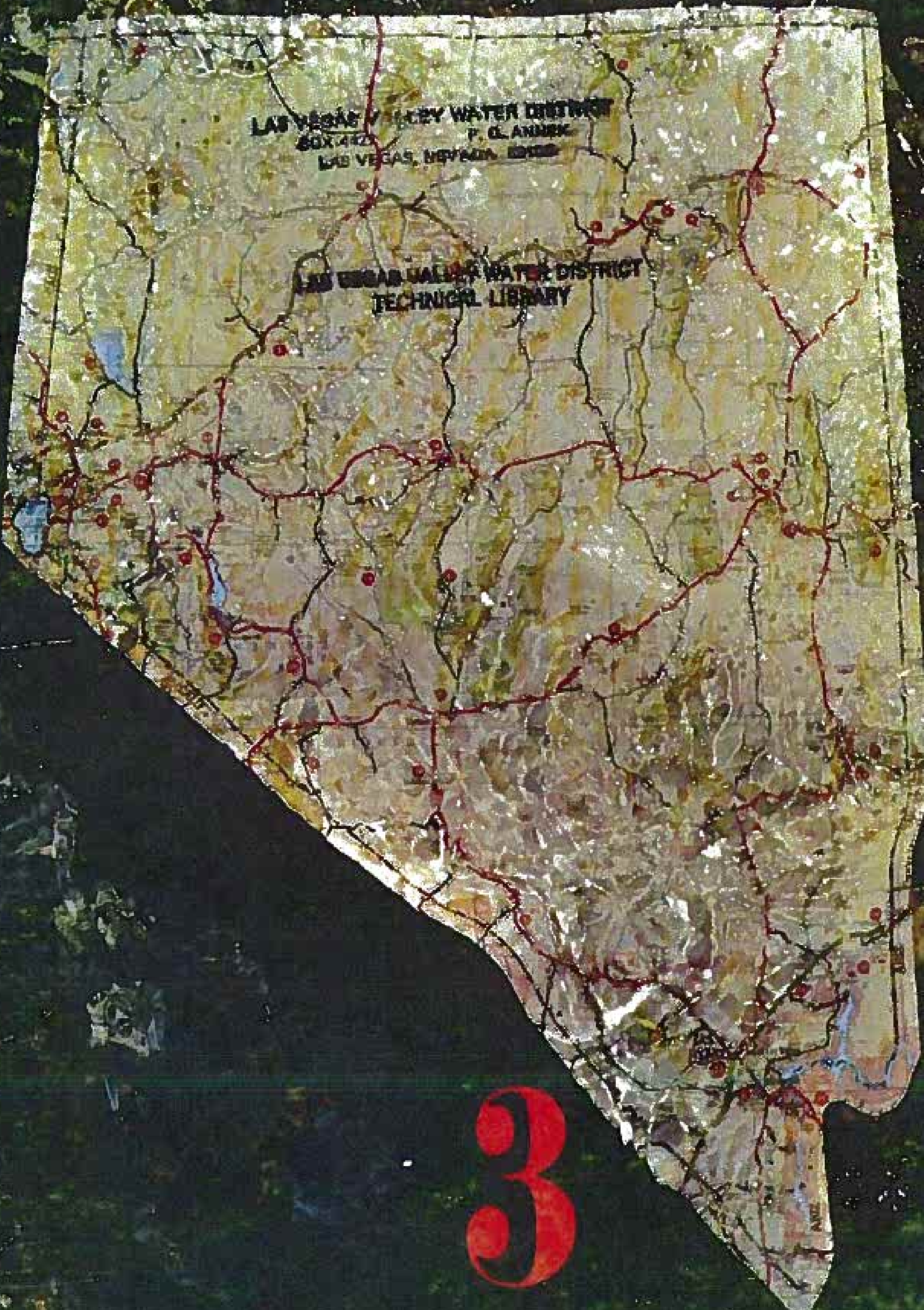
# Water for Nevada





# 3

## NEVADA'S WATER RESOURCES

### Summary of Data

Data are summarized in the tables for each of the 14 hydrographic regions and basins, and a state summary is given at the end of each table. Here are the principal totals for the state:

