Summary and Conclusions

The tectonic setting and regional seismicity of the northeastern Caribbean expose the island of Puerto Rico to a high seismic hazard. Large magnitude events in 1918 (est. magnitude 7.5), 1867 (est. magnitude 7.75), and 1787 (est. magnitude 8.-8.25) caused hundred of deaths and millions of dollars in material losses. Similar events will occur in the future. Off-shore faults in the Puerto Rico Trench, Mona Passage-Mona Canyon area, Anegada Passage, and the Muertos Trough are the most important potential earthquake sources in the Puerto Rico area. The Puerto Rico Trench, approximately 60 km. north of the metropolitan area of San Juan, poses the greatest hazard to the study area due to its proximity and high seismic potential (est. magnitude 8.8.25). On the basis of earthquake magnitude and intensity recurrence, regional attenuation and this researcher's judgement, the selected earthquake hazard level (most probable earthquake) for the risk analysis corresponds to a Modified Mercalli intensity VIII. This value is used as the basis for damage estimation.

The geology and geomorphology of the study area were defined as a preliminary step to mapping earthquake-induced geologic hazards. Three hazards were defined for the study area; ground shaking, landslides, and liquefaction. A map depicting hazard zones was prepared showing three levels of susceptibily for each hazard. Damage ratio was estimated for each zone adapting the procedures recommended by the Rice Center for earthquake risk analysis. The most important geologic hazard in the metropolitan area of San Juan is ground shaking, liquefaction and landslides. The analysis concludes that the most vulnerable areas are the

artificial fills placed over swamp deposits around San Juan Bay, Caño Martín Peña and Laguna San José and the alluvial deposits in the floodplains of Río Grande de Loíza, Río Piedras and Río Bayamón. Both areas are exposed to a high ground shaking and ground failure hazard. Located in these zones are important lifelines such as the Bahía de Puerto Nuevo thermoelectric plant, transmission lines, electric energy substations, water treatment plants, pumping stations, water mains, docks,airport facilities and vital expressways that link the capital with the rest of the Island.

Moderate to high liquefaction potential is present in the alluvial deposits of the floodplains of Río Grande de Loíza, Río Piedras and Río Bayamón and in the loose saturated sands near the coasts. Located in these zones are a large number of high rises and housing units, airport facilities, roads, water mains, pumping stations, and other lifelines.

Moderate to high landslide potential is present in the southern portion of the study area. Landslide damage potential in this zone varies with the antecedent moisture conditions of the hillslopes. An earthquake after a protracted period of rains can severely affect lifelines specially roads, where slope excavations, overloading, removal of lateral support, and other similar situations cause potentially unstable slope conditions.

It is recommended that earthquake mitigation strategies focus on high risk zones on the artificial fills surrounding the Bay and lagoons, the floodplains of Río Grande de Loíza, Río Bayamón and Río Piedras, and localized zones near the coast characterized by a moderate to high liquefaction

potential. Site specific geotechnical studies should be conducted in areas of greater risk in order to assess the specific vulnerability.

Puerto Rico must prepare for a big earthquake. A significant portion of the residential, commercial and transportation infrastructure are located in hazardous zones. Today the potential damage that will be created by a large earthquake event is greater than ever before. This study is a step in the efforts to prepare the Island for such event.

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APPENDIX I

Magnitude Recurrence For the Puerto Rico Region

Magnitude	100 years probability	One event every
4.0	198.266	
4.1	164.553	
4.2	137.187	
4.3	114.863	once a year
4.4	96.564	
4.5	81.499	
4.6	69.040	
4.7	58.695	
4.8	50.071	2 years
4.9	42.855	
5.0	36.794	
5.1	31.685	
5.2	27.366	
5.3	23.701	
5.4	20.582	5 years
5.5	17.920	
5.6	15.641	
5.7	13.685	
5.8	12.002	
5.9	10.549	10 years
6.0	9.292	
6.1	8.202	

