BIBLIOGRAPHY ON ARIZONA EARTH FISSURES AND RELATED SUBSIDENCE, WITH SELECTED REFERENCES FOR OTHER AREAS

by

Steven Slaff

Arizona Geological Survey
Open-File Report 90-7

1990

Arizona Geological Survey
416 W. Congress, Suite #100, Tucson, Arizona 85701

This report is preliminary and has not been edited
or reviewed for conformity with Arizona Geological Survey standards

BIBLIOGRAPHY ON ARIZONA EARTH FISSURES AND RELATED SUBSIDENCE, WITH SELECTED REFERENCES FOR OTHER AREAS

Since earth fissures were first discovered in south-central Arizona in the late 1920's (Seismological Society of America, 1927), they have been investigated by many workers, who have offered several theories to explain their cause. When the Arizona Geological Survey (AZGS) began to examine earth fissures in 1988, no comprehensive list of pertinent references was available. AZGS and other active investigators regularly receive requests from agencies and individuals for sources of information about land subsidence (sinking of the ground surface) and earth cracks or fissures. This bibliography serves as a starting point for those who need such information. The first section of the bibliography consists of references that pertain to land subsidence and/or earth fissures in Arizona. The second section includes selected references that deal with locations outside Arizona.

Land subsidence is occurring in many parts of the world. It has affected more than 7,770 km^2 (3,000 mi^2) in Arizona. In California's San Joaquin Valley (one of several portions of the state that have experienced or are experiencing subsidence) more than 13,470 km^2 (5,200 mi^2) have sunken, prompting Ireland and others (1984) to call it, "...probably...one of the greatest single manmade alterations in the configuration of the Earth's surface in the history of man." Land subsidence has caused considerable damage to engineering structures. More will occur. The hazard is of major concern in Arizona because the majority of our citizens and commercial agricultural operations are in regions of on-going or potential subsidence.

The following locations, grouped by state or country, have suffered costly damage from land subsidence: 1) Eloy-Picacho area, Arizona; 2) Wilmington, Lancaster area, Santa Clara Valley, San Joaquin Valley, Sacramento Valley, and San Jacinto Valley, California; 3) Las Vegas Valley, Nevada; 4) Raft River Valley, Idaho; 5) Galveston and Houston, Texas; 6) Baton Rouge and New Orleans, Louisiana; 7) Savannah, Georgia; 8) Denver, Colorado; 9) Osaka, Tokyo, and Honshu, Japan; 10) Mexico City, Mexico; 11) Venice, Italy; 12) Shanghai, Peoples' Republic of China; 13) London, United Kingdom; and 14) Taipei Basin, Taiwan.

Many human-induced and natural processes give rise to land subsidence. The most common are: 1) withdrawal of subsurface fluids (including water, petroleum, natural gas, geothermal brine, and others); 2) underground mining; 3) sink-hole formation; 4) dissolving of limestone, evaporites, and other soluble sedimentary rocks; 5) tectonic forces; 6) hydrocompaction of moisture-deficient deposits above the water table; 7) oxidation of peat and other organic soils; and 8) liquefaction.

This bibliography focuses on subsidence resulting from ground-water removal. As water is pumped from wells, interstices between unconsolidated aquifer sediment grains are drained, which decreases hydraulic pressure (neutral stress) and increases effective stress. The sediment grains adopt a more tightly packed configuration as the aquifer is compressed into a smaller volume. The land surface subsides in response to decreased aquifer volume at depth. Greater subsidence occurs in certain portions of a region, as dictated by a number of variables. Differential subsidence gives rise to horizontal stress, and earth fissures form where horizontal stress exceeds sediment tensile strength. Earth fissures are open surficial tension cracks in unconsolidated and semiconsolidated sediments that may exhibit vertical and/or horizontal displacement. Earth fissures caused by human-induced land subsidence have occurred in Arizona, California, Nevada, Utah, Idaho, Wyoming, New Mexico, Peoples Republic of China, Japan, Mexico, and probably in other locations.

The bibliography is divided into two sections: The first section is intended to be an exhaustive list of published works on land subsidence and earth fissures in Arizona; however many unpublished and obscure reports are not included. The second section, which pertains to land subsidence in locations outside Arizona, is not intended to be complete because the available literature is voluminous and many

overlapping areas of investigation make it hard to draw the line between appropriate and irrelevant references. Some of the papers that are included in the Arizona section are also of interest to investigators studying other parts of the world.

To make it useful to the greatest possible number of investigators, the bibliography is available as a printed document or on computer floppy diskette. It may be purchased as either a 3 1/2-inch or 5 1/4-inch high-density diskette. On each diskette, the information is stored in the following formats: 1) as a DOS-text file titled FISBIB.TXT; 2) as a Word Perfect 4.2 file titled FISBIB.WPF; 3) as a dBase IV file titled FISBIB.DBF; and, 4) as a Toolbook (for Windows 3.0) file titled FISBIB.TBK. This introductory statement is contained in a separate DOS-text file titled README.TXT.

This document was compiled in 1990. The AZGS will update the bibliography every year. Please send complete citations of additional pertinent reports to: Arizona Geological Survey, 845 N. Park Avenue, Tucson, AZ 85719, Attention: Subsidence/Fissure Bibliography.

Scientists, economists, planners, politicians, and others from around the world will gather in Houston, Texas in May 1991 for the Fourth International Symposium on Land Subsidence. One section of the meeting will concentrate solely on earth fissures. The proceedings volume resulting from the symposium (expected to be published in 1991 or 1992) will be a valuable addition to the available literature.

Several individuals contributed to the compilation of the bibliography. They include Mike Carpenter, Stan Leake, Don Pool, and Herb Schumann (U.S. Geological Survey Water Resources Division); Bill Haneberg (New Mexico Bureau of Mines & Mineral Resources); John Sandoval (U.S. Bureau of Reclamation); Don Helm and John Bell (Nevada Bureau of Mines and Geology); Troy Pewe (Arizona State University); and Stan Davis (University of Arizona). Their help is much appreciated. This project was partially funded by the U.S. Bureau of Reclamation.

REFERENCES PERTAINING TO AREAS IN ARIZONA

Alger, L.H., 1982, Degradation of an arid environment--earth fissures in central Arizona: Terre Haute, Indiana State University, unpublished Ph.D. dissertation, 103 p.

Anderson, S.L., 1973, Investigation of Mesa earth crack, Arizona, attributed to differential subsidence due to ground-water withdrawal: Tempe, Arizona State University, unpublished M.S. thesis, 111 p.

_____1978, The Mesa earth crack, Arizona [abs.]: Geological Society of America Abstracts with Programs, v. 10, p. 293.

Anderson, S.L., and Ragan, D.M., 1975, Earth cracks in central Arizona [abs.]: Arizona Academy of Science, Annual Meeting, 19th, Tempe, Ariz., 1975, Proceedings Supplement, v. 10, p. 43.

Anderson, S.R., 1978, Earth fissures in the Stewart area of the Willcox basin, Cochise County, Arizona: Tucson, University of Arizona, unpublished M.S. thesis, 72 p.

_____1987, Potential for aquifer compaction, land subsidence, and earth fissures in the Tucson basin, Pima County, Arizona: U.S. Geological Survey Open-File Report 86-482, scale 1:250,000, 3 sheets.

_____1988, Potential for aquifer compaction, land subsidence, and earth fissures in Avra Valley, Pima and Pinal Counties, Arizona: U.S. Geological Survey Open-File Report 87-685, scale 1:250,000, 3 sheets.

Anderson, S.R., and Hanson, R.T., 1987, Relation of Cenozoic depositional environments to aquifer-system compaction and land subsidence [abs.]: Geological Society of America Abstracts with Programs, v. 19, p. 573.

Anderson, S.R., Schumann, H.H., and Wallace, B.L., 1982, Progress report on measurements of aquifer compaction in the Tucson basin, in Johnson, R.B., Babcock, J.A., and Hix, G.L., eds., Annual static water level basic data report--Tucson basin and Avra Valley, Pima County, Arizona, 1981: City of Tucson, Water Planning Division, 32 p.

Anderson, T.W., 1968, Electric-analog analysis of ground-water depletion in central Arizona: U.S. Geological Survey Water-Supply Paper 1860, 21 p., scale 1:250,000, 4 sheets.

_____1972, Electrical-analog analysis of the hydrologic system, Tucson basin, southeastern Arizona: U.S. Geological Survey Water-Supply Paper 1939-C, 34 p.

Arizona Bureau of Geology and Mineral Technology, 1987, Subsidence areas and earth-fissure zones: Fieldnotes, v. 17, no. 1, p. 6-9.

Arizona Department of Transportation, 1981, 1981 NGS level line, Apache Junction to I-10 at Miller Road--ADOT preliminary adjustment: Highways Division, Photogrammetry and Mapping Services, unpublished report, 192 p.

Bales, J.T., Schulten, C.S., and Pewe, T.L., 1980, Environmental geology of the Tempe quadrangle, Maricopa County, Arizona: City of Tempe, unpublished report, scale 1:24,000, 16 sheets.

Bales, J.T., Wellendorf, C.S., and Pewe, T.L., 1986, Ground-water map, in Environmental geology of the Tempe quadrangle, Maricopa County, Arizona: Arizona Bureau of Geology and Mineral Technology

Geologic Investigation Folio GI-2-F, scale 1:24,000.

Boling, J.K., 1986, Earth-fissure movements in south-central Arizona, U.S.A., in Johnson, A.I., and others, eds., Land subsidence: International Symposium on Land Subsidence, 3d, Venice, Italy, 1984, Proceedings: International Association of Hydrological Sciences (IAHS) Publication 151, p. 757-766.

_____1987, Earth-fissure movements in south-central Arizona, U.S.A.: Tucson, University of Arizona, unpublished M.S. thesis, 98 p.

Boling, J.K., Jr., and Carpenter, M.C., 1978, Small-scale movements of earth fissures in south-central Arizona [abs.]: Geological Society of America Abstracts with Programs, v. 10, p. 97.

_____1980, Character of earth fissure movement in south-central Arizona [abs.], in Program and abstracts: University of Arizona Annual Geoscience Daze, 8th, Tucson, Ariz., 1980, p. 4.

Boling, J.K., Jr., Carpenter, M.C., and Davis, S.N., 1980, Geophysical and hydrologic prediction of fissuring and land subsidence, south-central Arizona: Tucson, University of Arizona Water Resources Research Center Project Partial Completion Report, 43 p.

Boling, J.K., Jr., Carpenter, M.C., Johnson, N.M., and Davis, S.N., 1980, Measurement, prediction, and hazard evaluation of earth fissures and subsidence, south-central Arizona: National Technical Information Service Accession PB 80-183 908, 46 p.

Bouwer, Herman, 1975, Subsidence of the land surface and formation of earth cracks due to ground-water withdrawal [abs.]: Geological Society of America Abstracts with Programs, v. 7, p. 1004-1005.

_____1977, Land subsidence and cracking due to ground-water depletion: Ground Water, v. 15, p. 358-364.

_____1978, Groundwater hydrology: San Francisco, McGraw-Hill, p. 313-338.

Briggs, P.C., 1976, Arizona groundwater resources, supplies, and problems, in Arizona watershed symposium, 20th, 1976, proceedings: Phoenix, Arizona Water Commission Report 8, p. 11-29.

Brooks, R.L., 1981, Satellite altimeter measurements of land subsidence in south-central Arizona--final report: Geoscience Research Corporation, NASA contract NAS6-3117, 24 p.

Brooks, S.J., 1988, Potential land-surface subsidence at the Arizona superconducting super collider (SSC) site; considering past, current, and possible future ground-water withdrawal: Arizona Geological Survey Open-File Report 88-20, 28 p.

