frequency techniques (e.g., mini-Sosie) will be initiated to determine subsurface conditions within the study area that are known to exhibit high ground response. For example, in the Los Angeles study near-surface velocity contrasts in the depth range of 10-20 meters were found to cause the highest levels of ground response for buildings that are in the 2- to 5-story class. Buildings having more than 5-stories were also found to be at greatest risk when located at sites where the depth to basement is the greatest. Because reflection techniques may provide the only means to define the important subsurface factors controlling site response in some urban areas, experiments will be conducted in Salt Lake City and Los Angeles at sites where measured site response can be correlated with reflection data.

5) Probabilistic Ground Shaking Hazard Maps Incorporating Ground Response--Following tasks 1-4, described above, revised estimates of the probabilistic ground-shaking hazard in the Salt Lake City region will be made. Maps of the peak acceleration and intensity will be prepared for exposure periods of 10, 50, and 250 years. These maps will incorporate the effects of local geologic conditions.

COMPONENT 4: LOSS ESTIMATION MODELS

In this component all available hazards data will be used in the development of economic loss (risk) and casualty estimates. Estimates of probable losses and casualties in an earthquake are important results. Loss estimates provide a scientific basis for land-use planning, an economic basis for the implementation of suitable building codes, and form the framework for disaster mitigation, preparedness and relief programs. A considerable amount of research on loss estimation (seismic risk) has already been done in the Wasatch front area by USGS and its consultants. An earthquake vulnerabilty study was completed in 1976 (Rogers, et al 1976) to provide planning guidance for earthquake preparedness and mitigation. Preliminary estimates of economic losses using three different loss models for Salt Lake City have recently been published (Algermissen and Steinbrugge, 1984).

Priorities--The first priority is to update the existing building inventory in Salt Lake City (especially considering high rise buildings) and to create an inventory for lifeline systems. The second priority is to establish building inventories and lifeline system inventories in other parts of the study area, seeking to achieve uniformity with the Salt Lake City inventories. The third priority is to reassess the vulnerability relationships for Utah.

Implementation--The research will be conducted primarily by Algermissen, (USGS). Non-USGS researchers will be invited to participate through the Survey's external grants and contract program. The tasks are described below:

1) Loss Estimation, Salt Lake City-Ogden-Provo--Begining in FY 84, the primary emphasis will be placed on research concerning earthquake loss (risk) studies is the Salt Lake City, Ogden, and Provo metropolitan areas. The data requirements are: 1) update the existing building inventory in Salt Lake City, 2) develop an inventory of buildings in other parts of the study area, 3) reassess vulnerability relationships for Utah, utilizing new data from the 1983 Coalinga, California, earthquake and data obtained from additional review and analysis of the 1971 San Fernando, California, earthquake, and 4) develop additional data on the distribution and vulnerability of lifeline systems in the Salt Lake City-Ogden-Provo areas.

   Deterministic loss and casualty estimates will be made for magnitude (M_s) 6.5 and 7.5 earthquakes having various locations on the Wasatch fault. Probabilistic loss and casualty estimates will be computed for exposure times of interest of 10, 50, and 250 years at the 90 percent probability level. Both deterministic and probabilistic loss estimates will be based on appropriate ground motion hazard maps which, where possible, will include site response (see above discussion of ground motion modeling). The loss estimates will also include, where possible, losses associated with the geologic effects of earthquakes such as liquefaction. Total economic losses will be estimated and, in addition, losses by class of construction and the vulnerability. In general, the classes of construction used will be based principally on their framing system. Casualty estimation will require additional data on building occupancy.

2) Loss Estimation, Other Parts of the Study Area--To the extent possible, the same data identified in task 1 above will be acquired in other counties in Utah and used to perform loss estimates.