Magnitude	100 years probability	One event every
6.2	7.255	
6.3	6.429	
6.4	5.709	20 years
6.5	5.078	
6.6	4.525	
6.7	4.040	
6.8	3.612	
6.9	3.235	30 years
7.0	2.902	
7.1	2.608	
7.2	2.346	
7.3	2.114	50 years
7.4	1.908	
7.5	1.724	
7.6	1.560	
7.7	1.413	
7.8	1.282	
7.9	1.165	
8.0	1.059	
8.1	.964	100 years
8.2	.879	
8.3	.802	
8.4	.733	
8.5	.670	

APPENDIX II

Earthquakes within 200 miles of Puerto Rico 1915 - 1983

Year	Month	Day	Latitude	Longitude	Magnitude
1946	Aug	04	19.25	69.00	8.1
1943	Jul	29	19.25	67.50	7.9
1918	Oct	11	18.50	67.50	7.5
1916	Apr	24	18.50	68.00	7.2
1917	Jul	27	19	67.50	7.0
1946	Oct	04	18.75	68.50	7.0
1915	Oct	11	19.00	67.00	6.8
1920	Feb	10	18.00	67.50	6.5
1927	Aug	02	19.00	64.50	6.5
1943	Jul	30	19.25	67.75	6.5
1919	Sep	06	19.50	64.50	6.3
1922	Dec	18	19.00	67.00	6.3
1930	Jun	25	19.00	64.00	6.3
1961	Nov	16	18.50	68.80	6.0
1964	Dec	22	18.40	68.00	6.0
1933	Jul	21	19.00	68.50	5.8
1955	May	13	19.28	64.38	5.8
1970	Jul	08	18.00	64.60	5.8
1935	Sep	15	19.00	65.00	5.6
1939	Dec	24	18.00	68.00	5.6
1939	Mar	07	18.00	67.00	5.6
1939	Mar	07	18.00	67.00	5.6

Year	Month	Day	Latitude	Longitude	Magnitude
1943	Aug	08	19.00	68.00	5.6
1943	Aug	15	19.00	68.25	5.6
1944	Aug	09	18.50	67.00	5.6
1966	Nov	03	19.20	68.00	6.25
1961	Aug	19	18.00	68.80	5.5
1964	Aug	10	19.10	67.30	5.5
1967	Sep	03	18.64	67.67	5.5
1965	Jun	12	19.20	64.90	5.4
1966	Jan	15	19.30	65.30	5.4
1959	Jul	21	18.87	68.04	5.3
1964	Jan	18	18.80	69.40	5.3
1965	Sep	06	18.60	67.60	5.3
1966	Dec	24	18.69	64.51	5.3
1966	Jan	13	19.00	64.70	5.3
1967	Apr	12	18.00	68.39	5.3
1971	Jun	26	19.02	68.01	5.3
1965	Nov	15	18.24	65.36	5.2
1965	Nov	16	18.73	67.50	5.2
1966	Nov	03	19.10	67.90	5.2
1965	Nov	21	19.30	67.40	5.1
1966	Sep	07	19.01	64.67	5.1
1968	Apr	13	19.00	66.90	5.1
1966	Aug	13	18.01	68.70	5.0

Year	Month	Day	Latitude	Longitude	Magnitud
1966	Dec	07	18.30	68.50	5.0
1966	Sep	08	17.63	65.65	5.0
1969	Aug	01	18.80	64.40	5.0
1971	Jul	08	19.07	68.03	5.0
1971	Jun	12	18.91	64.32	5.0
1974	Aug	23	19.05	68.04	5.0
1976	Dec	28	19.96	65.00	5.0
1943	Jul	31	19.00	67.10	4.9
1944	Feb	15	17.00	67.00	4.9
1945	Jul	13	19.00	64.00	4.9
1945	Nov	08	19.00	68.00	4.9
1945	Sep	26	19.00	65.00	4.9
1949	Dec	21	18.50	67.00	4.9
1949	Feb	08	18.00	68.50	4.9
1949	Jun	04	19.50	67.00	4.9
1949	Jun	12	19.00	69.00	4.9
1949	Jun	22	19.00	69.00	4.9
1949	Mar	23	19.00	68.50	4.9
1950	Jun	15	19.00	69.00	4.9
1951	Feb	21	18.57	69.00	4.9
1951	Jul	11	18.00	69.68	4.9
1963	May	23	19.20	64.50	4.9
1966	Sep	10	19.10	67.20	4.9
1967	Aug	15	19.20	68.50	4.9