Brown, S.G., and Schumann, H.H., 1969, Geohydrology and water utilization in the Willcox basin, Graham and Cochise Counties, Arizona: U.S. Geological Survey Water-Supply Paper 1859-F, p. 1-32.

Byars, D.D., 1975, The Casa Grande photogrammetric test range: American Society of Photogrammetry, Fall Convention, Phoenix, Ariz., 1975, Proceedings, p. 162-176.

Caito, T.J., and Sogge, R.L., 1982, A study of fissuring and subsidence in Avra Valley, Arizona: Tucson, Desert Earth Engineering, Inc., unpublished report, 69 p.

Carpenter, M.C., 1987, Water-level declines, land subsidence, and specific compaction near Apache Junction, south-central Arizona: U.S. Geological Survey Water-Resources Investigations Report 86-

4071, 22 p.

_____1988, Land-surface deformation and ground-water-level fluctuations near the Picacho earth fissure, south-central Arizona, 1980-1984: U.S. Geological Survey Open-File Report 88-97, 24 p.

_____1989, Earth-fissure movements associated with fluctuations in ground-water level, south-central Arizona, 1980-84 [abs.]: International Geological Congress, 28th, Washington, D.C., 1989, Proceedings, v. 1, p. 243.

_____1990a, Earth-fissure movements associated with fluctuations in ground-water levels near Picacho Mountains, south-central Arizona, 1980-84: Tucson, University of Arizona, unpublished Ph.D. dissertation, 116 p.

_____1990b (n.d.), Earth-fissure movements associated with fluctuations in ground-water levels near Picacho Mountains, south-central Arizona, 1980-84: U.S. Geological Survey Open-File Report 90-561, in press. (Pending publication as U.S. Geological Survey Professional Paper 437-K or 497-H).

Carpenter, M.C., and Boling, J.K., Jr., 1980, Character of earth-fissure movement in south-central Arizona [abs.], in Harwood, Gerald, ed., Hydrology and water resources in Arizona and the Southwest: American Water Resources Association, Arizona Section, and Arizona-Nevada Academy of Science, Hydrology Section, Annual Meeting, Las Vegas, Nev., 1980, Proceedings, v. 10, p. 261. (See also Journal of the Arizona-Nevada Academy of Science, v. 15, p. 49).

Carpenter, M.C., and Bradley, M.D., 1986, Legal perspectives on subsidence caused by groundwater withdrawal in Texas, California, and Arizona, U.S.A., in Johnson, A.I., and others, eds., Land subsidence: International Symposium on Land Subsidence, 3d, Venice, Italy, 1984, Proceedings: International Association of Hydrological Sciences (IAHS) Publication 151, p. 817-828.

Cella Barr Associates, 1984, Recharge feasibility study, Cave Creek area--for City of Phoenix Water and Wastewater Department: Phoenix, unpublished report, 89 p.

Chalmers, J.R., 1974, Southwestern ground-water law--a textual and bibliographic interpretation: University of Arizona, Office of Arid Lands Studies, Arid Lands Resources Information Paper 4, 229 p.

Chi, S.C., and Reilinger, R.E., 1984, Geodetic evidence for subsidence due to groundwater withdrawal in many parts of the United States of America: Journal of Hydrology, v. 67, p. 155-182.

Christenson, G.E., Welsch, D.G., and Pewe, T.L., 1978 and 1979, Environmental geology of the McDowell Mountains, Maricopa County, Arizona: Arizona Geological Survey Geologic Investigation Folio GI-1, scale 1:24,000, 10 sheets.

Christie, F.J., 1978a, Analysis of gravity data from the Picacho basin [abs.]: Geological Society of America Abstracts with Programs, v. 10, p. 100.

_____1978b, Analysis of gravity data from the Picacho basin, Pinal County, Arizona: Tucson, University of Arizona, unpublished M.S. thesis, 105 p.

City of Tucson, 1982, Annual static water level basic data report--Tucson basin and Avra Valley, Pima County, Arizona, 1981: unpublished report, 21 p., appendices.

Clyma, Wayne, and Young, R.A., 1968, Environmental effects of irrigation in the central valley of

Arizona, in National meeting on environmental engineering: American Society of Civil Engineers, Chattanooga, Tenn., 1968, preprint, 28 p. (Copies available for $0.50 each from ASCE, 345 E. 47th St., New York, NY 10017).

Coates, D.R., 1981, Environmental geology: New York, John Wiley and Sons, p. 457-462.

Cooley, M.E., 1973a, Map showing distribution and estimated thickness of alluvial deposits in the Phoenix area, Arizona: U.S. Geological Survey Miscellaneous Investigations Series Map I-845-C, scale 1:250,000.

_____1973b, Map showing distribution and estimated thickness of alluvial deposits in the Tucson area, Arizona: U.S. Geological Survey Miscellaneous Investigations Series Map I-844-C, scale 1:250,000.

Cordy, G.E., Holway, J.V., and Pewe, T.L., 1977a, Environmental geology, Paradise Valley quadrangle, Maricopa County, Arizona: Arizona State University and City of Scottsdale, unpublished report, scale 1:24,000, 14 sheets.

_____1977b, Geology for land-use planning in arid regions, Phoenix, Arizona [abs.]: Geological Society of America Abstracts with Programs, v. 9, p. 404-405.

Crossley, R.W., 1969, A geological investigation of foundation failures in small buildings in Tucson, Arizona: Tucson, University of Arizona, unpublished M.S. thesis, 58 p.

Davidson, E.S., 1973, Geohydrology and water resources of the Tucson basin, Arizona: U.S. Geological Survey Water-Supply Paper 1939-E, 81 p.

Davis, R.W., 1967, A geophysical investigation of hydrologic boundaries in the Tucson basin, Pima County, Arizona: Tucson, University of Arizona, unpublished Ph.D. dissertation, 64 p.

_____1971, An analysis of gravity data from the Tucson basin, Arizona: Arizona Geological Society Digest, v. 9, p. 103-121.

Davis, S.N., 1974, Hydrogeology of arid regions, in Brown, G.W., ed., Desert biology--special topics on the physical and biological aspects of arid regions: New York, Academic Press, v. 2, p. 1-30.

_____1978, Origin of earth fissures [abs.]: Geological Society of America Abstracts with Programs, v. 10, p. 102.

Davis, S.N., Boling, J.K., Carpenter, M.C., Harvey, J.P., Johnson, N.M., and Barker, Walter, 1983, Measurement, prediction, and hazard evaluation of earth fissuring and subsidence due to ground-water overdraft: Tucson, University of Arizona, Department of Hydrology and Water Resources Project Completion Report, U.S. Department of the Interior Project B-092-Ariz., 44 p.

Denlinger, R.P., Carpenter, M.C., and Riley, F.S., 1981, Differential subsidence, horizontal strain, and related tensional fissures near Apache Junction, Arizona: U.S. Geological Survey, unpublished report, 26 p.

Earth Sciences Association, 1971, Investigation of earth-fissure phenomena in the vicinity of Willcox, Arizona: Phoenix, Southwest Properties, Inc., unpublished report.

Eaton, G.P., 1969, Recent elevation changes in San Simon Valley, Arizona [abs.]: Geological Society of America Abstracts with Programs, v. 1, p. 21.

_____1972, Deformation of Quaternary deposits in two intermontane basins of southern Arizona, U.S.A., in Tectonics: International Geological Congress, 24th, Montreal, Quebec, 1972, Proceedings Section 3: Montreal, Harpell's Press, p. 607-616.

Eaton, G.P., Peterson, D.L., and Schumann, H.H., 1972, Geophysical, geohydrological, and geochemical reconnaissance of the Luke salt body, central Arizona: U.S. Geological Survey Professional Paper 753, 29 p.

Elliott, M.R., 1969a, Investigation of vertical displacement of ground surface, Casa Grande, Arizona: U.S. Geological Survey, unpublished report, 83 p.

_____1969b, Investigation of vertical displacement of ground surface, Phoenix-Mesa area, Arizona: U.S. Geological Survey, unpublished report, 80 p.

Epstein, V.J., 1987, Hydrologic and geologic factors affecting land subsidence near Eloy, Arizona: U.S. Geological Survey Water Resources Investigations Open-File Report 87-4143, 28 p.

Feth, J.H., 1951, Structural reconnaissance of the Red Rock quadrangle, Arizona: U.S. Geological Survey Open-File Report 2-51, 32 p.

Freethey, G.W., Pool, D.R., Anderson, T.W., and Tucci, Patrick, 1986, Description and generalized distribution of aquifer material in the alluvial basins of Arizona and adjacent parts of California and New Mexico: U.S. Geological Survey Hydrologic Investigations Atlas 663, scale 1:500,000.

Haire, S.A., 1983, Prediction and monitoring of subsidence for design at Palo Verde nuclear generating station, west of Phoenix, Arizona [abs.]: Arizona Consulting Engineers Association, Arizona Symposium on Subsidence, 2d, Phoenix, 1983, unpublished proceedings.

Hanson, R.T., 1989, Aquifer-system compaction, Tucson basin and Avra Valley, Arizona: U.S. Geological Survey Water-Resources Investigations Report 88-4172, 69 p.

Hardt, W.F., and Cattany, R.E., 1965, Description and analysis of the geohydrologic system in western Pinal County, Arizona: U.S. Geological Survey Open-File Report 65-68, 92 p.

Harmon, D.B., 1982, Subsidence in northeast Phoenix--a new problem for engineers: Arizona Bureau of Geology and Mineral Technology Fieldnotes, v. 12, no. 3, p. 10-11.

Harshbarger, J.W., Lewis, D.D., Skibitzke, H.E., Heckler, W.L., and Kister, L.R., revised by Baldwin, H.L., 1966, Arizona water: U.S. Geological Survey Water-Supply Paper 1648, p. 20-23.

Harvey, J.P., 1981, Groundwater extraction and radon anomalies in the Picacho area, south-central Arizona: Tucson, University of Arizona, unpublished M.S thesis, 120 p.

Hassamer, J.H., and Dansareau, D.C., 1980, Gravity survey in parts of Maricopa and Pinal Counties, Arizona: U.S. Geological Survey Open-File Report 80-1255, 9 p.

Holdahl, S.R., and Morrison, N.L., 1974, Regional investigations of vertical crustal movements in the U.S., using precise relevelings and mareograph data: Tectonophysics, v. 23, p. 373-390.

Holzer, T.L., 1976, Analysis of borehole extensometer data and consolidation tests from central Arizona: U.S. Geological Survey, unpublished report, 18 p.

_____1977a, Active surface faulting caused by ground-water extraction near Picacho, Arizona [abs.]: Geological Society of America Abstracts with Programs, v. 9, p. 437.

_____1977b, Crustal uplift caused by ground-water withdrawal in the lower Santa Cruz basin, Arizona [abs.]: Geological Society of America Abstracts with Programs, v. 9, p. 1023.

_____1977c, Ground failure in areas of subsidence due to ground-water decline in the United States, in Land subsidence symposium: International Symposium on Land Subsidence, 2d, Anaheim, Calif., 1976, Proceedings: International Association of Hydrological Sciences (IAHS) Publication 121, p. 423-433.

_____1978a, Results and interpretation of exploratory drilling near the Picacho fault, south-central Arizona: U.S. Geological Survey Open-File Report 78-1016, 17 p.

_____1978b, Vertical offset across ground failures associated with ground-water withdrawal from alluvial basins [abs.]: Geological Society of America Abstracts with Programs, v. 10, p. 109.

_____1979a, Elastic expansion of the lithosphere caused by ground-water depletion: Journal of Geophysical Research, v. 84, p. 4689-4698.

