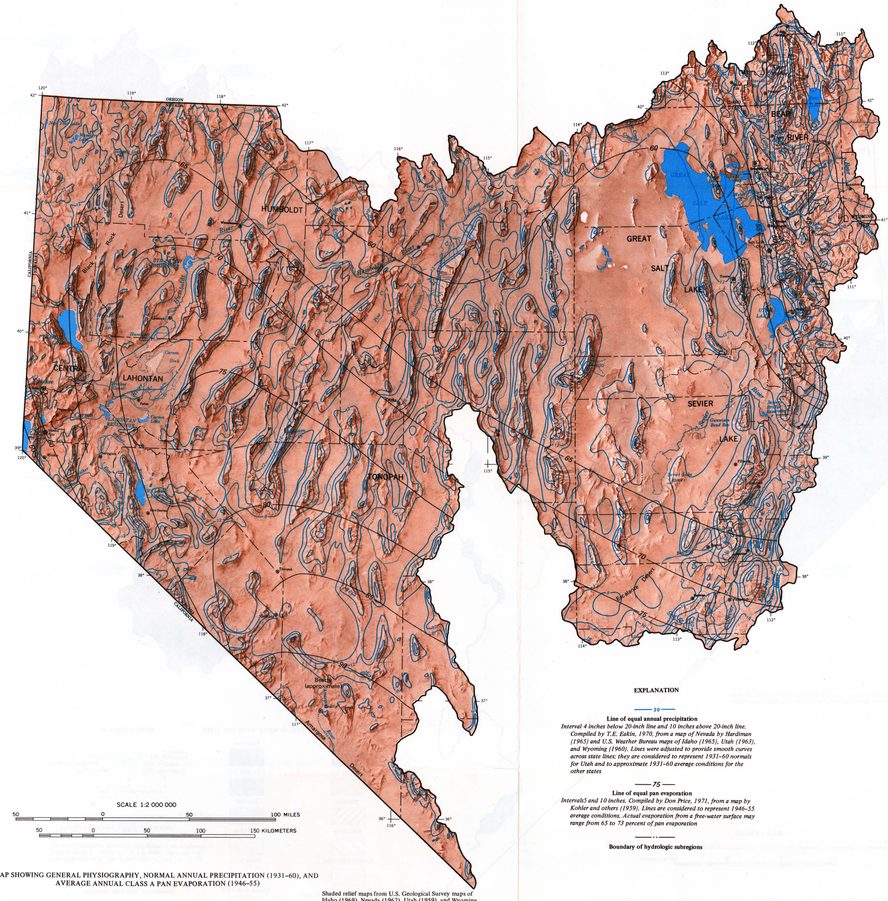


MAP SHOWING GENERAL PHYSIOGRAPHY, NORMAL ANNUAL PRECIPITATION (1931–60), AND AVERAGE ANNUAL CLASS A PAN EVAPORATION (1946–55)

Shaded relief maps from U.S. Geological Survey maps of Idaho (1969), Nevada (1967), Utah (1959), and Wyoming (1967). Planimetric base from U.S. Geological Survey maps of Idaho (1968), Nevada (1965), Utah (1959), and Wyoming (1962)

EXPLANATION

Line of equal annual precipitation
Interval 4 inches below 20-inch line and 10 inches above 20-inch line. Compiled by T.E. Eakin, 1970, from a map of Nevada by Hardman (1965) and U.S. Weather Bureau maps of Idaho (1965), Utah (1963), and Wyoming (1960). Lines were adjusted to provide smooth curves across state lines; they are considered to represent 1931–60 normals for Utah and to approximate 1931–60 average conditions for the other states

Line of equal pan evaporation
Interval 5 and 10 inches. Compiled by Don Price, 1971, from a map by Kohler and others (1959). Lines are considered to represent 1946–55 average conditions. Actual evaporation from a free-water surface may range from 65 to 75 percent of pan evaporation

Boundary of hydrologic subregions

PHYSICAL SETTING

INTRODUCTION

The Great Basin Region is defined to include the drainage of the Great Basin physiographic section (Fenneman, 1931) in Idaho, Nevada, Utah, and Wyoming. In October 1966, the President's Water Resources Council requested that a comprehensive framework study be made in the Great Basin Region under the leadership of the Pacific Southwest Interagency Committee. The study, which included evaluation of the water resources of the region and guidelines for future study and development, was completed June 30, 1971. Results of the study received limited distribution.