Year	Month	Day	Latitude	Longitude	Magnitude
1967	Feb	21	19.14	67.91	4.9
1970	Nov	08	18.60	64.70	4.9
1971	Jun	27	19.07	67.91	4.9
1971	Sep	30	18.06	64.52	4.9
1974	Jun	21	18.94	66.99	4.9
1975	Aug	25	15.97	67.62	4.9
1954	Apr	01	19.38	67.23	4.8
1964	Jul	14	19.00	66.50	4.8
1964	Nov	05	18.20	68.40	4.8
1967	Mar	20	19.31	64.94	4.8
1969	Oct	15	19.28	65.43	4.8
1970	Jun	13	19.25	65.22	4.8
1971	Aug	26	19.01	67.73	4.8
1971	Feb	02	18.19	68.39	4.8
1950	Jan	02	19.03	67.72	4.7
1964	Jun	16	19.60	66.80	4.7
1965	Dec	10	18.50	69.00	4.7
1965	Jun	30	18.50	68.70	4.7
1966	Nov	04	19.20	67.80	4.7
1966	Nov	09	19.20	67.90	4.7
1966	Nov	20	18.20	68.40	4.7
1968	Mar	29	18.80	64.80	4.7
1968	Oct	31	17.92	67.60	4.7
1969	Jan	03	18.50	65.06	4.7

Year	Month	Day	Latitude	Longitude	Magnitude
1970	Apr	07	18.18	68.12	4.7
1970	Aug	16	19.11	65.06	4.7
1970	Nov	15	18.98	66.83	4.7
1971	Aug	27	19.21	68.11	4.7
1972	Feb	02	18.50	66.90	4.7
1973	Apr	01	19.22	64.28	4.7
1973	Apr	01	19.28	64.17	4.7
1974	Jun	01	18.18	68.03	4.7
1974	Oct	09	19.32	65.18	4.7
1974	Oct	26	18.42	66.32	4.7
1964	Aug	24	18.40	68.80	4.6
1966	Jul	16	18.20	64.70	4.6
1966	Jun	17	18.50	68.80	4.6
1966	Nov	22	19.20	67.90	4.6
1966	Sep	10	19.30	67.90	4.6
1966	Sep	14	19.20	67.80	4.6
1967	Mar	01	19.20	67.80	4.6
1968	Apr	26	18.20	68.00	4.6
1969	Apr	06	19.40	64.57	4.6
1970	Jul	05	19.09	68.40	4.6
1970	Jul	05	19.02	68.42	4.6
1970	Sep	07	19.24	65.14	4.6
1971	Jul	08	19.12	64.39	4.6
1972	May	23	18.53	66.95	4.6

Year	Month	Day	Latitude	Longitude	Magnitude
1972	Sep	03	17.76	65.67	4.6
1973	Oct	16	19.48	64.43	4.6
1974	Aug	29	17.82	65.48	4.6
1974	Jan	01	19.05	64.94	4.6
1976	Dec	02	15.91	67.97	4.6
1976	Jul	02	19.63	69.63	4.6
1976	Jun	13	18.62	67.68	4.6
1961	Jun	01	19.30	69.30	4.5
1964	Aug	25	18.20	68.20	4.5
1964	Dec	08	19.00	64.00	4.5
1964	Feb	01	19.40	66.30	4.5
1967	Jun	13	19.10	66.30	4.5
1968	Nov	17	19.10	68.05	4.5
1970	Dec	03	19.04	64.92	4.5
1970	Nov	09	19.10	67.50	4.5
1971	Aug	21	18.33	67.72	4.5
1971	Feb	22	19.25	67.93	4.5
1971	Jun	12	19.43	64.47	4.5
1971	Mar	07	19.37	66.24	4.5
1972	Feb	23	18.23	68.79	4.5
1973	Nov	25	18.70	64.58	4.5
1977	Oct	13	19.79	68.37	4.4
1982	Sep	30	18.81	64.32	4.4
1966	Sep	31	19.40	67.70	4.3