_____1979b, Elastic expansion of the lithosphere caused by ground-water withdrawal in south-central Arizona [abs.]: Tectonophysics, v. 52, p. 304.

_____1979c, Surface effects from ground-water withdrawal in arid areas [abs.]: Geological Society of America Abstracts with Programs, v. 11, p. 84-85.

_____1980a, Land subsidence and ground failure induced by fluid withdrawal in urban areas [abs.]: Geological Society of America Abstracts with Programs, v. 12, p. 313.

_____1980b, Reconnaissance maps of earth fissures and land subsidence, Bowie and Willcox areas, Arizona: U.S. Geological Survey Miscellaneous Field Studies Map MF-1156, scale 1:24,000, 2 sheets.

_____1980c, Research at the U.S. Geological Survey on faults and earth fissures associated with land subsidence: The Engineering Geologist, v. 15, no. 3, p. 1-3.
(Newsletter of the Engineering Geology Division, Geological Society of America).

_____1981a, Preconsolidation stress of aquifer systems in areas of induced land subsidence: Water Resources Research, v. 17, p. 693-704.

_____1981b, A reply--Is there a Casa Grande Bulge, and will it cause earthquakes in Arizona?: Arizona Bureau of Geology and Mineral Technology Fieldnotes, v. 11, no. 1, p. 9-11.

_____1984, Ground failure induced by ground-water withdrawal from unconsolidated sediments, in Holzer, T.L., ed., Man-induced land subsidence: Geological Society of America Reviews in Engineering Geology, v. 6, p. 67-105.

_____1985, Surface deformation near ground failure associated with ground-water withdrawal [abs.]: Eos (American Geophysical Union, Transactions), v. 66, p. 850.

_____1986, Ground failure caused by groundwater withdrawal from unconsolidated sediments--United States, in Johnson, A.I., and others, eds., Land subsidence: International Symposium on Land Subsidence, 3d, Venice, Italy, 1984, Proceedings: International Association of Hydrological Sciences

(IAHS) Publication 151, p. 747-756.

Holzer, T.L., and Davis, S.N., 1976, Earth fissures associated with water-table declines [abs.]: Geological Society of America Abstracts with Programs, v. 8, p. 923-924.

_____1981, Earth fissures caused by ground-water level declines, Sonoran and Mojave Deserts [abs.]: Geological Society of America Abstracts with Programs, v. 13, p. 61-62.

Holzer, T.L., Davis, S.N., and Lofgren, B.E., 1977, Active surface faulting caused by ground-water extraction near Picacho, Arizona [abs.]: Geological Society of America Abstracts with Programs, v. 9, p. 437.

_____1979, Faulting caused by ground-water extraction in south-central Arizona: Journal of Geophysical Research, v. 84, p. 603-612.

Holzer, T.L., and Gray, R.E., 1988, Land subsidence in North America--the demise of terra firma [abs.]: Geological Society of America Abstracts with Programs, v. 20, p. 82.

Holzer, T.L., and Lluria, M.R., 1987, Selected hydrogeologic problems in central Arizona, in Davis, G.H., and VandenDolder, E.M., eds., Geologic diversity of Arizona and its margins--excursions to choice areas: Geological Society of America Annual Meeting, 100th, Phoenix, Ariz., 1987, Guidebook: Arizona Bureau of Geology and Mineral Technology Special Paper 5, p. 205-211.

Holzer, T.L., and Pampeyan, E.H., 1979a, Differential subsidence across earth fissures in Arizona, California, and Nevada [abs.]: Geological Society of America Abstracts with Programs, v. 11, p. 445.

_____1979b, Earth fissures and localized differential subsidence: U.S. Geological Survey Open-File Report 79-951, 7 p. (See also Water Resources Research, 1981, v. 17, p. 223-227).

Holzer, T.L., and Thatcher, Wayne, 1979, Modeling deformation due to subsidence faulting, in Saxena, S.K., ed., Evaluation and prediction of subsidence: American Society of Civil Engineers, International Conference, Pensacola Beach, Fla., 1978, Proceedings, p. 349-357.

International Association of Hydrological Sciences (IAHS), 1977, Land subsidence symposium: International Symposium on Land Subsidence, 2d, Anaheim, Calif., 1976, Proceedings: IAHS Publication 121, 665 p.

International Association of Scientific Hydrology (IASH) and Unesco, 1970, Land subsidence: Tokyo Symposium, 1969, Proceedings: Gentbrugge, Belgium, Studies and Reports in Hydrology 8, v. 1-2, 661 p.

Jachens, R.C., and Holzer, T.L., 1979, Geophysical investigations of ground failure related to ground-water withdrawal, Picacho basin, Arizona: Ground Water, v. 17, p. 574-585.

_____1982, Differential compaction mechanism for earth fissures near Casa Grande, Arizona: Geological Society of America Bulletin, v. 93, p. 998-1012.

Jennings, M.D., 1977, Geophysical investigations near subsidence fissures in northern Pinal and southern Maricopa Counties, Arizona: Tempe, Arizona State University, unpublished M.S. thesis, 102 p.

Johnson, A.I., Carbognin, Laura, and Ubertini, Lucio, eds., 1986, Land subsidence: International Symposium on Land Subsidence, 3d, Venice, Italy, 1984, Proceedings: International Association of

Hydrological Sciences (IAHS) Publication 151, 939 p.

Johnson, N.M., 1980, The relation between ephemeral stream regime and earth fissuring in south-central Arizona: Tucson, University of Arizona, unpublished M.S. thesis, 158 p.

Jones, N.O., 1968, The development of piping erosion: Tucson, University of Arizona, unpublished Ph.D. dissertation, 163 p.

Kam, William, 1965, Earth cracks--a cause of gullying, in Geological Survey research 1965: U.S. Geological Survey Professional Paper 525-B, p. 122-125.

Keith, S.J., 1977, The impact of groundwater development in arid lands--a literature review and annotated bibliography: University of Arizona, Office of Arid Lands Studies Arid Lands Resource Information Paper 10, 139 p.

Konieczki, A.D., and English, C.S., 1979, Maps showing ground-water conditions in the lower Santa Cruz area, Pinal, Pima, and Maricopa Counties, Arizona--1977: U.S. Geological Survey Water-Resources Investigations Open-File Report 79-56, scale 1:125,000, 4 sheets.

Lacy, W.C., 1964, Geological causes of foundation failures in the area of Tucson, Arizona: American Institute of Mining, Metallurgical, and Petroleum Engineers Transactions, v. 229, p. 40-44.

Laney, R.L., 1976, Water-level declines, land subsidence, and earth fissures in south-central Arizona, in Arizona Watershed Symposium, 20th, proceedings: Arizona Water Commission Report 8, p. 30-39.

_____1977, Water-table declines in the lower Salt River Valley, Arizona: U.S. Geological Survey, unpublished report.

Laney, R.L., and Pankratz, L.W., 1987, Investigations of land subsidence and earth fissures near the Salt-Gila aqueduct, Maricopa and Pinal Counties, Arizona: U.S. Geological Survey Miscellaneous Investigations Series Map I-1892-A, scale 1:36,000.

Laney, R.L., Raymond, R.H., and Winikka, C.C., 1978, Maps showing water-level declines, land subsidence, and earth fissures in south-central Arizona: U.S. Geological Survey Water-Resources Investigations Open-File Report 78-83, scale 1:125,000, 2 sheets.

Laney, R.L., Ross, P.P., and Littin, G.R., 1978, Maps showing ground-water conditions in the eastern part of the Salt River Valley area, Maricopa and Pinal Counties, Arizona, 1976: U.S. Geological Survey Water-Resources Investigations Open-File Report 78-61, scale 1:125,000, 2 sheets.

Larson, M.K., 1982a, Origin of land subsidence and earth fissures, northeast Phoenix, Arizona: Tempe, Arizona State University, unpublished M.S. thesis, 151 p.

_____1982b, Prediction of earth fissures related to groundwater withdrawal in the greater Phoenix area, Maricopa County, Arizona: Tempe, Arizona State University, Department of Geology, unpublished report, 16 p.

_____1983, Fissure prediction--geologic models and applications [abs.]: Arizona Consulting Engineers Association, Arizona Symposium on Subsidence, 2d, Phoenix, 1983, unpublished proceedings.

_____1986, Potential for subsidence fissuring in the Phoenix, Arizona, U.S.A. area, in Johnson, A.I., and others, eds., Land subsidence: International Symposium on Land Subsidence, 3d, Venice, Italy, 1984,

Proceedings: International Association of Hydrological Sciences (IAHS) Publication 151, p. 291-299.

Larson, M.K., and Pewe, T.L., 1981, Gravity methods applied to the investigation and prediction of earth fissures related to groundwater withdrawal in Phoenix, Arizona [abs.]: Eos (American Geophysical Union, Transactions), v. 62, p. 863.

_____1982, Investigation and prediction of earth fissures related to ground-water withdrawal, Phoenix, Arizona [abs.]: Geological Society of America Abstracts with Programs, v. 14 p. 179.

_____1983, Earth fissures and land subsidence hazards in northeast Phoenix: Arizona Bureau of Geology and Mineral Technology Fieldnotes, v. 13, no. 2, p. 8-11.

_____1986, Origin of land subsidence and earth fissuring, northeast Phoenix, Arizona: Association of Engineering Geologists Bulletin, v. 23, p. 139-165.

Lausten, C.D., 1974, Gravity methods applied to the geology and hydrology of Paradise Valley, Maricopa County, Arizona: Tempe, Arizona State University, unpublished M.S. thesis, 137 p.

Lee, W.T., 1905, Underground waters of Salt River Valley, Arizona: U.S. Geological Survey Water-Supply Paper 136, 196 p.

Leonard, R.J., 1929, An earth fissure in southern Arizona: Journal of Geology, v. 37, no. 8, p. 765-774.

Lofgren, B.E., 1978, Hydraulic stresses cause ground movement and fissures, Picacho, Arizona [abs.]: Geological Society of America Abstracts with Programs, v. 10, p. 113.

Lysonski, J.C., Sumner, J.S., Aiken, C.L.V., and Schmidt, J.S., 1980, Complete residual Bouguer gravity anomaly map of Arizona: Arizona Geological Survey Open-File Report 80-15, scale 1:1,000,000.

Mann, L.J., and Rohne, P.B., Jr., 1983, Streamflow losses and changes in ground-water levels along the Salt and Gila rivers near Phoenix, Arizona, February 1978 to June 1980: U.S. Geological Survey Water-Resources Investigations Open-File Report 83-4043, 15 p., scale 1:250,000.

McCauley, C.A., 1973, Management of subsiding lands--an economic evaluation: Tucson, University of Arizona, unpublished Ph.D. dissertation, 70 p.

McCauley, C.A., and Gum, R.L., 1972, Subsidence damage in southern Arizona, in Fogel, M.M., ed., Hydrology and water resources in Arizona and the Southwest, v. 2: American Water Resources Association, Arizona Section, and Arizona Academy of Science, Hydrology Section, Annual Meeting, Prescott, Ariz., 1972, Proceedings, p. 87-94.

_____1975, Land subsidence--an economic analysis: Water Resources Bulletin, v. 11, p. 148-154.

Morrison, R.B., 1972, Progress on geologic-terrain mapping for land-use planning in the Tucson area: Annual Conference on Remote Sensing in Arid Lands, 3d, Tucson, Ariz., 1972, Proceedings, p. 344-372.

Morton, D.R., 1979, A selected bibliography of recent subsidence studies: University of Colorado, Natural Hazards Research and Applications Information Center, 42 p.