COMPONENT 5: IMPLEMENTATION

The goal of this component is effective use of scientific information to reduce loss of life and damage to property caused by earthquake hazards as well as by other geologic and hydrologic hazards. Successful achievment of the goal requires **COMMUNICATION** of **TRANSLATED SCIENTIFIC INFORMATION to RESPONSIBLE OFFICIALS** and **INTERESTED PARTIES** seeking to **REDUCE HAZARDS** by use of one or more **REDUCTION TECHNIQUES**. These aspects of the problem and its solution will be discussed below, providine a framework for an integrated work plan involving all concerned parties and guidelines for proposals to the Survey's external grants and contracts program.

Priorities--The first priority is to determine the needs of users in Utah for earthquake hazards information. The second priority is to produce translated (i.e., interpreted information derived from basic scientific data) scientific information that meets the needs of these user groups. The third priority is to foster an environment for implementation of research results by local governments, utilizing workshops, training classes, questionnaires and other procedures to communicate the scientific information.

Implementation--Leadership for the implementation components will be provided by Atwood and Mabey (UGMS) and Gori, Hays, and Kockelman (USGS). One objective of this component is to make it easy for local government, engineers, architects, planners, emergency preparedness planners, and emergency responders to use the technical information generated in this program. A key strategy is to build on past successful activities such as the Utah Seismic Safety Advisory Council (1977-1980) and the "Governor's Conference on Geologic Hazards" (August 1983). Partnerships between the research community (USGS, UGMS, universities, and the private sector) and those who will ultimatly use the information to implement hazard-reduction plans are necessary for success, and the strongest possible effort will be made to achieve these partnerships within the initial three years. However, implementation activities, described below, must continue after the Wasatch front is no longer receiving first priority in the Survey's "Regional and Urban Earthquake Hazards Evaluation program element".

1) Scientific Information--This task began before FY 84 because many prior studies (e.g., conducted by the University of Utah, Utah State University, Woodward Clyde Consultants, USGS, UGMS, and others) have produced considerable high-quality information. Translated scientific information is a prerequisite to its transfer to a user and its use in a loss-reduction measure or technique. While a great deal of scientific information can be used directly by engineers or other scientists, some information must be translated to enhance its understanding and effective use by nonscientists. Such translated information includes: fault-rupture location with forecasts of recurrence intervals and anticipated displacement, liquefaction with levels of susceptibility, areas of landslide hazard with levels of susceptibility, areas of inundation caused by hypothetical dam failures, and areas of building failures caused by ground shaking. The following actions are likely to improve use of scientific information by nonscientists:

-- Identify and catalog existing hazard maps and reports.

-- Identify the hazard maps and reports needed for hazard-reduction measures.

-- Estimate cost and determine responsibility, funding, and delivery of the information that can be provided.

-- Assure that new information is prepared in the detail and at the scales needed by the users (see Table 1).

-- Make special efforts to present the information in a format and language suitable for use by engineers, planners, and decisionmakers.

-- Assure that information (including discoveries, advances, and innovative uses) is released promptly through appropriate communicators and communication techniques (see Tables 2 and 3).

2) Communication--This task is also a continuation of past activities. Communication of scientific information consists of both its transfer and its effective use for hazard reduction. Examples of communicators and communication techniques are listed in Tables 2 and 3. The following actions are likely to improve effective use of the technical information:

-- Design the communications program after an assessment of potential users' needs and capabilities.

-- Select the most effective educational, advisory, and review services (Table 2) appropriate to the targeted users.

-- Design the communications program so that information can be effectively disseminated (including use of the scientists and investigators to help communicate).

3) Determine Users' Needs--The past work by the Utah Seismic Safety Advisory Council (1977-1980) and the August 1983 Governor's Conference on geologic hazards succeeded to some extent in determining the needs for earthquake hazards information in Utah. Use of scientific information by nonscientists requires a considerable effort on the part of both the producers and the users to communicate with each other, and although a variety of users exist, effective use depends upon the users' interests, capabilities, and experience in hazard reduction. Examples of users are

listed in Table 1. The following actions will ensure effective transfer of the information to potential users:

-- Identify and target users (Table 1) that have urgent needs and who could be expected to use the information most effectively.