Year	Month	Day	Latitude	Longitude	Magnitude
1976	Oct	15	18.93	64.49	4.3
1976	Oct	31	19.79	65.60	4.3
1976	Sep	16	18.70	68.51	4.3
1977	Dec	03	18.89	68.51	4.3
1977	Dec	26	17.65	69.72	4.3
1977	Oct	06	19.52	64.10	4.3
1982	Jun	11	18.80	64.37	4.3
1976	Sep	16	18.18	64.58	4.2
1977	Oct	18	19.00	64.96	4.2
1977	Sep	23	18.87	64.50	4.2
1976	Jun	08	17.92	63.85	4.1
1976	May	10	19.24	69.06	4.1
1976	Oct	13	17.17	63.90	4.1
1977	Feb	05	18.51	67.13	4.1
1977	Jun	06	19.26	69.07	4.1
1977	Sep	27	16.48	67.66	4.1
1983	Mar	03	17.99	65.86	4.1
1976	Jul	15	19.39	63.95	4.0
1977	Aug	14	16.78	65.18	4.0
1983	Jun	27	17.91	66.94	4.0

APPENDIX III

MODIFIED MERCALLI INTENSITY SCALE OF 1931
(Unabridged)

[Adapted from Sieberg's Mercalli-Cancani scale, modified and condensed.]

I. a. Not felt - or, except rarely under especially favorable circumstances.
Under certain conditions, at and outside the boundary of the area in which a great shock is felt:
b. Sometimes birds, animals, reported uneasy or disturbed.
c. Sometimes dizziness or nausea experienced.
d. Sometimes trees, structures, liquids, bodies of water, may sway, doors may swing, very slowly.

II. a. Felt indoors by few, especially on upper floors, or by sensitive, or nervous persons.
Also, as in grade I, but often more noticeably:
b. Sometimes hanging objects may swing, especially when delicately suspended.
c. Sometimes trees, structures, liquids, bodies of water, may sway, doors may swing, very slowly.
d. Sometimes birds, animals, reported uneasy or disturbed.
e. Sometimes dizziness or nausea experienced.

III. a. Felt indoors by several....
b. Motion usually rapid vibration.
c. Sometimes not recognized to be an earthquake at first.
d. Duration estimated in some cases.
e. Vibration like that due to passing of light, or lightly loaded trucks, or heavy trucks some distance away.
f. Hanging objects may swing slightly.
g. Movements may be appreciable on upper levels of tall structures.
h. Rocked standing motorcars slightly.

IV. a. Felt indoors by many, outdoors by few.
b. Awakened few, especially light sleepers.
c. Frightened no one, unless apprehensive from previous experience.
d. Vibration like that due to passing of heavy, or heavily loaded trucks.

e. Sensation like heavy body striking building, or falling of heavy objects inside.
f. Rattling of dishes, windows, doors; glassware and crockery clink and clash.
g. Creaking of walls, frame, especially in the upper range of this grade.
h. Hanging objects swung, in numerous instances.
i. Disturbed liquids in open vessels slightly.
j. Rocked standing motorcars noticeably.

V. a. Felt indoors by practically all, outdoors by many or most.
b. Outdoors direction estimated.
c. Awakened many, or most.
d. Frightened few--slight excitement, a few ran outdoors.
e. Buildings trembled throughout.
f. Broke dishes, glassware, to some extent.
g. Cracked windows--in some cases, but not generally.
h. Overturned vases, small or unstable objects, in many instances, with occasional fall.
i. Hanging objects, doors, swing generally or considerably.
j. Knocked pictures against walls, or swung them out of place.
k. Opened, or closed, doors, shutters, abruptly.
l. Pendulum clocks stopped, started, or ran fast, or slow.
m. Moved small objects, furnishings, the latter to slight extent.
n. Spilled liquids in small amounts from well-filled open containers.
o. Trees, bushes, shaken slightly.