Narasimhan, T.N., and Holzer, T.L., 1978, Possibility of soil deformation in the partially saturated zone due to pore-pressure changes [abs.]: Geological Society of America Abstracts with Programs, v. 10,

p. 138-139.

Nemecek, E.A., compiler, 1975, Quality of groundwater, changes in water levels, amounts of groundwater in storage, and groundwater pumpage in Arizona, in Phase I of Arizona state water plan: Phoenix, Arizona State Water Commission, plate 2, scale 1:500,000.

Newlin, C.W., 1966, Land subsidence caused by pumping: Arizona Professional Engineer, v. 18, p. 6-9.

Oppenheimer, J.M., 1980, Gravity modeling of the alluvial basins, southern Arizona: Tucson, University of Arizona, unpublished M.S. thesis, 81 p.

Oppenheimer, J.M., and Sumner, J.S., 1980, Depth-to-bedrock map, Basin and Range province, Arizona: Tucson, University of Arizona, Laboratory of Geophysics, scale 1:1,000,000.

_____1981, Gravity modeling of the basins in the Basin and Range province, Arizona: Arizona Geological Society Digest, v. 13, p. 111-115.

Ostercamp, W.R., 1973a, Map showing depth to water in wells in the Phoenix area, Arizona, 1972: U.S. Geological Survey Miscellaneous Investigations Series Map I-845-D, scale 1:250,000.

_____1973b, Map showing depth to water in wells in the Tucson area, Arizona, 1972: U.S. Geological Survey Miscellaneous Investigations Series Map I-844-D, scale 1:250,000.

Pankratz, L.W., Ackermann, H.D., Grim, M.S., and Jachens, R.C., 1978, Geophysical studies near Picacho, Arizona [abs.]: Geological Society of America Abstracts with Programs, v. 10, p. 141.

Pankratz, L.W., Ackermann, H.D., and Jachens, R.C., 1978, Results and interpretation of geophysical studies near the Picacho fault, south-central Arizona: U.S. Geological Survey Open-File Report 78-1106, 17 p.

Pankratz, L.W., Hassemer, J.H., and Ackermann, H.D., 1978, Geophysical studies relating to earth fissures in central Arizona [abs.]: Geophysics, v. 44, p. 367.

Pashley, E.F., Jr., 1961, Subsidence cracks in alluvium near Casa Grande, Arizona: Arizona Geological Society Digest, v. 4, p. 95-101.

Patino, F.H., Robertson, John, and Pewe, T.L., 1985, Geological hazards, in Environmental geology of the Chandler quadrangle, Maricopa County, Arizona: City of Chandler, unpublished report, scale 1:24,000, 13 sheets.

Peirce, H.W., 1979, Subsidence--fissures and faults in Arizona: Arizona Bureau of Geology and Mineral Technology Fieldnotes, v. 9, no. 2, p. 1-2, 6-7.

Peterson, D.E., 1962a, Earth fissuring in the Picacho area, Pinal County, Arizona: Tucson, University of Arizona, unpublished M.S thesis, 35 p.

_____1962b, Earth fissuring in the Picacho area, Pinal County, Arizona: U.S. Geological Survey Open-File Report, 52 p.

Peterson, D.L., 1968, Bouger gravity map of parts of Maricopa, Pima, Pinal, and Yuma Counties, Arizona: U.S. Geological Survey Geophysical Investigations Map GP-615, scale 1:250,000.

Pewe, T.L., 1978a, Geologic hazards in the Phoenix area, Arizona: Tempe, Arizona State University, Department of Geology Reprint 228, 3 p.

_____1978b, Terraces of the lower Salt River Valley in relation to the late Cenozoic history of the Phoenix basin, Arizona--a review, in Burt, D.M., and Pewe, T.L., eds., Guidebook to the geology of central Arizona: Arizona Bureau of Geology and Mineral Technology Special Paper 2, p. 1-14.

_____1980, Earth crack, 40th Street and Lupine, Phoenix, Arizona: City of Phoenix, unpublished report, 13 p.

_____1984, Land subsidence and earth fissures, in Pewe, T.L., and Kenny, Ray, Geologic hazards of Arizona: Tempe, Arizona State University, Department of Geology, p. 4-12.

_____1990, Land subsidence and earth-fissure formation caused by groundwater withdrawal in Arizona--a review, in Higgins, C.G., and Coates, D.R., eds., Groundwater geomorphology--the role of subsurface water in earth-surface processes and landforms: Geological Society of America Special Paper 252, in press.

Pewe, T.L., and Larson, M.K., 1982, Origin of land subsidence and earth fissures in northeast Phoenix, Arizona: City of Phoenix Engineer's Office, unpublished report, 98 p.

Pewe, T.L., Raymond, R.H., and Schumann, H.H., 1987, Land subsidence and earth-fissure formation in eastern Phoenix metropolitan area, Arizona, in Davis, G.H., and VandenDolder, E.M., eds., Geologic diversity of Arizona and its margins--excursions to choice areas: Geological Society of America Annual Meeting, 100th, Phoenix, Ariz., 1987: Arizona Bureau of Geology and Mineral Technology Special Paper 5, p. 199-204.

Platt, W.S., 1963, Land-surface subsidence in the Tucson area: Tucson, University of Arizona, unpublished M.S. thesis, 38 p.

Poland, J.F., 1967, Land subsidence, in Geological Survey research 1967: U.S. Geological Survey Professional Paper 575-A, p. 57-58.

_____1970, Status of present knowledge and needs for additional research on compaction of aquifer systems, in Land subsidence: Tokyo Symposium, 1969, Proceedings: Gentbrugge, Belgium, International Association of Scientific Hydrology (IASH) and Unesco, Studies and Reports in Hydrology 8, v. 1, p. 11-21. (Also published as IASH Publication 88-89).

_____1972, Land subsidence in the western states due to ground-water overdraft: Water Resources Bulletin, v. 8, p. 118-131.

_____1973, Subsidence in United States due to ground-water overdraft--a review, in Agricultural and urban considerations in irrigation and drainage: American Society of Civil Engineers, Irrigation and Drainage Division Specialty Conference, Fort Collins, Colo., 1973, p. 11-38.

_____1981, Subsidence in United States due to ground-water withdrawal, in Proceedings of the American Society of Civil Engineers: Journal of the Irrigation and Drainage Division, v. 107, no. 2, p. 115-135.

_____1988, Subsidence due to ground-water withdrawal, in Speidel, D.H., Ruedisili, L.C., and Agnew, A.F., eds., Perspectives on water--uses and abuses: New York, Oxford University Press, p. 272-285.

Poland, J.F., and Davis, G.H., 1969, Land subsidence due to withdrawal of fluids, in Varnes, D. J., and Kiersch, George, eds., Reviews in engineering geology: Geological Society of America, v. 2, p. 187-269.

Poland, J.F., Lofgren, B.E., and Riley, F.S., 1972, Glossary of selected terms useful in studies of the mechanics of aquifer systems and land subsidence due to fluid withdrawal: U.S. Geological Survey Water-Supply Paper 2025, 9 p.

Pool, D.R., 1984, Aquifer geology of alluvial basins of Arizona, in Replogle, J.A., and Renard, K.G., eds., Water today and tomorrow: Specialty Conference, American Society of Civil Engineers, Irrigation and Drainage Division, Flagstaff, Ariz., 1984, Proceedings, p. 683-690.

_____1986, Aquifer geology of alluvial basins of Arizona, in Anderson, T.W., and Johnson, A.I., eds., Regional aquifer systems of the United States--southwest alluvial basins of Arizona: American Water Resources Association Monograph Series, 21st, Bethesda, Md., 1985, Proceedings of Symposium, p. 25-36.

Pope, C.W., Bland, B., Buchheim, R., and Bell, J.W., 1972, Resistivity and gravity studies of earth cracks: Tempe, Arizona State University, Department of Geology, unpublished report, 3 p.

Prokopovich, N.P., 1980, Future subsidence along Salt-Gila aqueduct, Arizona [abs.]: Geological Society of America Abstracts with Programs, v. 12, p. 301-302.

_____1983, Reconnaissance estimates of subsidence along Salt-Gila aqueduct, Arizona: Association of Engineering Geologists Bulletin, v. 20, p. 297-316.

Ragan, D.M., 1982, Model of the Phoenix earthcrack, in Pewe, T.L., and Larson, M.K., eds., Origin of land subsidence and earth fissures in northeast Phoenix, Arizona: City of Phoenix Engineers Office, unpublished report, Appendix H, p. 1-6.

_____1986, Model of the Phoenix earth crack, in Larson, M.K., and Pewe, T.L., Origin of land subsidence and earth fissuring, northeast Phoenix, Arizona: Association of Engineering Geologists Bulletin, v. 23, no. 2, p. 163-165.

Raymond, R.H., 1985, Earth fissure investigations for reaches 2A, Salt-Gila aqueduct: U.S. Bureau of Reclamation, unpublished report, 23 p., 7 plates.

_____1986, Seven geologic settings for earth fissures in south-central Arizona [abs.]: Journal of the Arizona-Nevada Academy of Science, Proceedings Supplement, v. 21, p. 51.

Raymond, R.H., Cordy, G.E., and Tuttle, G.J., 1980, Is there a Casa Grande bulge and will it cause earthquakes in Arizona?: Arizona Bureau of Geology and Mineral Technology Fieldnotes, v. 10, no. 3, p. 10-11.

Raymond, R.H., Laney, R.L., Pankratz, L.W., Riley, F.S., and Carpenter, M.C., 1979, Relationship of earth fissures in alluvial basins in south-central Arizona to irregularities in the underlying formations [abs.]: Geological Society of America Abstracts with Programs, v. 11, p. 501.

Raymond, R.H., Winikka, C.C., and Laney, R.L., 1978, Earth fissures and land subsidence, eastern Maricopa and northern Pinal Counties, Arizona, in Burt, D.M., and Pewe, T.L., eds., Guidebook to the geology of central Arizona: Arizona Bureau of Geology and Mineral Technology Special Paper 2, p. 107-113.

Robinson, G.M., and Peterson, D.E., 1962, Notes on earth fissures in southern Arizona: U.S. Geological Survey Circular 466, 7 p.

Sauck, W.A., 1971, Land subsidence and earth cracks [abs.]: Tempe, Arizona State University, Research and Special Programs, p. 29.

_____1973, Preliminary geophysical studies near subsidence fissures in central Arizona [abs.]: Journal of the Arizona Academy of Science, v. 8, p. 42.

_____1975a, Geophysical studies near earth fissures north of the Santan Mountains, Maricopa and Pinal Counties, Arizona [abs.]: Arizona Academy of Sciences Annual Meeting, 19th, Tempe, 1975, Proceedings Supplement, v. 10, p. 43.

_____1975b, Geophysical studies near subsidence fissures in central Arizona [abs.]: Eos (American Geophysical Union, Transactions), v. 56, p. 984-985.

Saxena, S.K., ed., 1979, Evaluation and prediction of subsidence: American Society of Civil Engineers, International Conference, Pensacola Beach, Fla., 1978, Proceedings, 594 p.

Schumann, H.H., 1974, Land subsidence and earth fissures in alluvial deposits in the Phoenix area, Arizona: U.S. Geological Survey Miscellaneous Investigations Series Map I-845-H, scale 1:250,000, 2 sheets.

_____1986, Ground-water depletion and land subsidence in western Pinal County, Arizona, in Southwestern ground water issues: National Water Well Association Conference, Tempe, Ariz., 1986, Proceedings, p. 533-552.

_____1988, U.S. Geological Survey ground-water studies in Arizona: U.S. Geological Survey Open-File Report 88-164, Water Fact Sheet, 2 p.

