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A STUDY PLAN

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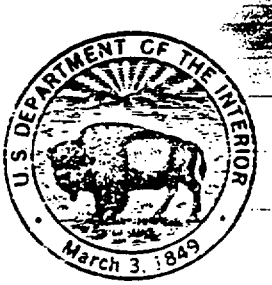

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By James R. Harrill, Alan H. Welch, David E. Prudic, James M. Thomas, Rita L. Carman, Russell W. Plume, Joseph S. Gates, and James L. Mason

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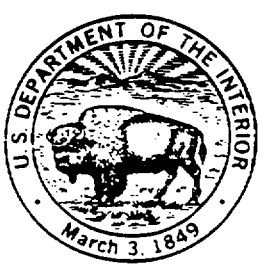

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UNITED STATES DEPARTMENT OF THE INTERIOR

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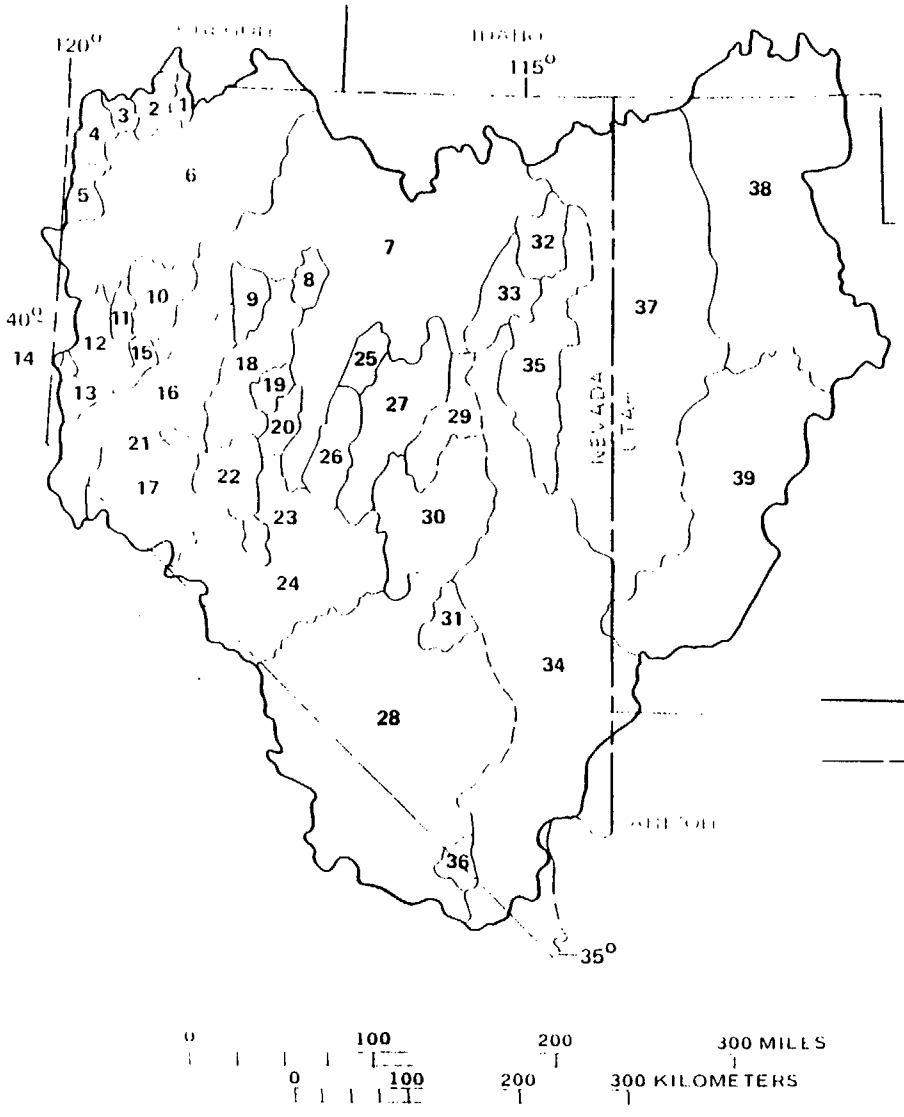
ABSTRACT