-- Consult with those users about their needs and priorities and prioritize the information needed.

-- Monitor and analyze the enactment of local, State, and Federal hazard-reduction laws or regulations and the issues that affect users in order to anticipate and respond to their needs.

-- Encourage users--both public and private--to develop an in-house capability to obtain and apply the information (including risk assessment).

-- Orient or train targeted users in order to enable them to understand and to use the information effectively.

4) <u>Reduction Techniques</u>--This task must also build on past activities. Many opportunities are available for reducing geologic and hydrologic hazards. Examples of hazard-reduction techniques are listed in Table 4. The following actions will increase the likelihood of an effective reduction of hazards:

-- Identify the most effective reduction techniques that are either being used by the targeted users or are available to them.

-- Review existing State programs or laws that could incorporate such reduction techniques and recommend changes or new programs and laws.

-- Devise and test innovative reduction techniques.

5) <u>Evaluation</u>--Continuing systematic evaluation will be a part of this program and is a key to any successful State-local hazard reduction

program. An inventory of uses made of the scientific information, interviews with users, and an analysis of the inventory and responses will result in identifying new users, and any obstacles to communication of the information or its effective use. The following actions will make evaluation easier and enhance implementation:

-- Inventory uses of information (Table 4) to identify and document the type and number of uses of each hazards map or report.

-- Analyze uses of the hazards information and any problems identified and suggest improvement to the information or to the communication techniques.

-- Identify problems with and suggest improvements to reduction techniques by the monitoring of land-use decisions.

-- Interview users of information (Table 1) to evaluate the adequacy of the information and the communication techniques and to identify obstacles to their effectiveness.

Proposed-Selection Criteria--Numerous combinations of scientific information, communication techniques, users, and reduction techniques exist. Consideration of the following factors will be helpful in the selection of proposals for grants and contracts in support of the above implementation tasks:

-- User is an applicant.

-- Experienced communicator is an applicant.

-- A high probability exists for successful transfer and effective use of the information.

-- A communicator is in place and communication technique are in operation.

-- Translated scientific information is immediately available to the user.

-- Minimum time is required for translation and transfer of the information.

-- A large number of people or numerous critical facilities are at risk in the targeted area.

-- Rapidly urbanizing areas are located in the targeted area.

-- An opportunity exists for innovative or prototypical communication or reduction techniques.

-- Sponsor, convene, and coordinate at least one workshop each year designed to foster an environment for implementation of loss reduction measures at the local level.

-- Evaluate proposals and fund selected projects that will enhance implementation.

-- Enlist Federal partners.

Suggested Roles for UGMS--Initially, the role of the UGMS would be to:

-- Advise the USGS on the selection of projects that will enhance implementation.

-- Serve as a technical advisor and reviewer of funded implementation projects.

-- Enlist partners in Utah.

Table 1

Some Potential Users of Geologic and Hydrologic Information for Earthquake-Hazard Reduction along the Wasatch Front, Utah

City, County, and Areawide Government Users
City building, engineering, zoning, and safety departments
County building, engineering, zoning, and safety departments
Mayors and city council members
Multicounty planning, development, and preparedness agencies
Municipal engineers, planners, and administrators
City and county offices of emergency services
Planning and zoning officials, commissions and departments
Police, fire, and sheriff's departments
Public works departments
County tax assessors
School districts

State Governments Users
Department of Community and Economic Development (Community Services Office, Economic and Industrial Development)
Department of Business Regulation (Contracts Division, Real Estate Division)
Department of Financial Institutions
Department of Health (Environmental Health, Health Care Financing)
Department of Natural Resources
Department of Transportation
Division of Comprehensive Emergency Management
Division of Water Resources
Division of Water Rights
Facilities Construction and Management
Geological and Mineral Survey
Governor's Office
Legislative Fiscal Analyst
Legislative Research and General Counsel
National Guard
Planning and Budget Office
Public Service Commission
Science Advisor
State Tax Commission