_____1989, Geophysical investigations of earth fissures caused by land subsidence near Apache Junction, Arizona [abs.]: International Geological Congress, 28th, Washington, D.C., 1989, Proceedings, v. 3, p. 58.

Schumann, H.H., and Anderson, S.R., 1988, Land-subsidence measurements and aquifer-compaction monitoring in Tucson basin and Avra Valley, Arizona: U.S. Geological Survey Water-Resources Investigations Report 88-4167, 15 p.

Schumann, H.H., and Genualdi, R.B., 1986a, Land subsidence, earth fissures, and water-level change in southern Arizona: Arizona Bureau of Geology and Mineral Technology Map M-23, scale 1:1,000,000.

_____1986b, Land subsidence, earth fissures, and water-level change in southern Arizona: Arizona Bureau of Geology and Mineral Technology Open-File Report 86-14, scale 1:500,000.

Schumann, H.H., Laney, R.L., and Cripe, L.S., 1986, Land subsidence and earth fissures caused by ground-water depletion in southern Arizona, in Anderson, T.W., and Johnson, A.I., eds., Regional aquifer systems of the United States--southwest alluvial basins of Arizona: American Water Resources Association Monograph Series 7, 21st, Bethesda, Md., Proceedings of Symposium, p. 81-91.

Schumann, H.H., and Littin, G.R., 1985, Land subsidence and earth fissures in southern Pinal County, Arizona [abs.]: Eos (American Geophysical Union, Transactions), v. 66, p. 850.

Schumann, H.H., Litton, G.R., and Wallace, B.L., 1983, Monitoring water-level change, aquifer compaction, and land subsidence along the Salt-Gila aqueduct in south-central Arizona [abs.]: Arizona Consulting Engineers Association, Arizona Symposium on Subsidence, 2d, Phoenix, 1983, unpublished proceedings.

Schumann, H.H., and Poland, J.F., 1970, Land subsidence, earth fissures and ground-water withdrawal in south-central Arizona, U.S.A., in Land subsidence: Tokyo Symposium, 1969, Proceedings: Gentbrugge, Belgium, International Association of Scientific Hydrology (IASH) and Unesco, Studies and Reports in Hydrology 8, v. 1, p. 295-302. (Also published as IASH Publication 88-89).

Schumann, H.H., and Tosline, D.J., 1983, Occurrence and prediction of earth fissure hazards caused by ground-water depletion in south-central Pinal County, Arizona [abs.]: Arizona Consulting Engineers Association, Arizona Symposium on Subsidence, 2d, Phoenix, 1983, unpublished proceedings.

Schumann, H.H., Tosline, D.J., and Wrege, B.M., 1984, Occurrence and prediction of earth-fissure hazards caused by ground-water depletion in south-central Arizona, U.S.A. [abs.], in Replogle, J.A., and Renard, K.G., eds., Water today and tomorrow, specialty conference proceedings: American Society of Civil Engineers Meeting, Irrigation and Drainage Division, Flagstaff, Ariz., 1984, p. 673.

Scott, J.D., and Moore, R.T., 1976, The Palo Verde nuclear power station: Arizona Bureau of Mines Fieldnotes, v. 6, no. 3-4, p. 1-7.

Seismological Society of America, 1927, Seismological notes: Seismological Society of America Bulletin, v. 17, p. 199.

Sergent, Hauskins, & Beckwith, Inc., 1984a, City of Phoenix--study of subsidence effects on sanitary sewers, northeast Phoenix, Arizona, phase I--initial studies: Phoenix, unpublished report, 71 p.

_____1984b, City of Phoenix--study of subsidence effects on sanitary sewers, northeast Phoenix, Arizona, phase II--field survey: Phoenix, unpublished report, 21 p., 3 appendices, scale 1:24,000, 5 sheets.

_____1985a, City of Phoenix--study of subsidence effects on sanitary sewers, northeast Phoenix, Arizona, phase III--subsidence model: Phoenix, unpublished report, 55 p., 2 appendices, scale 1:24,000, 2 sheets.

_____1985b, City of Phoenix--study of subsidence effects on sanitary sewers, northeast Phoenix, Arizona, phase IV--subsidence predictions and mitigating measures: Phoenix, unpublished report, 49 p., 2 appendices, scale 1:24,000, 8 sheets.

Shank, P.C., and Pewe, T.L., 1973, Environmental geology in the Phoenix Mountains, Maricopa County, Arizona: City of Phoenix Engineer's Office, scale 1:15,000, 8 sheets.

Slaff, Steven, 1989, Patterns of earth-fissure development--examples from Picacho basin, Pinal County, Arizona: Arizona Geological Survey Arizona Geology, v. 19, no. 3, p. 4-5.

Slaff, Steven, Jackson, G.W., and Pearthree, P.A., 1989, Development of earth fissures in Picacho basin, Pinal County, Arizona from 1959 to 1989: Arizona Geological Survey Open-File Report 89-10, 38 p., scale 1:24,000, 6 sheets.

_____1990, Temporal and spatial development patterns of earth fissures in the lower Santa Cruz River basin, Pinal County, Arizona from 1959 to 1989 [abs.]: Geological Society of America Abstracts

with Programs, v. 22, p. 84.

Smith, G.E.P., 1938, The physiography of Arizona valleys and the occurrence of ground water: Tucson, University of Arizona Agricultural Experiment Station Technical Bulletin 77, 91 p.

_____1940, The ground-water supply of the Eloy district in Pinal County, Arizona: Tucson, University of Arizona Agricultural Experiment Station Technical Bulletin 87, 42 p.

Strange, W.E., 1983, Subsidence monitoring for State of Arizona: Rockville, Md., National Geodetic Survey, National Oceanic and Atmospheric Administration report, 74 p.

Streitz, Robert, 1962, Subsurface stratigraphy and hydrology of the Rillito Creek-Tanque Verde Wash areas, Tucson, Arizona: Tucson, University of Arizona, unpublished M.S. thesis, 60 p.

Stulik, R.S., and Twenter, F.R., 1964, Geology and ground water of the Luke area, Maricopa County, Arizona: U.S. Geological Survey Water-Supply Paper 1779-P, 30 p.

Sumner, J.S., and Christie, F.I., 1980, Geophysical and hydrologic prediction of fissuring and land subsidence, south-central Arizona: National Technical Information Service, Accession PB 80-159 908, 5 p.

Thomsen, B.W., and Baldys, Stanley, III, 1985, Ground-water conditions in and near the Gila River Indian Reservation, south-central Arizona: U.S. Geological Survey Water Resources Investigations Report 85-4073, scale 1:250,000, 2 sheets.

U.S. Department of the Interior, Bureau of Reclamation, 1976a, Geology and groundwater resources report, Maricopa and Pinal Counties, Arizona--Central Arizona Project: unpublished report, v. 1, 105 p., 73 plates.

_____1976b, Geology and groundwater resources report, Maricopa and Pinal Counties, Arizona--Central Arizona Project: unpublished report, v. 2, 110 plates.

_____1979, Final environmental statement, Salt-Gila aqueduct, Central Arizona Project: INT FES 79-60, 191 p., 75 plates.

U.S. Geological Survey, 1980, Annual summary of ground-water conditions in Arizona, spring 1978 to spring 1979: Water Resources Investigations Open-File Report 80-330, scale 1:1,000,000.

Viets, V.F., Vaughan, C.K., and Harding, R.C., 1979, Environmental and economic effects of subsidence: Lawrence Berkeley Laboratory Report LBL-8615, 232 p.

Wallace, B.L., Wrege, B.M., and Schumann, H.H., 1986, Geohydrologic data along the Salt-Gila aqueduct of the Central Arizona Project in Maricopa and Pinal Counties, Arizona: U.S. Geological Survey Open-File Report 86-236, 49 p.

Weeks, R.E., and Hanson, A.L., 1983, Restoration of McMicken Dam--repairing the effects of ground subsidence and protecting against earth fissuring [abs.]: Arizona Consulting Engineers Association, Arizona Symposium on Subsidence, 2d, Phoenix, 1983, unpublished proceedings.

West, R.E., 1972, A regional Bouguer gravity anomaly map of Arizona: Tucson, University of Arizona, unpublished Ph.D. dissertation, 186 p.

West, R.E., and Sumner, J.S., 1973, Bouguer gravity anomaly map of Arizona: Tucson, University of Arizona, Department of Geosciences, scale 1:1,000,000.

White, N.D., 1963, Analysis and evaluation of available hydrologic data for San Simon basin, Cochise and Graham Counties, Arizona: U.S. Geological Survey Water-Supply Paper 1619-DD, 33 p.

Whittaker, B.N., and Reddish, D.J., 1989, Subsidence--occurrence, prediction, and control: New York, Elsevier, p. 359-376.

Wickersham, Ginia, 1983, Progress report--subsidence monitoring in Arizona [abs.]: Arizona Consulting Engineers Association, Arizona Symposium on Subsidence, 2d, Phoenix, 1983, unpublished proceedings.

Winikka, C.C., 1964, Subsidence in the Eloy-Picacho area, in Proceedings of the 10th and 11th Arizona Land Surveyors' Conference: Tucson, University of Arizona Engineering Experiment Station, p. 39-43.

_____1975, Arizona earth fissure investigation, hazard reduction, directory of disaster-related technology: U.S. Department of Housing and Urban Development Report 401-FDAA, p. 6-184.

_____1981, New leveling across Arizona: Arizona Bureau of Geology and Mineral Technology Fieldnotes, v. 11, no. 2, p. 10.

_____1984, A view of subsidence: Arizona Bureau of Geology and Mineral Technology Fieldnotes, v. 14, no. 3, p. 1-5.

Winikka, C.C., Raymond, R.H., and Laney, R.L., 1978, Water-level declines for 1923-77, land subsidence for 1952-77, and earth fissures as of 1977 in south-central Arizona [abs.]: Geological Society of America Abstracts with Programs, v. 10, p. 154.

Winikka, C.C., and Wold, P.D., 1977, Land subsidence in central Arizona, in Land subsidence symposium: International Symposium on Land Subsidence, 2d, Anaheim, Calif., 1976, Proceedings: International Association of Hydrological Sciences (IAHS) Publication 121, p. 95-103.

Wrege, B.M., 1986a, Earth fissure prediction by seismic surface-wave attenuation [abs.]: Journal of the Arizona-Nevada Academy of Science, Proceedings Supplement, v. 21, p. 50.

_____1986b, Surface- and borehole-geophysical surveys used to define hydrogeological units in south-central Arizona, in Conference on Southwestern ground water issues: Tempe, Ariz., 1986, Proceedings: Dublin, Ohio, National Water Well Association, p. 485-499.

Wrege, B.M., Hasbrouck, W.P., and Schumann, H.H., 1987, Seismic surface-wave attenuation across earth fissures in alluvium, south-central Arizona, in Surface and borehole geophysical methods and ground water instrumentation: National Conference and Exposition, 2d, Denver, 1986, Proceedings: Dublin, Ohio, National Water Well Association, p. 121-130.

Wrege, B.M., Schumann, H.H., and Wallace, B.L., 1985, Geohydrologic data along the Tucson aqueduct of the Central Arizona Project in Pinal and Pima Counties, Arizona: U.S. Geologic Survey Open-File Report 85-565, 77 p.

Wright, J.J., and Johnson, B.R., 1976, The significance of ground-water level declines in eastern Pima County, Arizona: Annual Arizona Watershed Symposium, 20th, Proceedings: Arizona Water

Commission Report 8, p. 22-29.

REFERENCES PERTAINING TO AREAS OUTSIDE OF ARIZONA

Bear, Jacob, and Corapcioglu, M.Y., 1981a, Mathematical model for regional land subsidence due to pumping--1. Integrated aquifer subsidence equations based on vertical displacement only: Water Resources Research, v. 17, p. 937-946.