| | Acre feet per year, (except as otherwise stated) |
|---|---|
| **Precipitation:** | |
| Estimated annual average | 5 ,000,000 |
| **Surface water:** | |
| Estimated runoff from mountains | 3,200,000 |
| Estimated inflow crossing the state line (excluding the Colorado River) | 1,300,000 |
| Colorado River | 9,700,000 |
| *Estimated outflow crossing the state line (excluding the Colorado River) | 700,000 |
| Colorado River | 9,400,000 |
| Surface water storage capacity (excluding Nevada's portion of Lake Mead, Lake Mohave, Lake Tahoe and Topaz Lake in ac. ft.) | 25,000,000 |
| Lake Mead (Total Capacity, ac. ft.) | 29,700,000 |
| Lake Mohave (Total Capacity, ac. ft.) | 1,820,000 |
| Lake Tahoe (Total Capacity, ac. ft.) | 122,000,000 |
| Topaz Lake (Total Capacity, ac. ft.) | 59,400 |
| **Ground water:** (Ground water budget for valley-fill reservoirs)* | |
| Estimated ground water inflow | 2,000,000 |
| Estimated ground water outflow | 2,000,000 |
| Ground water recharge from precipitation | 2,200,000 |
| Perennial yield of valley-fill reservoirs | 1,700,000 |
| Ground water stored in upper 100 feet of saturated valley fill (ac. ft. | 250,000,000 |
| Estimated transitional storage reserve (ac. ft.) | 84,000,000 |
| Estimated outflow crossing the state line | 150,000 |
| Estimated inflow crossing the state line | 3,000 |

Includes 1970 flow to Lake Mead from Las Vegas Wash
Water underground in a given valley.

## HYDROLOGIC SUMMARY

### Explanation of Table Headings
### Table 1

#### General

As previously indicated, most of the information shown in the tables has been derived as a result of the cooperative program between the Department of Conservation and Natural Resources and the U.S. Geological Survey. The reader is directed to the Reports referenced in Table 1 for more detailed information on the individual hydrographic areas.

#### Water Budget

Two types of water budget have been computed for the hydrographic areas – a ground water budget for dry areas, and a water resources budget where there are relatively larger amounts of streamflow (see below for details). For a few areas, budgets have been computed identifying the average amount of inflow to and outflow from both the ground water system and the combined surface water and ground water systems.

For natural conditions and over the long term – assuming that climatic conditions remain reasonably constant – ground water inflow to and outflow from an area are about equal. Thus, a ground water budget can be used to: (1) compare the estimates of natural inflow to and outflow from each valley; (2) determine the magnitude of errors in the two estimates provided that one or more elements are not estimated by difference; and (3) select a value that represents both inflow and outflow. This value is listed in Table 1 and is identified by an "a" following the number in the "Water Budget" column in Table 1.

The water resources budget is the quantity selected to represent both inflow and outflow. It is similar to a ground water budget, except that both surface water and ground water inflow and outflow are elements of this budget. This value is identified by a "b" following the number in the "Water Budget" column in Table 1.

#### Water Yield

Also computed for the hydrographic areas are two types of water yield – perennial yield and system yield. The relationship between these is similar to that between the ground water budget and the water resources budget described above; however, because of the uniqueness of the various hydrologic areas scientific judgment is also a factor in interpreting the relationship between water budget and water yield.

Perennial yield of a ground water reservoir may be defined as the maximum amount of ground water that can be salvaged each year over the long term without depleting the ground water reservoir. Perennial yield is ultimately limited to the maximum amount of natural discharge that can be salvaged for beneficial use. Perennial yield cannot be more than the natural recharge to a ground water basin and in some cases is less. An example of such a condition is Pahrump Valley (162). In Pahrump the average annual recharge is estimated to be 22,000 acre feet, however, because of the difficulty in salvaging the subsurface outflow from the deep carbonate-rock reservoir, the perennial yield is only 12,000 acre feet. Perennial yield is identified by a "C" following the number under the "Yield" column in Table 1.

System yield is defined as the maximum amount of surface and ground water that can be obtained each year from sources within a system for an indefinite period of time. System yield cannot be more than the natural inflow to or outflow from a system. Generally, estimates of system yield are based on the following limitations and assumptions: (1) present beneficial uses represent salvage and are therefore included; (2) most evapotranspiration discharge can be salvaged; (3) half the surface water outflow and ground water outflow can be salvaged (up to all of the surface water if a dam is feasible); and (4) the estimated system yield is within the limits allowed by legal appropriations and decrees. This value is identified by the "d" following the number in the "Yield" column in Table 1.