The purpose of this atlas is to make available to the public the hydrologic data (including a general appraisal) that were compiled for the comprehensive framework study. Most of the work was done by a water-resources work group consisting of members from several Federal and State agencies under the chairmanship of Thomas E. Eakin of the U.S. Geological Survey. This atlas contains some data not included in the framework study.

The data presented herein are reconnaissance in nature and should be used with discretion. The maps are highly generalized and are intended only to illustrate the regional distribution of the supply and general chemical quality of water. Sources of more detailed information on the hydrology of specific parts of the Great Basin Region are listed in the selected references.

PHYSIOGRAPHY

The Great Basin Region has no surface drainage to the sea. Streams in the region end in lakes or in sinks, including playas, mudflats, and salt marshes. The largest terminal lakes or sinks, all of which are saline, include Great Salt Lake, Sevier Lake (usually dry), Walker Lake, Pyramid Lake, and Carson Sink. Altitudes in the region range from about 2,200 feet in the Amargosa Desert to more than 10,000 feet above mean sea level in the highest mountain ranges. The climate is arid to semiarid in the valleys and subhumid to humid in the mountains. The highest mountains in the east, west, and north-central parts of the region receive the largest amounts of precipitation and are the headwater areas for the principal river systems. The region is subdivided into six hydrologic subregions, largely on the basis of drainage, as follows:

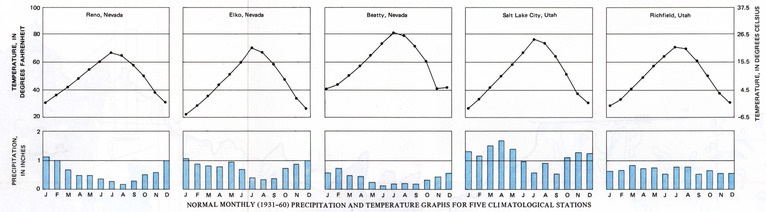
Area and population of hydrologic subregions

[From data compiled by State-Federal Interagency Work Group, Great Basin comprehensive framework study (written commun., Nov. 30, 1970.)]

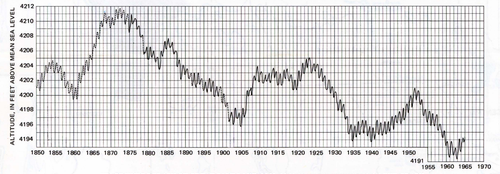
Subregion	Area (square miles)	Population	
		Total	Persons per square mile
Bear River	7,463	90,235	12.1
Great Salt Lake	28,952	800,000	27.6
Sevier Lake	16,184	48,600	3.0
Humboldt	29,906	27,600	.9
Central Lahontan	9,843	166,400	16.9
Tonopah	44,311	18,300	.4
Regional total	136,659	1,151,135	8.4

PRECIPITATION

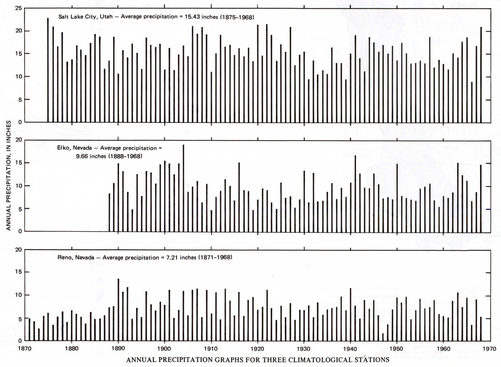
Precipitation is unevenly distributed throughout the year and from year to year. Generally most of the precipitation falls during the cooler months from October to May; the hot summer months are usually drier. The general decline in the stages of the terminal lakes is caused partly by the long-term trend toward drier climatic conditions in the region and partly by increased consumptive use of water from the principal streams that drain to the lakes.