_____1981b, Mathematical model for regional land subsidence due to pumping--2. Integrated aquifer subsidence equations for vertical and horizontal displacements: Water Resources Research, v. 17, p. 947-958.

Bell, J.W., 1980, Results of leveling across fault scarps in Las Vegas Valley, Nevada, April, 1978-June, 1980: Nevada Bureau of Mines and Geology Open-File Report 80-7, 5 p.

_____1981a, Results of leveling across fault scarps in Las Vegas Valley, Nevada, April, 1978-June, 1981: Nevada Bureau of Mines and Geology Open-File Report 81-5, 7 p.

_____1981b, Subsidence in Las Vegas Valley: Nevada Bureau of Mines and Geology Bulletin 95, 84 p., scale 1:62,500.

_____1989, Subsidence in Las Vegas Valley: Nevada Bureau of Mines and Geology Nevada Geology, no. 3, p. 1-2.

Brown, C.B., and Burgess, S.J., 1973, Ground motions caused by single-well pumping: Water Resources Research, v. 9, p. 1420-1427.

Bull, W.B., 1964, Alluvial fans and near-surface subsidence in western Fresno County, California: U.S. Geological Survey Professional Paper 437-A, 70 p., scale 1:250,000, 4 sheets.

_____1972, Prehistoric near-surface subsidence cracks in western Fresno County, California: U.S. Geological Survey Professional Paper 437-C, 85 p., scale 1:250,000, 2 sheets.

_____1973, Geologic factors affecting compaction of deposits in land-subsidence areas: Geological Society of America Bulletin, v. 84, p. 3783-3802.

_____1975, Land subsidence due to ground-water withdrawal in the Los Banos-Kettleman City area, California--part 2, subsidence and compaction of deposits: U.S. Geological Survey Professional Paper 437-F, 90 p.

Bull, W.B., and Miller, R.E., 1975, Land subsidence due to ground-water withdrawal in the Los Banos-Kettleman City area, California--part 1, changes in the hydrologic environment conducive to subsidence: U.S. Geological Survey Professional Paper 437-E, 71 p.

Bull, W.B., and Poland, J.F., 1975, Land subsidence due to ground-water withdrawal in the Los Banos-Kettleman City area, California--part 3, interrelations of water-level change, change in aquifer-system thickness, and subsidence: U.S. Geological Survey Professional Paper 437-G, 62 p.

Carver, R.E., 1970, Model studies of differential compaction, in Land subsidence: Tokyo Symposium, 1969, Proceedings: Gentbrugge, Belgium, International Association of Scientific Hydrology (IASH)

and Unesco, Studies and Reports in Hydrology 8, v. 2, p. 450-458. (Also published as IASH Publication 88-89).

Casagrande, Arthur, 1936, The determination of the pre-consolidation load and its practical significance, in International conference on soil mechanics and foundation engineering, 1st, proceedings: Cambridge, Harvard University, v. 3, p. 60-64.

Castle, R.O., and Yerkes, R.F., 1976, Recent surface movements in the Baldwin Hills, Los Angeles County, California: U.S. Geological Survey Professional Paper 882, 125 p.

Christensen, G.E., 1986, Utah's geologic hazards: Utah Geological and Mineral Survey Survey Notes, v. 20,, no. 1, p. 3-8.

Clanton, U.S., and Amsbury, D.L., 1975, Active faults in southeastern Harris County, Texas: Environmental Geology, v. 1, no. 3, p. 149-154.

Clark, M.M., Buchanan-Banks, J.M., and Holzer, T.L., 1978, Creep along parts of the Garlock fault--possible relation to decline in ground-water levels [abs.]: Geological Society of America Abstracts with Programs, v. 10, p. 100.

Compton, R.L., 1961, The right to the subjacent support of oil and gas: California Law Review, v. 49, p. 354-367.

Contaldo, G.J., 1989, Earth fissures and land subsidence near Deming, New Mexico: Las Cruces, New Mexico State University, unpublished M.S. thesis, 106 p.

Contaldo, G.J., and Mueller, J.E., 1988, Earth fissures in the Deming area, in Mack, G.H., Lawton, T.F., and Lucas, S.G., eds., Cretaceous and Laramide tectonic evolution of southwestern New Mexico: New Mexico Geologic Society annual field conference, 39th, 1988, Socorro, p. 3-5.

_____1990, Earth fissures of the Mimbres basin, southwestern New Mexico: New Mexico Bureau of Mines and Mineral Resources New Mexico Geology, in review.

Corapcioglu, M.Y., 1984, Land subsidence--A. A state of the art review, in Bear, Jacob, and Corapcioglu, M.Y., eds., Fundamentals of transport phenomena in porous media: NATO Advanced Study Institute on Mechanics of Fluids in Porous Media, Newark, Del., 1982, Proceedings: Hingham, Mass., NATO Applied Sciences Series E, no. 82, p. 371-444.

Corapcioglu, M.Y., and Bear, Jacob, 1983, A mathematical model for regional land subsidence due to pumping--3. Integrated equations for a phreatic aquifer: Water Resources Research, v. 19, p. 895-908.

Cordova, R.M., 1975, Fracturing and subsidence of the land surface caused by the withdrawal of ground water in the Milford area, Utah [abs.]: Geological Society of America Abstracts with Programs, v. 7, p. 1039.

Cordova, R.M., and Mower, R.W., 1976, Fracturing and subsidence of the land surface caused by the withdrawal of groundwater in the Milford area, Utah: U.S. Geological Survey Journal of Research, v. 4, no. 5, p. 505-510.

Davis, G.H., Counts, H.B., and Holdahl, S.R., 1977, Further examination of subsidence at Savannah, Georgia 1955-1975, in Land subsidence symposium: International Symposium on Land Subsidence, 2d,

Anaheim, Calif., 1976, Proceedings: International Association of Hydrological Sciences (IAHS) Publication 121, p. 347-354.

Davis, G.H., Small, J.B., and Counts, H.B., 1963, Land subsidence related to decline of artesian pressure in the Ocala Limestone at Savannah, Georgia, in Trask, P.D., and Kiersch, G.A., eds., Engineering geology case histories 4: Geological Society of America, p. 1-8.

Davis, S.N., Peterson, E.L., and Halderman, A.D., 1969, Measurement of small surface displacements induced by fluid flow: Water Resources Research, v. 5, p. 129-138.

Domenico, P.A., and Mifflin, M.D., 1965, Water from low-permeability sediments and land subsidence: Water Resources Research, v. 1, p. 563-576.

Domenico, P.A., Mifflin, M.D., and Mindling, A.L., 1966, Geologic controls on land subsidence in Las Vegas Valley, in Annual engineering geologists soils engineering symposium, 4th, Proceedings: Association of Engineering Geologists, p. 113-121.

Domenico, P.A., Stephenson, D.A., and Maxey, G.B., 1964, Groundwater in Las Vegas Valley: Reno, Nevada University System, Desert Research Institute Technical Report 7, Center for Water Resources Research, 53 p.

Ege, J.R., 1979a, Selected bibliography on ground subsidence caused by dissolution and removal of salt and other soluble evaporites: U.S. Geological Survey Open-File Report 79-1133, 30 p.

_____1979b, Selected bibliography on subsidence processes and related engineering problems in carbonate rocks: U.S. Geological Survey Open-File Report 79-1214, 25 p.

_____1979c, Surface subsidence and collapse in relation to extraction of salt and other soluble evaporites: U.S. Geological Survey Open-File Report 79-1666, 34 p.

Fife, D.L., 1977, Engineering geologic significance of giant desiccation polygons, Lucerne Valley playa, San Bernardino County, California [abs.]: Geological Society of America Abstracts with Programs, v. 9, p. 419.

Fletcher, J.E., Harris, Karl, Peterson, H.B., and Chandler, V.N., 1954, Piping; paper presented at the symposium on land erosion, annual meeting, 34th, Washington, D.C., 1953: American Geophysical Union Transactions, v. 35, p. 258-262.

Forrester, F., 1971, Rate of land subsidence decreases in California: California Division of Mines and Geology California Geology, v. 24, p. 148-149.

Fowler, L.C., 1981, Economic consequences of land-surface subsidence: American Society of Civil Engineers, Journal of the Irrigation and Drainage Division, v. 107, no. IR2, p. 151-159.

Gabrysch, R.K., and Bonnet, C.W., 1975a, Land-surface subsidence at Seabrook, Texas: U.S. Geological Survey Open-File Report 75-413, 51 p.

_____1975b, Land-surface subsidence in the area of Moses Lake near Texas City, Texas: U.S. Geological Survey Open-File Report 75-424, 44 p.

_____1875c, Land-surface subsidence in the Houston-Galveston region, Texas: Austin, Texas Water Development Board Report 188, 19 p.

Gambolati, Giuseppe, 1974, Second-order theory of flow in three-dimensional deforming media: Water Resources Research, v. 10, p. 1217-1228.

Gambolati, Giuseppe, Gatto, Paolo, and Freeze, R.A., 1974, Mathematical simulation of the subsidence of Venice: Water Resources Research, v. 10, p. 563-577.

Green, J.H., 1964, The effect of artesian pressure decline on confined aquifer systems and its relation to land subsidence: U.S. Geological Survey Water-Supply Paper 1779-T, 11 p.

Guacci, Gary, 1979, The Pixley fissure, San Joaquin Valley, California, in Saxena, S.K., ed., Evaluation and prediction of subsidence: American Society of Civil Engineers, International Conference, Pensacola Beach, Fla., 1978, Proceedings, p. 303-319.

Hall, W.A., and Dracup, J.A., 1967, The optimum management of ground-water resources, in International conference on water for peace: Wash., D.C., U.S. Government Printing Office, Water for Peace, v. 3, p. 20-27.

Haneberg, W.C., 1990a, Geologic hazards of New Mexico, in Annual highway geology symposium, 41st, Albuquerque, 1990, proceedings: in press.

_____1990b, Use of seismic reflection profiles to characterize soil deformation associated with earth fissures and groundwater withdrawal near Deming, New Mexico: New Mexico Bureau of Mines and Mineral Resources Open-File Report 367, 19 p.

Haneberg, W.C., Reynolds, C.B., and Reynolds, I.B., 1990, Monoclinal flexure of surficial strata and the origin of an earth fissure near San Marcial, New Mexico: Journal of Geophysical Research, in review.

Hanna, W.S., 1950, Settlement studies in Egypt: Geotechnique, v. 2, p. 139-147.

Heindl, L.A., and Feth, J.H., 1955, Piping--a discussion on paper presented by J.E. Fletcher, Karl Harris, H.B. Peterson, and V.N. Chandler: American Geophysical Union Transactions, v. 36, p. 342-345.

Helm, D.C., 1972, Evaluation of stress-dependent aquitard parameters by simulating observed compaction from known stress history: Berkeley, University of California, unpublished Ph.D. dissertation, 175 p.

_____1973, Theory of flow through deforming granular material: U.S. Geological Survey, unpublished report, 184 p.

_____1975, One-dimensional simulation of aquifer-system compaction near Pixley, California--1. constant parameters: Water Resources Research, v. 11, p. 465-478.

_____1976, One-dimensional simulation of aquifer-system compaction near Pixley, California--2. stress-dependent parameters: Water Resources Research, v. 12, p. 375-391.

_____1977, Estimating parameters of compacting fine-grained interbeds within a confined aquifer system by a one-dimensional simulation of field observations, in Land subsidence symposium: International Symposium on Land Subsidence, 2d, Anaheim, Calif., 1976, Proceedings: International Association of Hydrological Sciences (IAHS) Publication 121, p. 145-156.