Federal Government Users

Army Corps of Engineers
Bureau of Land Management
Bureau of Reclamation
Congress and Congressional staffs
Department of Agriculture
Department of Energy
Department of Housing and Urban Development
Department of Interior
Department of Transportation
Environmental Protection Agency
Farmers Home Administration
Federal Emergency Management Agency
Federal Housing Administration
Federal Insurance Administration
Federal Power Commission
Forest Service
General Services Administration
Geological Survey
National Bureau of Standards
National Oceanic and Atmospheric Administration
National Park Service
National Science Foundation
Nuclear Regulatory Commission
Small Business Administration
Soil Conservation Service

Other National Users

Applied Technology Council
American Association of State Highway and Transportation Officials
American Public Works Association
American Red Cross
Association of Engineering Geologists
Association of State Geologists
Council of State Governments
Earthquake Engineering Research Institute
International Conference of Building Officials
National Academy of Sciences
National Association of Counties
National Association of Insurance Commissioners
National Governors' Association
National Institute of Building Sciences
Natural Hazards Research and Applications Center
National League of Cities
Professional and scientific societies (including geologic, engineering, architecture, and planning societies)
United States Conference of Mayors

Private, Corporate, and Quasi-public Users

Civic and voluntary groups
Concerned citizens
Construction companies
Consulting planners, geologists, architects, and engineers
Extractive, manufacturing, and processing industries
Financial and insuring institutions
Landowners, developers, and real-estate persons
News media
Real-estate salespersons
Utility companies
University departments (including geology, civil engineering, architecture, urban and regional planning, and environmental departments).

Table 2

Typical Communication Techniques

Educational services
Assisting and cooperating with universities and their extension divisions in the preparation of course outlines, detailed lectures, casebooks, and display materials.
Contacting speakers and participating as lecturers in regional and community educational programs related to the application of hazard information.
Sponsoring, conducting and participating in topical and areal seminars, conferences, workshops, short courses, technology utilization sessions, cluster meetings, innovative transfer meetings, training symposia, and other discussions with user groups, e.g. 1983 Utah Governor's Conference on Geologic Hazards, UGMS Circular 74.
Releasing information needed to address critical hazards early through oral briefings, newsletters, seminars, map-type "interpretive inventories," open-file reports, reports of cooperating agencies, and "official use only" materials.
Sponsoring or cosponsoring conferences or workshops for planners and decisionmakers at which the results of hazard studies are displayed and reported on to users, e.g. scheduled USGS workshop, August 1984.
Providing speakers to government, civic, corporate, conservation, and citizen groups, and participating in radio and television programs to explain or report on hazard-reduction programs and products.
Assisting and cooperating with regional and community groups whose intention it is to incorporate hazard information into school curricula.
Preparing and exhibiting displays that present hazard information and illustrate their use in hazard reduction.
Attending and participating in meetings with local, district, and State agencies and their governing bodies for the purpose of presenting hazard information.
Guiding field trips to potentially hazardous sites.
Preparing and distributing brochures, TV spots, films, and other visual materials to the news media.

Advisory services
Preparing annotated and indexed bibliographies of hazard information and providing lists of pertinent reference material to various users.
Assisting local, State, and Federal agencies in designing policies, procedures, ordinances, statutes, and regulations that cite or make other use of hazard information.
Assisting in recruiting, interviewing, and selecting planners, engineers, and scientists by government agencies for which education and training in hazard information collection, interpretation, and application are criteria, e.g. pending proposal to fund county geologists.
Assisting local, State, and Federal agencies in the design of their hazard information collection and interpretation programs and in their work specifications.

Providing expert testimony and depositions concerning hazard research information and its use in reduction techniques.
Assisting in the presentation and adoption of plans and plan-implementation devices that are based upon hazard information.
Assisting in the incorporation of hazard information into local, State, and Federal studies and plans.
Preparing brief fact sheets or transmittal letters about hazard products explaining their impact on, value to, and most appropriate use to local, State, and Federal planning and decisionmaking.
Assisting users in the creation, organization, staffing, and formation of local, State, and Federal planning and planning-implementation programs so as to assure the proper and timely use of hazard information.
Preparing and distributing appropriate user guides relating to earth hazard processes, mapping, and hazard-reduction techniques, e.g. UGMS fliers.
Preparing model State safety legislation, regulations, and development policies.
Preparing model local safety policies, plan criteria, and plan-implementation devices.