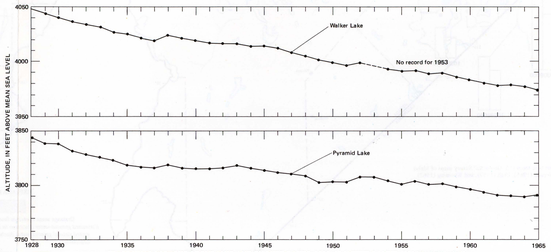
NORMAL MONTHLY (1931–60) PRECIPITATION AND TEMPERATURE GRAPHS FOR FIVE CLIMATOLOGICAL STATIONS



STAGE HYDROGRAPH OF GREAT SALT LAKE, 1851–1965 (DASHED SEGMENTS OF THE GRAPH ARE BASED ON TRADITIONAL INFORMATION)



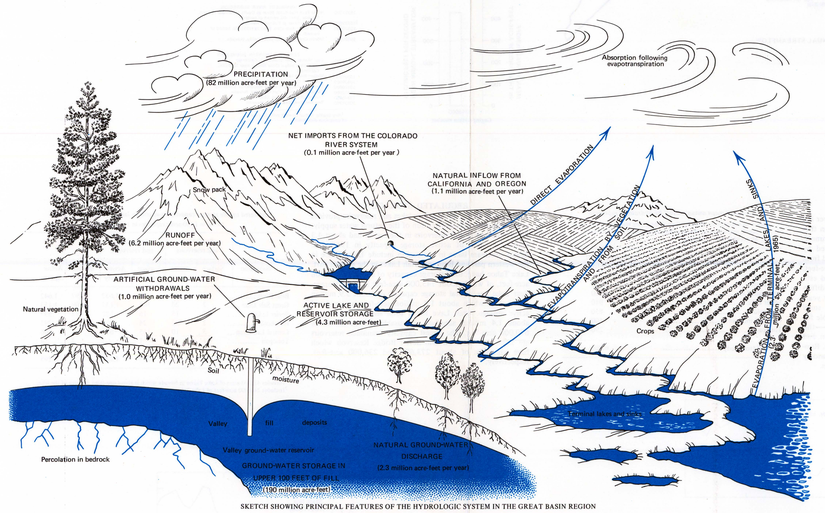
ANNUAL PRECIPITATION GRAPHS FOR THREE CLIMATOLOGICAL STATIONS



STAGE HYDROGRAPHS OF PYRAMID AND WALKER LAKES, 1928–65 (AFTER LAMKE AND MOORE, 1965)

WATER SUPPLY, DEPLETION, AND USE

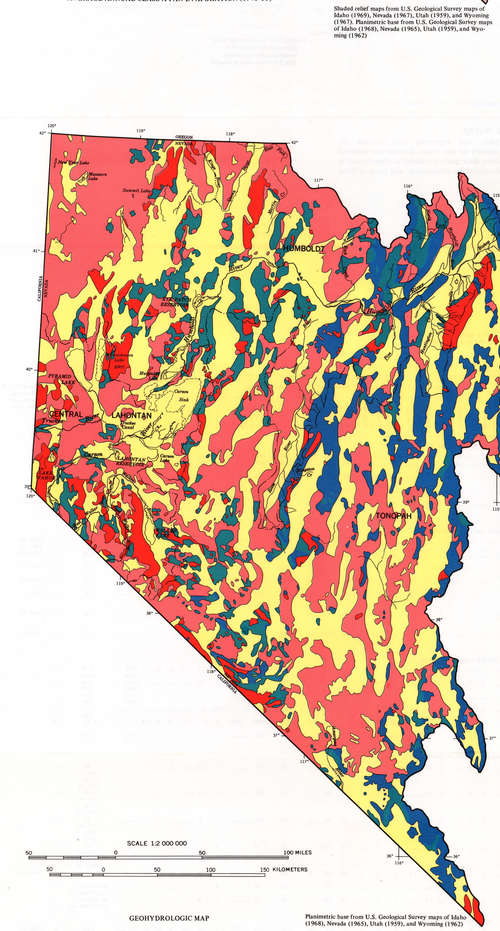
Precipitation and evapotranspiration are the principal means of supply and depletion of water in the region. The principal source of water for the region is precipitation that falls within its drainage area. About 90 percent of the precipitation is directly consumed by evapotranspiration. The remainder becomes overland runoff and ground-water recharge, but most of it, too, is eventually consumed within the region by evapotranspiration.