_____1978, Field verification of a one-dimensional mathematical model for transient compaction and expansion of a confined aquifer system, in Verification of mathematical and physical models in hydraulic engineering: Specialty Conference, 26th, College Park, Md., 1978, Proceedings: American Society of Civil Engineers, Hydraulics Division, p. 189-196.

_____1979, A postulated relation between granular movement and Darcy's law for transient flow, in Saxena, S.K., ed., Evaluation and prediction of subsidence: American Society of Civil Engineers, International Conference, Pensacola Beach, Fla., 1978, Proceedings, p. 417-440.

_____1982, Conceptual aspects of subsidence due to fluid withdrawal, in Narasimhan, T.N., ed., Recent trends in hydrogeology: Geological Society of America Special Paper 189, p. 103-139.

_____1984, Field-based computational techniques for predicting subsidence due to fluid withdrawal, in Holzer, T.L., ed., Man-induced land subsidence: Geological Society of America Reviews in Engineering Geology, v. 6, p. 1-22.

Holzer, T.L., 1978a, Documentation of potential for surface faulting related to ground-water withdrawal in Las Vegas valley, Nevada: U.S. Geololgical Survey Open-File Report 78-79, 21 p.

_____1978b, Surface faulting probably related to ground-water withdrawal, San Joaquin Valley, California [abs.]: Geological Society of America Abstracts with Programs, v. 10, p. 424.

_____1979, Leveling data--Eglington fault scarp, Las Vegas Valley, Nevada: U.S. Geological Survey Open-File Report 79-950, 7 p.

_____1980, Faulting caused by ground-water level declines, San Joaquin Valley, California: Water Resources Research, v. 16, p. 1065-1070.

_____1985, A review of methods for predicting land subsidence caused by withdrawal of ground water: International Symposium on the North American Vertical Datum, 3d, Rockville, Md., 1985, Proceedings: National Oceanic and Atmospheric Administration, National Ocean Service, p. 177-185.

_____1986, Land subsidence: Earthquakes and Volcanoes, v. 18, no. 3, p. 131-137.

_____1987, Modern surface deformation across fault scarps in Las Vegas Valley, Nevada [abs.]: Geological Society of America Abstracts with Programs, v. 19, p. 706.

_____1989, State and local response to damaging land subsidence in United States urban areas, in Johnson, A.M., and others, eds., Richard H. Jahns memorial volume: Engineering Geology, v. 27, p. 449-456.

Holzer, T.L., Gabrysch, R.K., and Verbeek, E.R., 1983, Faulting arrested by control of ground-water withdrawal in Houston, Texas: Earthquake Information Bulletin, v. 15, no. 6, p. 204-209.

Inter-agency Committee on Land Subsidence in the San Joaquin Valley, 1958, Progress report on land-subsidence investigations in the San Joaquin Valley, California, through 1957: Sacramento, unpublished report, 160 p.

Ireland, R.L., Poland, J.F., and Riley, F.S., 1984, Land subsidence in the San Joaquin Valley, California, as of 1980: U.S. Geological Survey Professional Paper 437-I, 193 p., scale 1:126,720.

Johnson, A.I., Moston, R.P., and Morris, D.A., 1968, Physical and hydrologic properties of water-bearing

deposits in subsiding areas in central California: U.S. Geological Survey Professional Paper 457-A, 71 p.

Jones, L.L., and Larson, J.L., 1975, Economic effects of land subsidence due to excessive groundwater withdrawal in the Texas gulf coast area: College Station, Texas A&M University, Water Resources Institute Technical Report 67, 33 p.

Kazmann, R.G., and Heath, M.M., 1968, Land subsidence related to ground-water offtake in the New Orleans area: Gulf Coast Association of Geological Societies Transactions, v. 18, p. 108-113.

Kopper, William, and Finlayson, D.J., 1979, Legal aspects of subsidence due to well pumping: American Society of Civil Engineers, Journal of the Irrigation and Drainage Division, v. 107, no. IR2, p. 137-149.

Kreitler, C.W., 1976, Lineations and faults in the Texas coastal zone: Texas Bureau of Economic Geology Investigation Report 85, 32 p.

_____1977, Fault control of subsidence, Houston, Texas: Ground Water, v. 15, p. 203-214.

Kreitler, C.W., Lewis, C.R., and McKalips, D., 1975, Geologic control of land subsidence, Houston-Galveston, Texas [abs.]: Geological Society of America Abstracts with Programs, v. 7, p. 1154.

Layne Texas Company, 1962, A study of land-surface subsidence conditions at the National Administration Space Association site in the vicinity of Houston, Texas; consulting report for U.S. Army Corps of Engineers: Dallas, p. A2-A3.

Leake, S.A., 1990, Interbed storage changes and compaction in models of regional groundwater flow: Water Resources Research, v. 26, p. 1939-1950.

Leake, S.A., and Prudic, D.E., 1987, Nonlinear subsidence package for three-dimensional finite-difference ground-water flow model [abs.]: Eos (American Geophysical Union, Transactions), v. 68, p. 1301.

_____1988, Documentation of a computer program to simulate aquifer-system compaction using the modular finite-difference ground-water flow model: U.S. Geological Survey Open-File Report 88-482, 80 p.

Lee, K.L., and Shen, C.K., 1969, Horizontal movements related to subsidence: American Society of Civil Engineers, Journal of the Soil Mechanics and Foundations Division, v. 95, no. 1, p. 139-166.

Lee, K.L., and Strauss, M.E., 1970, Prediction of horizontal movements due to subsidence over mined areas, in Land subsidence: Tokyo Symposium, 1969, Proceedings: Gentbrugge, Belgium, International Association of Scientific Hydrology (IASH) and Unesco, Studies and Reports in Hydrology 8, v. 2, p. 512-522. (Also published as IASH Publication 88-89).

Leonards, G.A., and Narain, J., 1963, Flexibility of clay and cracking of earth dams: American Society of Civil Engineers, Journal of the Soil Mechanics and Foundations Division, v. 89, no. SM2, p. 47-98.

Lofgren, B.E., 1961, Measurement of compaction of aquifer systems in areas of land subsidence, in Geological Survey research 1961: U.S. Geological Survey Professional Paper 424-B, p. 49-52.

_____1968, Analysis of stresses causing land subsidence, in Geological Survey research 1968: U.S. Geological Survey Professional Paper 600-B, p. 219-225.

_____1970, Field measurement of aquifer-system compaction, San Joaquin Valley, California, U.S.A., in Land subsidence: Tokyo Symposium, 1969, Proceedings: Gentbrugge, Belgium, International Association of Scientific Hydrology (IASH) and Unesco, Studies and Reports in Hydrology 8, v. 1, p. 272-284. (Also published as IASH Publication 88-89).

_____1971a, Estimated subsidence in the Chino-Riverside and Bunker Hill-Yucaipa areas in southern California for a postulated water-level lowering, 1965-2015: U.S. Geological Survey Open-File Report, 25 p.

_____1971b, Significant role of seepage stresses in compressible aquifer systems [abs.]: Eos (American Geophysical Union, Transactions), v. 52, p. 832.

_____1975a, Land subsidence and tectonism, Raft River Valley, Idaho: U.S. Geological Survey Open-File Report 75-585, 21 p.

_____1975b, Land subsidence due to ground-water withdrawal, Arvin-Maricopa area, California: U.S. Geological Survey Professional Paper 437-D, 55 p., scale 1:250,000, 5 sheets.

_____1976, Land subsidence and aquifer-system compaction in the San Jacinto Valley, Riverside County, California--a progress report: U.S. Geological Survey Journal of Research, v. 4, no. 1, p. 9-18.

_____1977, Changes in aquifer-system properties with ground-water depletion: U.S. Geological Survey pamphlet, 46 p. (Paper presented at 11th Biennial Groundwater Conference, 15-16 September 1977, Fresno, Calif.).

_____1979, Changes in aquifer-system properties with ground-water depletion, in Saxena, S.K., ed., Evaluation and prediction of subsidence: American Society of Civil Engineers, International Conference, Pensacola Beach, Fla., 1978, Proceedings, p. 26-46.

Lofgren, B.E., and Ireland, R.L., 1973, Preliminary investigation of land subsidence in the Sacramento Valley, California: U.S. Geological Survey Open-File Report, 40 p., scale 1:494,500, 4 sheets.

Lofgren, B.E., and Klausing, R.L., 1969, Land subsidence due to ground-water withdrawal, Tulare-Wasco area, California: U.S. Geological Survey Professional Paper 437-B, 103 p.

Malmberg, G.T., 1964, Land subsidence in Las Vegas Valley, Nevada, 1935-63: Las Vegas, Nevada Department of Conservation and Natural Resources, Ground Water Resources Information Series Report 5, 10 p.

_____1965, Available water supply of the Las Vegas ground-water basin, Nevada: U.S. Geological Survey Water-Supply Paper 1780, 116 p.

Martin, R.T., 1962, Absorbed water on clay--a review, in Swineford, A., ed., Clays and clay minerals: New York, Pergamon Press, p. 28-70.

Maxey, G.B., and Jameson, C.H., 1948, Geology and water resources of Las Vegas, Pahrump, and Indian Springs Valleys, Clark and Nye Counties, Nevada: Nevada Water Resources Bulletin 5, 121 p.

Meade, R.H., 1964, Removal of water and rearrangement of particles during the compaction of clayey sediments--a review: U.S. Geological Survey Professional Paper 497-B, 23 p.

_____1967, Petrology of sediments underlying areas of land subsidence in central California: U.S. Geological Survey Professional Paper 497-C, 83 p.

_____1968, Compaction of sediments underlying areas of land subsidence in central California: U.S. Geological Survey Professional Paper 497-D, 39 p.

Meyer, W.R., and Carr, J.E., 1979, A digital model for simulation of ground-water hydrology in the Houston area, Texas: Austin, Texas Department of Water Resources Report LP-103, 26 p.

Miller, R.E., 1961, Compaction of an aquifer system from consolidation tests and decline in artesian head: U.S. Geological Survey Professional Paper 424-B, p. 54-58.

Miller, R.E., Green, J.H., and Davis, G.H., 1971, Geology of the compacting deposits in the Los Banos-Kettleman City subsidence area, California: U.S. Geological Survey Professional Paper 497-E, 46 p.

Mindling, A.L., 1965, An investigation of the relationship of the physical properties of fine-grained sediments to land subsidence in Las Vegas Valley, Nevada: Reno, University of Nevada, unpublished M.S. thesis, 90 p.

_____1971, A summary of data relating to land subsidence in Las Vegas Valley: Reno, University of Nevada, Desert Research Institute, Center for Water Resources Research, 55 p.

Mindling, A.L., and John A. Blume & Associates, 1974, Effects of ground-water withdrawal on I-15 Freeway and vicinity in north Las Vegas, Nevada: Reno, University of Nevada, Desert Research Institute, Center for Water Resources Research, Project Report Series, no. 33, 37 p.

Mitchell, J.K., 1976, Fundamentals of soil behavior: New York, John Wiley and Sons, p. 104-111, 186-196, 253-339.

Morris, Jennele, 1980, Subsidence--an emerging area of the law: American Law Review, v. 22, p. 891-917.

Morton, D.M., 1977, Surface deformation in part of the San Jacinto Valley, southern California: U.S. Geological Survey Journal of Research, v. 5, no. 1, p. 117-124.

Murayama, Sakuro, 1970, Land subsidence in Osaka, in Land subsidence: Tokyo Symposium, 1969, Proceedings: Gentbrugge, Belgium, International Association of Scientific Hydrology (IASH) and Unesco, Studies and Reports in Hydrology 8, v. 1, p. 105-130. (Also published as IASH Publication 88-89).