The Great Basin Regional Aquifer Study includes about 140,000 square miles in parts of Nevada, Utah, California, Idaho, Oregon, and Arizona. Within that area, 240 hydrographic areas occupy structural depressions formed primarily by basin-and-range faulting. The principal aquifers are in basin-fill deposits; however, permeable carbonate rocks underlie valleys in much of eastern Nevada and western Utah and are significant regional aquifers. Anticipated future water needs require a better understanding of the resource so that wise management will be possible. In October 1980, the U.S Geological Survey started a 4-year study to (1) describe the ground-water systems as they existed under natural conditions and as they exist today, (2) analyze the changes that have led to the systems' present condition, (3) tie the results of this and previous studies together in a regional analysis, and (4) provide means by which effects of future ground-water development can be estimated.

A plan of work is presented that describes the general approach to be taken in this study. It defines (1) the major task necessary to meet objectives and (2) constraints on the scope of work. The approach has been strongly influenced by the diverse nature of ground-water flow systems and the large number of basins. A detailed appraisal of 240 individual areas would require more resources than are available. Consequently, the general approach is to study selected "typical" areas and key hydrologic processes. Effort during the first 3 years will be directed toward describing the regional hydrology, conducting detailed studies of "type" areas, and studying selected hydrologic processes. Effort during the final year will be directed toward developing a regional analyses of results.

Special studies that will address hydrologic processes, key components of the ground-water system, and improved use of technology include evaluations of regional geochemistry, regional hydrogeology, recharge, ground-water discharge, and the use of remote sensing. Areas selected for study using ground-water flow models include the regional carbonate-rock province in eastern Nevada and western Utah, six valleys--Las Vegas, Carson, Paradise, Dixie, Smith Creek, and Stagecoach--in Nevada, plus Jordan Valley, the Milford area, and Tule Valley in Utah.



FLOW SYSTEMS

1 Continental Lake system
2 Virgin Valley
3 Swan Lake Valley
4 Long Valley
5 Duck Lake Valley
6 Black Rock Desert system
7 Humboldt system
8 Buffalo Valley
9 Buena Vista Valley
10 Granite Springs system
11 Winnemucca Lake Valley
12 Truckee system
13 Lemmon Valley*
14 Cold Spring Valley
15 Fernley Sink system
16 Carson system
17 Walker system
18 Dixie Valley system
19 Edwards Creek Valley
20 Smith Creek Valley
21 Rawhide Flats
22 Gabbs Valley
23 Monte Cristo Valley
24 South Central Marshes
25 Grass Valley
26 Northern Big Smoky Valley
27 Diamond Valley system
28 Death Valley system
29 Newark Valley system
30 Railroad Valley system
31 Penoyer Valley
32 Independence Valley system
33 Ruby Valley system
34 Colorado system
35 Goshute Valley system
36 Mesquite Valley
37 Great Salt Lake Desert system
38 Great Salt Lake system
39 Sevier Lake system

*Part of multibasin system. Not known whether subsurface drainage is to the northwest (out of study area) or to the Truckee system.

Figure 3.--Delineation of major flow systems.

The valley was chosen for further studies because it is a small basin where boundary effects and interference between pumped wells are more noticeable than in larger valleys, and because water levels in several wells were monitored prior to increased pumping for irrigation. Computer modeling of the area will hopefully determine whether ground water in Stagecoach Valley is interconnected with the Carson River and whether increased pumping in the valley could cause water to move from the river toward the heavily pumped wells.

Regional Analysis of Results

During the last year of the project, efforts will be concentrated on summarizing and drawing together results of the descriptive work and special studies. The objective will be to produce information that portrays the ground-water resources of the area from a regional perspective.

Information that portrays the character and magnitude of the ground-water resource will be summarized graphically. Results of the various model studies will be regionalized in two ways: First, the individual models will be analyzed in terms of how they, or parts of them, could be applied to other areas throughout the region. The results of this analysis will be helpful in setting up other models throughout the region as the need arises. Second, a set of generalized management alternatives will be defined that reflect the choices most commonly considered by planners and managers, and the models then will be stressed according to the manner prescribed for each alternative. The results will be compared and differences analyzed in terms of the ways in which various types of flow systems will respond to typical patterns of development. Finally, a summary report that deals with the overall results of the entire study will be prepared during this phase of the work.