VI. a. Felt by all, indoors and outdoors.
b. Frightened many, excitement general, some alarm, many ran outdoors.
c. Awakened all.
d. Persons made to move unsteadily.
e. Trees, bushes, shaken slightly to moderately.
f. Liquid set in strong motion.
g. Small bells rang--church, chapel, school, etc.
h. Damage slight in poorly built buildings.
i. Fall of plaster in small amount.
j. Cracked plaster somewhat, especially fine cracks (in) chimneys in some instances.
k. Broke dishes, glassware, in considerable quantity, also some windows.
l. Fall of knickknacks, books, pictures.
m. Overturned furniture in many instances.
n. Moved furnishings of moderately heavy kind.

VII.
a. Frightened all--general alarm, all ran outdoors.
b. Some, or many, found it difficult to stand.
c. Noticed by persons driving motorcars.
d. Trees and bushes shaken moderately to strongly.
e. Waves on ponds, lakes, and running water.
f. Water turbid from mud stirred up.
g. Incaving to some extent of sand or gravel stream banks.
h. Rang large church bells, etc.
i. Suspended objects made to quiver.
j. Damage negligible in buildings of good design and construction.
k. (Damage) 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.
l. Cracked chimneys to considerable extent, walls to some extent.
m. Fall of plaster in considerable to large amount, also some stucco.
n. Broke numerous windows, furniture to some extent.
o. Shook down loosened brickwork and tiles.
p. Broke weak chimneys at the roofline (sometimes damaging roofs).
q. Fall of cornices from towers and high buildings.
r. Dislodged bricks and stones.
s. Overturned heavy furniture, with damage from breaking.
t. Damage considerable to concrete irrigation ditches.

VIII.
a. Fright general--alarm approaches panic.
b. Disturbed persons driving motorcars.
c. Trees shaken strongly--branches, trunks, broken off, especially palm trees.
d. Ejected sand and mud in small amounts.
e. Changes: temporary, permanent; in flow of springs and wells; dry wells renewed flow; in temperature of spring and well waters.
f. Damage slight in structures (brick) built especially to withstand earthquakes.
g. (Damage) 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.
h. Fall of walls.
i. Cracked, broke, solid stone walls seriously. Wet ground to some extent, also ground on steep slopes.
j. Twisting, fall, of chimneys, columns, monuments, also factory stacks, towers.
k. Moved conspicuously, overturned, very heavy furniture.

IX. a. Panic general
b. Cracked ground conspicuously.
c. Damage considerable in (masonry) structures built especially to withstand earthquakes.
d. Threw out of plumb some wood frame houses built especially to withstand earthquakes.
e. (Damage) great in substantial (masonry) buildings, some collapse in large part; or wholly shifted frame buildings off foundations, racked frames.
f. (Damage) serious to reservoirs.
g. Underground pipes sometimes broken.

X. a. 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.
b. Landslides considerable from river banks and steep coasts.
c. Shifted sand and mud horizontally on beaches and flat land.
d. Changed level of water in wells.
e. Threw water on banks of canals, lakes, rivers, etc.
f. Damage serious to dams, dikes, embankments.
g. (Damage) severe to well-built wooden structures and bridges, some destroyed.
h. Developed dangerous cracks in excellent brick walls.
i. Destroyed most masonry and frame structures, also their foundations.
j. Bent railroad rails slightly.
k. Tore apart, or crushed endwise, pipelines buried in earth.
l. Open cracks and broad wavy folds in cement pavements and asphalt road surfaces.