Narasimhan, T.N., 1979, The significance of the storage parameter in saturated-unsaturated groundwater flow: Water Resources Research, v. 15, p. 569-576.

Narasimhan, T.N., and Witherspoon, P.A., 1977, Numerical model for saturated-unsaturated flow in deformable porous media--1. Theory: Water Resources Research, v. 13, p. 657-664.

Neal, J.T., 1965, Giant desiccation polygons of Great Basin playas: Hanscom Field, Mass., U.S. Air Force Environmental Research Paper 123, 30 p.

_____1972, Playa surface features as indicators of environment, in Reeves, C.C., ed., Playa lake symposium: Lubbock, Tex., 1970, Proceedings: International Center for Arid and Semiarid Land Studies Publication 4, p. 107-132.

Neal, J.T., Langer, A.M., and Kerr, P.F., 1968, Giant desiccation polygons of Great Basin playas: Geological Society of America Bulletin, v. 79, p. 69-90.

Neal, J.T., and Motts, W.S., 1967, Recent geomorphic changes in playas of western United States, in Neal, J.T., ed., Playas and dried lakes--occurrence and development: Stroudsburg, Pa., Dowden, Hutchinson, and Ross, Inc., Benchmark Papers in Geology, v. 20, p. 327-342.

Neuman, S.P., Preller, Christian, and Narasimhan, T.N., 1982, Adaptive explicit-implicit quasi-three-dimensional finite element model of flow and subsidence in multi-aquifer systems: Water Resources Research, v. 18, p. 1551-1561.

Newton, J.G., 1977, Induced sinkholes--a continuing problem along Alabama highways, in Land subsidence symposium: International Symposium on Land Subsidence, 2d, Anaheim, Calif., 1976, Proceedings: International Association of Hydrological Sciences (IAHS) Publication 121, p. 453-463.

Okumura, Tatsuro, 1970, Analysis of land subsidence in Niigata, in Land subsidence: Tokyo Symposium, 1969, Proceedings: Gentbrugge, Belgium, International Association of Scientific Hydrology (IASH) and Unesco, Studies and Reports in Hydrology 8, v. 1, p. 130-143. (Also published as IASH Publication 88-89).

Ortiz, I.S., 1967, Subsidence in Mexico City in relation to ground-water overdraft, in Hydrology of fractured rocks: Symposium, Dubrovnik, 1965, Proceedings: Gentbrugge, Belgium, International Association of Scientific Hydrology (IASH) Publication 74, v. 2, p. 665-671.

Pampeyan, E.H., Holzer, T.L., and Clark, M.M., 1988, Modern ground failure in the Garlock fault zone, Fremont Valley, California: Geological Society of America Bulletin, v. 100, p. 677-691.

Patt, R.O., and Maxey, G.B., 1978, Mapping of earth fissures in Las Vegas Valley, Nevada: Reno, University of Nevada, Water Resources Center, Desert Research Institute Publication 41051, 19 p.

Peterson, F.L., 1967, Short-term surface responses in the vicinity of flowing wells: Stanford, Stanford University, unpublished Ph.D. dissertation, 187 p.

Poland, J.F., 1961, The coefficient of storage in a region of major subsidence caused by compaction of an aquifer system, in Geological Survey research 1961: U.S. Geological Survey Professional Paper 424-B, p. 52-54.

_____1969, Land subsidence in the western states due to ground-water overdraft: U.S. Geological Survey Open-File Report, 16 p.

_____1970, Land subsidence and aquifer-system compaction, Santa Clara Valley, California, U.S.A., in Land subsidence: Tokyo Symposium, 1969, Proceedings: Gentbrugge, Belgium, International Association of Scientific Hydrology (IASH) and Unesco, Studies and Reports in Hydrology 8, v. 1, p. 285-292. (Also published as IASH Publication 88-89).

_____1971, Land subsidence in the Santa Clara Valley, Alameda, San Mateo, and Santa Clara Counties, California: U.S. Geological Survey and U.S. Department of Housing and Urban Development Office of Research and Technology Technical Report 2, scale 1:125,000.

_____1972, Subsidence and its control, in Cook, T.D., ed., Underground waste management and environmental implications: Houston, Tex., American Association of Petroleum Geologists Memoir

18, p. 50-71.

_____1977, Land subsidence stopped by artesian-head recovery, Santa Clara Valley, California, in Land subsidence symposium: International Symposium on Land Subsidence, 2d, Anaheim, Calif., 1976, Proceedings: International Association of Hydrological Sciences (IAHS) Publication 121, p. 124-132.

_____ed., 1984, Guidebook to studies of land subsidence due to ground-water withdrawal: International Hydrological Programme Studies and Reports in Hydrology 40: Paris, Unesco, 305 p.

Poland, J.F., and Davis, G.H., 1956, Subsidence of the land surface in the Tulare-Wasco (Delano) and Los Banos-Kettleman City area, San Joaquin Valley, California: American Geophysical Union Transactions, v. 37, no. 3, p. 287-296.

Poland, J.F., and Green, J.H., 1962, Subsidence in the Santa Clara Valley, California--a progress report: U.S. Geological Survey Water-Supply Paper 1619-C, 16 p.

Poland, J.F., Lofgren, B.E., Ireland, R.L., and Pugh, R.G., 1975, Land subsidence in the San Joaquin Valley, California, as of 1972: U.S. Geological Survey Professional Paper 437-H, 78 p.

Proctor, R.J., 1974, New localities for fault creep in southern California--Raymond and Casa Loma faults [abs.]: Geological Society of America Abstracts with Programs, v. 6, p. 238.

Prokopovich, N.P., 1972, Land subsidence and population growth, in Gill, J.E., ed.: International Geological Congress, 24th, Montreal, 1972, Proceedings: Gardenvale, Quebec, Harpell's Press, v. 13, p. 44-54.

Reid, W.M., 1973, Active faults in Houston, Texas: Austin, University of Texas, unpublished Ph.D. dissertation, 122 p.

Riley, F.S., 1970a, Analysis of borehole extensometer data from central California, in Land subsidence: Tokyo Symposium, 1969, Proceedings: Gentbrugge, Belgium, International Association of Scientific Hydrology (IASH) and Unesco, Studies and Reports in hydrology 8, v. 2, p. 423-431.

_____1970b, Land-surface tilting near Wheeler Ridge, southern San Joaquin Valley, California: U.S. Geological Survey Professional Paper 497-G, 29 p.

Riley, F.S., and Davis, S.N., 1960, A tiltmeter to measure surface subsidence around a pumping well [abs.]: Journal of Geophysical Research, v. 65, p. 1637.

Riley, F.S., and McClelland, E.J., 1972, Application of the modified theory of leaky aquifers to a compressible multiple-aquifer system: U.S. Geological Survey Open-File Report, 96 p.

Robson, S.G., 1972, Water-resources investigation using analog model techniques in the Saugus-Newhall area, Los Angeles County, California: U.S. Geological Survey Water-Resources Investigations Open-File Report 5021-04, 58 p.

Rogers, T.H., 1967, Active extensional faulting north of Hollister near the Calaveras fault zone: Seismological Society of America Bulletin, V. 57, p. 813-816.

Roll, J.R., 1967, Effect of subsidence on well fields: American Water Works Association Journal, v. 59, p. 80-88.

Rosenqvist, I.T., 1962, The influence of physicochemical factors upon the mechanical properties of clays, in Swineford, A., ed., Clays and clay minerals: New York, Pergamon Press, p. 12-27.

Rosepiler, M.J., and Reilinger, R.E., 1977, Land subsidence due to water withdrawal in the vicinity of Pecos, Texas: Engineering Geology, v. 11, p. 295-304.

Sanford, A.R., Budding, A.J., Schlue, J.W., and Oravecz, Kalman, 1983, Investigations of the San Marcial crack, August 1982-August 1983: New Mexico Institute of Mining and Technology, Geosciences Department and Geophysical Research Center, Geophysics Open-File Report 46, 12 p.

Sanford, A.R., Schlue, J.W., Budding, A.J., and Payne, M.A., 1982, Report on San Marcial crack, August 1981-August 1982: New Mexico Institute of Mining and Technology, Geosciences Department and Geophysical Research Center, Geophysics Open-File Report 41, 28 p.

Segall, Paul, 1985, Stress and subsidence resulting from subsurface fluid withdrawal in the epicentral region of the 1983 Coalinga earthquake: Journal of Geophysical Research, v. 90, p. 6801-6816.

_____1989, Earthquakes triggered by fluid extraction: Geology, v. 17, p. 942-946.

Smith, C.G., and Kazmann, R.G., 1978, Subsidence in the capital area ground-water conservation district--an update: Baton Rouge, Capital Area Ground Water Conservation Commission Bulletin 2, 31 p.

Steelhammer, R.H., and Garland, J.G., 1970, Subsidence resulting from the removal of ground waters: South Texas Law Journal, v. 12, p. 201-213.

Sweet, A.L., 1965, Validity of a stochastic model for predicting subsidence: American Society of Civil Engineers Journal of the Engineering Mechanics Division, v. 91, no. EM6, p. 111-128.

Sweet, A.L., and Bogdanoff, J.L., 1965, Stochastic model for predicting subsidence: American Society of Civil Engineers Journal of the Engineering Mechanics Division, v. EM2, p. 21-45.

U.S. Geological Survey, 1976, Field trip to Nevada test site: U.S. Geological Survey Open-File Report 76-313, 64 p.

Van Siclen, D.C., 1967, The Houston fault problem, in Proceedings of annual meeting, 3d, Texas Section: American Institute of Professional Geologists, Dallas, 1967, p. 9-31.

Verbeek, E.R., and Clanton, U.S., 1978, Map showing surface faults in the southeastern Houston metropolitan area, Texas: U.S. Geological Survey Open-File Report 78-797, scale 1:24,000.

Verbeek, E.R., Ratzlaff, K.W., and Clanton, U.S., 1979, Faults in parts of north-central and western Houston metropolitan area, Texas: U.S. Geological Survey Miscellaneous Field Studies Map MF-1136, scale 1:24,000.

Weaver, P., and Sheets, M.M., 1962, Active faults, subsidence, and foundation problems in the Houston, Texas area: Geological Society of America, Annual Meeting, 74th, Guidebook, p. 254-265.

White, E.M., 1970, Giant desiccation cracks in central South Dakota soils: Soil Science, v. 110, p. 71-73.

Winslow, A.G., and Doyel, W.W., 1954, Land surface subsidence and its relation to the withdrawal of ground water in the Houston-Galveston region, Texas: Economic Geology, v. 49, p. 413-422.

Winslow, A.G., and Wood, L.A., 1959, Relation of land subsidence to ground-water withdrawals in the upper gulf coast region, Texas: Mining Engineering, v. 11, p. 1030-1034.

Wolff, R.G., 1970, Relationship between horizontal strain near a well and reverse water-level fluctuation: Water Resources Research, v. 6, p. 1721-1728.

Wolfskill, L.A., 1960, The consolidation characteristics of undisturbed soil samples of deep formations and their application to problems of regional subsidence: College Station, Texas A&M University, unpublished M.S. thesis.

Yerkes, R.F., and Castle, R.O., 1970, Surface deformation associated with oil and gas field operations in the United States, in Land subsidence: Tokyo Symposium, 1969, Proceedings: Gentbrugge, Belgium, International Association of Scientific Hydrology (IASH) and Unesco, Studies and Reports in Hydrology 8, v. 1 , p. 55-66. (Also published as IASH Publication 88-89).

_____1976, Seismicity and faulting attributable to fluid extraction: Engineering Geology, V. 10, no. 2-4, p. 151-166.