SKETCH SHOWING PRINCIPAL FEATURES OF THE HYDROLOGIC SYSTEM IN THE GREAT BASIN REGION

PRINCIPAL GEOHYDROLOGIC UNITS

The characteristic Basin and Range landscape of the region is largely the result of block faulting and related structural deformation. The mountain-building activity began near the end of the Mesozoic Era and has continued to the present. Intrusive and extrusive igneous activity has accompanied the mountain building in many parts of the region. As the mountain blocks are elevated, detritus eroded from them is deposited in the valleys, mostly as alluvial and lacustrine deposits. The rocks are here grouped into five principal geohydrologic units, which are shown on the map above and described below.



GEOHYDROLOGIC MAP

Planimetric base from U.S. Geological Survey maps of Idaho (1968), Nevada (1965), Utah (1959), and Wyoming (1962)

Distribution of geohydrologic units by J.R. Harrill, T.E. Eakin, and N.P. Dion, 1970, from maps of California and Nevada (Feray and others, 1968), Utah (Stokes, 1964), Idaho (Dion, 1969), and Wyoming (Rodionova and Berry, 1963)

Lithologic character and hydrologic properties of the principal geohydrologic units

Map color	Unit	Lithologic character	Hydrologic properties
	Valley-fill deposits (generally unconsolidated)	Mostly alluvial, colluvial, and lacustrine deposits of generally interbedded clay, sand, gravel, and boulders; some interbedded evaporite deposits beneath terminal sinks, and volcanic rocks in areas of late igneous activity. Coarser grained alluvial and colluvial deposits predominate near margins of valleys; finer grained lacustrine deposits predominate beneath lowest parts of valleys. Oldest fill deposits commonly partly consolidated to consolidated.	Deposits contain the most productive aquifers of the region. Most saturated deposits yield some water to wells. Sand and gravel aquifers in most valleys generally yield 200 to 2,000 gpm (gallons per minute) to wells; as do some interbedded volcanic rocks (as in the Soda Springs area and Gem, Pavant, and Curlew Valleys). Fine-grained lake-bottom deposits generally yield less than 10 to 200 gpm to individual wells.
	Volcanic rocks	Mostly rhyolite, andesite, and basalt. Also include associated mudflow and pyroclastic deposits as well as interbedded sedimentary deposits.	Commonly have low interstitial permeability except where highly vesicular, jointed, or fractured. Yields to wells generally are less than 10 gpm. Large-yield wells in basalts are most common in the Soda Springs area and Gem Valley, Idaho.
	Clastic sedimentary rocks	Mostly sandstone, shale, and conglomerate with some interbedded limestone and dolomite; some quartzite.	Generally low permeability except where highly fractured; generally yield less than 1 to 10 gpm to wells, but locally yield more than 100 gpm to springs and wells.
	Carbonate rocks	Mostly limestone and dolomite with some interbedded sandstone and shale.	Unit generally has low permeability, but local high permeability in solution cavities and fracture zones; many of the large springs of the region discharge from these rocks; yields to wells generally are less than 10 gpm but may exceed 200 gpm locally.
	Intrusive and metamorphic rocks	Intrusive rocks are mostly granite and granodiorite; metamorphic rocks are mostly schist, gneiss, quartzite, phyllite, marble, and slate.	Unit as a whole has very low permeability. Yields some water from fractures to small mountain springs. Deeply weathered zones in granitic rocks may locally yield less than 10 gpm to wells. Local highly fractured zones may be highly permeable.

Contact, approximately located

Boundary of hydrologic subregions

NOMINAL WATER SUPPLY

The nominal water supply for the region totals about 9.6 million acre-feet annually. The nominal annual water supply of the region is the total volume of water that moves through the system each year and is theoretically divertable. It does not include reuse of water, nor does it include time-limited supplies such as one-time ground-water storage (storage that is not replenished by natural means over a long term) or storage in terminal lakes.