XI. a. Disturbances in ground many and widespread, varying with ground material.
b. Broad fissures, earth slumps, and land slips in soft, wet ground.
c. Ejected water in large amounts charged with sand and mud.
d. Caused sea-waves ("tidal" waves) of significant magnitude.
e. Damage severe to wood frame structures, especially near shock centers.
f. (Damage) great to dams, dikes, embankments, often for long distances.
g. Few, if any, (masonry) structures remained standing.
h. Destroyed large well-built bridges by the wrecking of supporting piers, or pillars.
i. Affected yielding wooden bridges less.
j. Bent railroad rails greatly, and thrust them endwise.
k. Put pipelines buried in earth completely out of service.

XII. a. Damage total--practically all works of construction damaged greatly or destroyed.
b. Disturbances in ground great and varied, numerous shearing cracks.
c. Landslides, falls of rock of significant character, slumping of river banks, etc., numerous and extensive.
d. Wrenched loose, tore off, large rock masses.
e. Fault slips in firm rock, with notable horizontal and vertical offset displacements.
f. Water channels, surface and underground, disturbed and modified greatly.
g. Dammed lakes, produced waterfalls, deflected rivers, etc.
h. Waves seen on ground surfaces (actually seen, probably, in some cases).
i. Distorted lines of sight and level.
j. Threw objects upward into the air.

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

A WORKSHOP ON "GEOLOGIC HAZARDS IN PUERTO RICO"

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SAN JUAN, PUERTO RICO

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EVALUATION OF THE WORKSHOP ON GEOLOGIC HAZARDS IN PUERTO RICO

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At the conclusion of the workshop, program participants were asked to answer several questions: How well did the workshop succeed in reaching its goals? How useful were various workshop procedures in communicating? Did changes in their levels of awareness and concern occur as a result of having participated? The workshop was designed to define the threats posed by earthquakes and ground-failure in Puerto Rico, describe current capabilities for responding to geologic hazards in Puerto Rico, develop strategies to increase awareness and concern, and aid in the formation of plans to incorporate geologic information into local land use and emergency plans.

Responses were elicited on a five-point scale, 1 and 2 representing the lowest level of agreement, 3 moderate agreement, and 4 and 5 highest agreement, or a "yes" response (see Table 1). Since not all respondents answered all the questions, percentages are based only on those who submitted evaluations (see Table 2).

Evaluations returned by 55 participants indicate that the workshop was successful in meeting its goals. Eighty-two percent of the evaluators thought the workshop did a good job of defining the earthquake threat; 78% also thought that the workshop did a good job in defining the ground-failure hazard in Puerto Rico. The workshop's role in formalizing plans to increase awareness and concern for earthquake and other geologic hazards and to incorporate geologic information into planning activities were both well received. Over 50% of the respondents found the workshop successful in its description of earthquake response capabilities; 25% thought it moderately helpful; and 14% (the largest "low" percentage for question #1) viewed the workshop as marginally helpful in this regard.

In order to determine in what specific ways the meeting was useful to participants, questions addressed sources of information and how they provided a better understanding of geologic hazards in Puerto Rico. Eighty percent of the respondents gave the workshop high marks for providing new sources of information or expertise, and the remaining 14% were at least moderately happy with new sources suggested by the workshop.

Certainly a major achievement of the workshop was the extent to which it gave participants an appreciation of the problems faced by decisionmakers. Again, eighty percent said that the workshop was very successful in providing a better understanding of problems faced by decisionmakers, and 14% said that it was at least moderately successful.

To indicate which activities were viewed as the most useful, participants were asked to rate formal presentations, follow-up discussions, small group discussions, informal discussions, and materials such as notebooks and abstracts. The small discussion groups received the most enthusiastic evaluation; 91% of the respondents judged them to be highly useful. Formal presentations and discussions following the formal presentations were judged highly successful by nearly 80% of the respondents. The written materials were well received, with 85% of the respondents giving them high marks. Informal discussions were seen to be a valuable part of the meeting as well.

The importance attached to this workshop is shown in the response of 98% of those submitting evaluations that they would, knowing now what to expect, most definitely wish to attend again. Not one person indicated a reluctance to take part in similar future gatherings.