REFERENCES CITED

Birtles, A. B., and Reeves, M. J., 1977, A simple, effective method for the computer simulation of ground-water storage and its application in the design of water resource systems: Journal of Hydrology, v. 34, p. 77-96.

Blankennagel, R. K., and Weir, J. E., 1973, Geohydrology of the eastern part of Pahute Mesa, Nevada Test Site, Nye County, Nevada: U.S. Geological Survey Professional Paper 712-B, 35 p.

Bolke, E. L., and Sumison, C. T., 1978, Hydrologic reconnaissance of the Fish Springs Flat Area, Tooele, Juab, and Millard Counties, Utah: Utah Department of Natural Resources Technical Publication 64, 30 p.

Bredehoeft, J. D., and Farvolden, R. N., 1963, Disposition of aquifers in intermontane basins of northern Nevada: International Association of Scientific Hydrology, Commission of Subterranean Waters Publication 64, p. 197-212.

Cohen, Philip, and Everett, D. E., 1963, A brief appraisal of the ground-water hydrology of the Dixie-Fairview Valley area, Nevada: Nevada Department of Conservation and Natural Resources, Ground-Water Resources - Reconnaissance Report 23, 40 p.

Cooley, R. L., 1977, A method of estimating parameters and assessing reliability for models of steady state groundwater flow. 1. Theory and numerical properties: Water Resources Research, v. 13, no. 2, p. 318-324.

Eakin, T. E., 1966, A regional interbasin ground-water system in the White River area, southeastern Nevada: Water Resources Research, v. 2, no. 2, p. 251-271.

Eakin, T. E., Price, Don, and Harrill, J. R., 1976, Summary appraisals of the Nation's ground-water resources--Great Basin Region: U.S. Geological Survey Professional Paper 813-G, 37 p.

Everett, D. E., and Rush, F. E., 1964, Ground-water appraisal of Smith Creek and Ione Valleys, Lander and Nye Counties, Nevada: Nevada Department of Conservation and Natural Resources, Ground-Water Resources - Reconnaissance Report 28, 21 p.

Frind, E. O., and Verge, M. J., 1978, Three-dimensional modeling of ground-water flow systems: Water Resources Research, v. 14, no. 5, p. 844-856.

Gates, J. S., and Kruer, S. A., 1980, Hydrologic reconnaissance of the southern Great Salt Lake Desert and summary of the hydrology of west central Utah: Salt Lake City, Utah, U.S. Geological Survey Open-File Report 80-445, 85 p.

Glancy, P. A., and Katzer, T. L., 1975, Water-resources appraisal of the Carson River Basin, western Nevada: Nevada Division of Water Resources Reconnaissance Report 59, 126 p.

Harrill, J. R., 1976, Pumping and ground-water storage depletion in Las Vegas Valley, Nevada, 1955-74: Nevada Division of Water Resources Bulletin 44, 70 p.

----- 1982, Ground-water storage depletion in Pahrump Valley, Nevada-California, 1962-75: U.S. Geological Survey Open-File Report 81-635, 76 p.

Harrill, J. R., and Moore, D. O., 1970, Effects of ground-water development on the water regimen of Paradise Valley, Humboldt County, Nevada, 1948-68, and hydrologic reconnaissance of the tributary areas: Nevada Division of Water Resources Bulletin 39, 123 p.

Hawley, J. W., and Wilson, W. E., III, 1965, Quaternary geology of the Winnemucca area, Nevada: University of Nevada, Desert Research Institute Technical Report H-W 5, 66 p.

Heimes, F. J., and Luckey, R. R., 1980, Evaluating methods for determining water use in the High Plains in parts of Colorado, Kansas, Nebraska, New Mexico, Oklahoma, South Dakota, Texas, and Wyoming, 1979: Denver, Colo., U.S. Geological Survey Water-Resources Investigations 80-111, 118 p.

Hely, A. G., Mower, R. W., and Harr, C. A., 1971, Water resources of Salt Lake County, Utah: Utah Department of Natural Resources Technical Publication 31, 244 p.