Estimated nominal annual water supply

[Thousands of acre-feet, includes 1965 use]

Subregion	Areas upstream from key gaging station[1]			Other areas			Combined water supply
	Key gaging station	Upstream depletion (includes natural ground-water discharge)	Gaged outflow	Streamflow (Exclusive of upstream depletion areas)	Natural ground-water discharge		
Bear River	10126000	1,150	838	101	40	2,130	
Great Salt Lake	(2)	1,009	517	388	630	2,544	
Sevier Lake	10219000	539	139	234	328	1,240	
Humboldt	10322500	300	254	300	480	1,334	
Central Lahontan	(3)	(4)	1,120	108	104	1,332	
Tonopah				290	680	970	
Regional total		2,998	2,868	1,421	2,262	9,550	

[1]Key gaging station: Lowest point on main stem in area of upstream depletion. Station locations and upstream depletion areas are shown on runoff map (sheet 2).
[2]Value is sum of values for Weber River (10141000) and Jordan River (10167000) station flow records.
[3]Value is summation of Truckee River (10346000), West Fork Carson River (10310000), East Fork Carson River (10309000), West Walker River (10296000), and East Walker River (10293000) station flow records. Represents outflow from California.
[4]Upstream depletion is in California.

WITHDRAWALS AND DEPLETIONS

Estimated withdrawals and depletions (water consumed and no longer available for use) in the Great Basin Region in 1965 were 8.7 and 6.0 million acre-feet, respectively. The difference between the nominal annual water supply and the 1965 depletion is about 3.6 million acre-feet and is the residual supply that theoretically might be available for future development. Evaporation from Great Salt Lake and Pyramid and Walker Lakes was not included in the estimate for 1965 use depletions. If part of this evaporation were considered a use depletion, then the residual supply would be somewhat less than 3.6 million acre-feet. Full development of this residual supply is dependent on economic and legal considerations that are governed by such factors as areal distribution and chemical quality of the undeveloped sources and by effects on existing developments. Studies of ways to increase the nominal water supply of the region are being made or considered. Proposals include precipitation management, vegetation manipulation in watershed areas, and more efficient treatment and reuse of existing supplies.

Estimated withdrawals and depletions of water, 1965

[Thousands of acre-feet]

Type of use	Bear River	Great Salt Lake[1]	Sevier Lake	Humboldt	Central Lahontan	Tonopah	Region
Withdrawals:							
Municipal and industrial	75	319	20	12	54	13	493
Electric power[2]	.....	5	.....	.....	1	1	7
Recreation	1	3	1	1	1	1	8
Minerals	1	86	1	2	6	14	110
Irrigation	1,716	1,573	1,320	929	1,075	419	7,032
Fish and wildlife	350	255	55	25	271	61	1,017
Total	2,143	2,241	1,397	969	1,408	509	8,667
Depletions:							
Municipal and industrial	24	103	7	4	20	3	161
Electric power[2]	.....	5	.....	.....	1	1	7
Recreation	1	1	1	1	1	1	6
Minerals	1	13	1	1	2	10	28
Irrigation	667	651	600	375	406	234	[3]2,933
Nonirrigated wet meadows	125	310	190	335	120	40	1,120
Managed fish and wildlife	169	165	55	25	[4]259	61	[4]734
Unmanaged fish and wildlife and associated wetlands	221	91	47	.....	46	.....	405
Reservoir evaporation	167	303	70	20	63	1	624
Total	1,375	1,642	971	761	918	351	6,018

[1]About 14,000 acre-feet of withdrawals and about 5,000 acre-feet of depletions for a copper smelter operation are included in both municipal and industrial and minerals uses.
[2]Thermal plants only.
[3]Includes 97,000 acre-feet from one-time ground-water storage.
[4]Includes 24,000 acre-feet depletion in California between West Walker gage and State line.

INTERIOR—GEOLOGICAL SURVEY, RESTON, VIRGINIA—1974

WATER IN THE GREAT BASIN REGION; IDAHO, NEVADA, UTAH, AND WYOMING

By
Don Price, T. E. Eakin, and others

1974

For sale by U.S. Geological Survey, Reston, Virginia 22092, price $2.25 per set