Review services

Review of proposed programs for collecting and interpreting hazard information.
Review of local, State, and Federal policies, administrative procedures, and legislative analyses that have a direct effect on hazard information.
Review studies and plans based on hazard information.

Table 3

Representative Communicators of Hazard Information

American Institute of Architects/Research Corporation
American Institute of Certified Planners, Utah Chapter
American Institute of Professional Geologists, Utah Chapter
American Society of Public Administrators, Utah Chapter
American Society of Civil Engineers, Utah Chapter
Association of Engineering Geologists, Utah Chapter
Bear River Association of Governments
Children's Museum
Church groups, church organizations, and church-sponsored events
Circuit riders (regional or project area)
City Management Association
Civic and voluntary groups
Community planning assistance programs
Council of State Governments
County extension agents
Educators (univerity, college, high school, and elementary school levels)
Governor's Advisory Council on Local Governments
Hansen Planetarium
Hazrd-information clearinghouse (national, regional, or project area)
Hazard researchers, interpreters, and mappers
International Conference of Building Officials, Utah Chapter
Journalists, commentators, and editors, and their professional associates
Local seismic safety advisory groups
Mountain Lands Association of Governments
Museum of Natural History
National Council of State Legislators
National Governor's Conference
Neighborhood associations
Public information offices (Federal and State)
Researchers, engineers, and planners
Speakers bureaus (regional or project area)
Society of American Foresters, Wasatch Front Chapter
Urban and Regional Information Systems Association
University of Utah Seismograph Stations
Utah Association of Counties
Utah Geological Association
Utah League of Cities and Towns
Utah Geological and Mineral Survey
United States Conference of Mayors
U.S. Bureau of Land Management
U.S. Forest Service
U.S. Geological Survey
U.S. Soil Conservation Service
Wasatch Front Regional Council
Western Governor's Policy Office

Table 4

Some Opportunities for Using Geologic and Hydrologic Information to Reduce Earthquake Hazards along the Wasatch Front, Utah

Preparing development studies and plans

Circulation of transportation studies or plans
Community facility and utility inventories or plans
Environmental impact assessments and reports
Land-use and open-space inventories or plans
Land subdivision lot layouts
Multi-hazards inventories, risk analyses, and response capabilities
Natural-hazards reduction plans
Redevelopment plans (pre- and post-earthquake)
Seismic safety and public safety plans

Discouraging new or removing existing unsafe development

Capital-improvements expenditures
Costs of insurance
Disclosing hazards to real-estate buyers
Financial incentives and disincentives
Governor's executive orders
Policies of private lenders
Non-conforming use provisions in zoning ordinances
Posted warnings of potential hazards
Public acquisition of hazardous areas
Public facility and utility service policies
Public information and education
Recording the hazard on public records
Removing unsafe structures
Special assessments or tax credits

Regulating development

Building ordinances
Design and construction regulations
Grading regulations
Hazard-zone investigations
Land-use zoning districts and regulations
Special hazard-reduction ordinances
Subdivision ordinances

Designing and building structures

Strengthening or retrofitting of unsafe structures
Critical facilities, siting, design, and construction
Engineering, geologic, and seismologic reports
Public-facility or utility reconstruction or relocation
Reconstruction after earthquakes
Repair of dams
Site-specific investigations and hazard evaluations

Preparing for and responding to disasters

Anticipating damage to critical facilities
Damage inspection, repair, and recovery procedures
Dam and reservoir supervision
Disaster training exercises
Earthquake-prediction response plans
Earthquake-preparedness plans
Emergency response plans
Monitoring and warning systems
Relocating occupants of exceptionally hazardous buildings