Hess, J. W., and Mifflin, M. D., 1978, A feasibility study of water production from deep carbonate aquifers in Nevada: University of Nevada, Desert Research Institute Publication 41054, 125 p.

MacCary, L. M., 1981, Apparent water resistivity, porosity, and ground-water temperature of the Madison Limestone and underlying rocks: U.S. Geological Survey Open-File Report 81-629, 36 p.

Marine, I. W., and Price, Don, 1964, Geology and ground-water resources of Jordan Valley, Utah: Utah Geological and Mineralogical Survey Water Resources Bulletin 7, 68 p.

Mifflin, M. D., 1968, Delineation of ground-water flow systems in Nevada: University of Nevada, Desert Research Institute Technical Report H-W 4, 89 p.

Mower, R. W., and Cordova, R. M., 1974, Water resources of the Milford area, Utah, with emphasis on ground water: Utah Department of Natural Resources Technical Publication 43, 106 p.

Nichols, W. D., 1979, Simulation analysis of the unconfined aquifer, Raft River geothermal area, Idaho-Utah: U.S. Geological Survey Water-Supply Paper 2060, 46 p.

Pinder, G. F., and Bredehoeft, J. D., 1968, Application of a digital computer for aquifer evaluation: Water Resources Research, v. 4, no. 5, p. 1069-1093.

Plummer, L. N., and Back, William, 1980, The mass balance approach: Application to interpreting the chemical evolution of hydrologic systems: American Journal of Science, v. 280, no. 2, pages 130-142.

Prickett, T. A., and Lonnquist, C. G., 1971, Selected digital computer techniques for ground-water resource evaluation: Illinois State Water Survey Bulletin 55, 62 p.

Remson, Irwin, Hanberger, G. M., and Molz, F. J., 1971, Numerical methods in subsurface hydrology: New York, John Wiley, 389 p.

Richardson, G. B., 1906, Underground water in the valleys of Utah Lake and Jordan River, Utah: U.S. Geological Survey Water-Supply Paper 157, 81 p.

Rush, F. E., Scott, B. R., Van Denburgh, A. S., and Vasey, B. J., compilers, 1971, State of Nevada water resources and inter-basin flows: Nevada Division of Water Resources map.

Stephens, J. C., 1977, Hydrologic reconnaissance of the Tule Valley basin, Juab and Millard Counties, Utah: Utah Department of Natural Resources Technical Publication 56, 37 p.

Stewart, J. H., 1980, Geology of Nevada, A discussion to accompany the geologic map of Nevada: Nevada Bureau of Mines and Geology Special Publication 4, 136 p.

Taylor, G. H., and Leggette, R. M., 1949, Ground water in the Jordan Valley, Utah: U.S. Geological Survey Water-Supply Paper 1029, 357 p.

Trescott, P. C., 1975, Documentation of finite difference model for simulation of three-dimensional ground-water flow: U.S. Geological Survey Open-File Report 75-438, 103 p.

Trescott, P. C., Pinder, G. F., and Larson, S. P., 1976, Finite difference model for aquifer simulation in two dimensions with results of numerical experiments: U.S. Geological Survey Techniques of Water Resources Investigations Book 7, Chapter C1, 116 p.

Winograd, I. J., 1962, Interbasin movement of ground water at the Nevada Test Site, Nevada, *in* Geological Survey Research 1962, short papers in geology and hydrology, articles 60-119: U.S. Geological Survey Professional Paper 450-C, p. C108-C111.

Winograd, I. J., and Eakin, T. E., 1965, Interbasin movement of ground water in south-central Nevada - The evidence, *in* Abstracts for 1964: Geological Society of America Special Paper 82, p. 227.

Winograd, I. J., and Friedman, Irving, 1972, Deuterium as a tracer of regional ground-water flow, southern Great Basin, Nevada and California: Geological Society of America Bulletin, v. 83, no. 12, p. 3691-3708.

Winograd, I. J., and Thordarson, William, 1975, Hydrogeologic and hydrochemical framework, south-central Great Basin, Nevada - California, with special reference to the Nevada Test Site: U.S. Geological Survey Professional Paper 712-C, 126 p.

THIS PAGE IS AN OVERSIZED DRAWING OR FIGURE,

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