The most interesting and significant impact of the workshop has been its influence on heightening levels of awareness and concern. Significant numbers of participants (27%). reported their levels of awareness prior to the workshop would have been described as "low." Thirty-five percent rated their levels of awareness as "moderate," and 36% rated them as "high" before the workshop. Following the workshop, however, no participant felt his or her awareness was "low;" only 5% considered their awareness moderate, while 93% judged their awareness to be "high." Similarly, levels of concern were heightened significantly by participation. Before the workshop, concern was judged to have

been low by one-half of the respondents, with 22% registering moderate concern and only 25% high concern. After the workshop, participants revised their perceptions of concern significantly; only 5% defined their levels of concern as low, no one said they were moderate, and 89% said they were highly concerned about the state of earthquake preparedness in Puerto Rico.

Another important judgment of the success or failure of a workshop can be made by looking beyond the impacts it had on attitudes, to ways in which it may have affected behavior. In order to determine whether the workshop had any long-term effect on the behavior of participants, the final question asked respondents to consider actions they might take to improve the awareness and concern of others or to implement mitigation activities in Puerto Rico. Response from 33 participants to this question was strikingly uniform.

Virtually all of the respondents were planning to become involved in some type of educational activity, either among their friends and social acquaintances or their co-workers. Many stated they were going to volunteer to share their new knowledge with local service organizations (Rotary, Lions, Masonic Lodges), private schools, or their agencies or businesses through workshops or seminars, and with the general public, via the media. One participant planned to write a comprehensive article in Spanish on the nature of earthquake hazards in Puerto Rico. Civil defense personnel saw their agencies adding earthquake information to their annual training program and conducting lectures for public and private agencies. Another participant planned to propose that the local Association of Engineers and Surveyors promote and participate in earthquake education for the general public.

Of the respondents who were planning steps besides educational activities, one mentioned working to convince the Federal Emergency Management Agency to increase funding for earthquake hazards planning in Puerto Rico. Numerous other respondents planned on working on the ad hoc earthquake committee formed during the workshop. One person anticipated working to ensure the coordination of efforts of persons who volunteered for committee work. It is evident from their lengthy responses that the workshop provided enough new information to cause participants to enthusiastically begin to pass on their expanded knowledge of geologic hazards to others in Puerto Rico.

Table 1
Evaluations of the Workshop by Individual Participants

	LOW 1&2	MED 3	HIGH 4&5
1. Did you find the workshop to be useful for:			
a. Defining the nature and extent of earthquake hazards in Puerto Rico?	--	8	45
b. Defining the nature and extent of ground-failure hazards in Puerto Rico?	1	9	43
c. Describing the current capabilities to respond to geologic hazards in Puerto Rico?	8	14	32
d. Formalizing plans to increase awareness and concern for earthquake and other geologic hazards?	2	11	39
e. Formulating plans to incorporate geologic information in land-use planning, emergency response planning, and earthquake-resistant design?	2	11	41
2. Did the workshop benefit you or your organization by:			
a. Providing new sources of information and expertise you might want to utilize in the future?	--	8	44
b. Establish better understanding of the problems faced by researchers and decisionmakers?	1	8	44
3. Did you find the following activities useful:			
a. Formal presentations?	--	10	43
b. Discussions following the formal presentations?	2	7	50
c. Small discussion groups?	1	2	50
d. Informal discussions during coffee breaks, lunches, and after hours?	5	8	38
e. Notebook and abstracts?	1	6	47
4. If the clock were turned back and the decision to attend the workshops were given you again, would you want to attend?	--	1	54
5. Should future workshops be planned to continue the work initiated at this meeting?	--	2	49
6. Prior to attending this workshop, I would rate my awareness of the earthquake threat in the Puerto Rico as	15	19	20
7. Prior to attending this workshop, I would rate my concern about the state-of-earthquake preparedness in the Puerto Rico as	28	12	14
8. I now rate my awareness as	--	3	51
9. I now rate my concern	3	--	49
10. Some steps I plan to take to increase others awareness, concern, and activities to lessen the effects of potential earthquakes in Puerto Rico.			

*Evaluations were completed by fifty-five participants. Totals vary as not all respondents completed all questions.