## Ground Water in Storage

The amount of ground water in storage in a valley reservoir is estimated to average about 10 percent of the volume of the saturated valley fill. The quantities of stored ground water listed in Table 1 are for each (one) foot of thickness. Therefore, the storage in the upper 100 feet of saturated alluvium is 100 times this quantity.

## Transitional Storage Reserve

Transitional storage reserve is the quantity of water in storage in a particular ground water reservoir that is extracted during the transition period between natural equilibrium conditions and new equilibrium conditions under the perennial-yield concept of ground water development.

In the arid environment of Nevada, the transitional storage reserve of such a reservoir means the amount of stored water which is available for withdrawal by pumping during the non-equilibrium period of development, (i.e., the period of lowering water levels).

In valleys where natural discharge is partly or entirely by sub-surface outflow, the amount that can be salvaged with a dewatering (taken from storage) of 50 feet is estimated to average roughly 50 percent of the outflow. The transitional storage reserve estimates for the regions are based on an average dewatering of 30 to 40 feet of valley-fill reservoir. These values are shown for each region in Table 1-A.

## Report References

References to reports, prepared by the U.S. Geological Survey, describing hydrographic areas are: "R" – Nevada Water Resources Reconnaissance Series Reports; "B" – Nevada Water Resources Bulletins; "W" – Water Supply Paper, U.S. Geological Survey; and "P" – Professional Paper, U.S. Geological Survey.

## Region, Basin and State Totals

Note that the total ground water, water resources budgets, perennial yields and system yields for each basin, region or the state are not necessarily the sum of the individual areas. This is because quantities of water circulate among hydrographic areas (valleys) within regions, basins and the state, and therefore must be included in two or more area budgets. All other water quantities are generally additive.

footnote from page 3

1 From the Virginia Evening Chronicle as quoted by Hugh A Shamberger in the forthcoming U.S.G.S. Professional Paper 779, "The Story of the Water Supply for the Comstock", p 24.

CENTRAL REGION, continued



| Hydrographic Area Number | Hydrographic Area | Water Budget (Acre-Feet Per Year) a-Ground Water Budget b-Water Resources Budget | Water Yield (Acre-Feet Per Year) c-Perennial Yield d-System Yield | Groundwater in Storage (Acre-Feet Per Foot) | Report Reference |
|---|---|---|---|---|---|
| 164 | Ivanpah V. | | | | R46 |
| | a) Northern Part | 1,500a | 700c | 7,400 | R46 |
| | b) Southern Part | 500a | 250c | 1,000 | R46 |
| 165 | Jean Lake V. | 100a | 50c | 3,200 | R46 |
| 166 | Hidden Valley (South) | Minor(a) | Minor(c) | 800 | R46 |
| 167 | Eldorado V. | 1,100a | 500c | 14,000 | R36 |
| 168 | Three Lakes V. (Northern Part) | 8,000a | 4,000c | 8,300 | R54 |
| 169 | Tikapoo Valley | | | | R54 |
| | a) Northern Part | 2,600a | 1,300c | 14,000 | R54 |
| | b) Southern Part | 6,000a | 3,000c | 7,500 | R54 |
| 170 | Penoyer V. (Sand Springs V.) | 5,000a | 5,000c | 22,000 | B12 |
| 171 | Coal V. | 10,000a | 6,000c | 15,000 | R18, B33 |
| 172 | Garden V. | 10,000a | 6,000c | 15,000 | R18, B33 |
| 173 | Railroad V. | 51,000a | 50,000c | | B12 |
| | a) Southern Part | | | 21,000 | B12 |
| | b) Northern Part | | | 60,000 | B12 |
| 174 | Jakes V. | 25,000a | 12,000c | 9,800 | B33 |
| 175 | Long V. | 10,000a | 6,000c | 16,000 | R3, B33 |
| 176 | Ruby V. | 68,000a | 53,000c | 33,000 | B12 |
| 177 | Clover V. | 20,000a | 20,000c | 15,000 | B12 |
| 178 | Butte V. | | | | R49 |
| | a) Northern Part | 6,300a | 6,000c | 9,800 | R49 |
| | b) Southern Part | 14,000a | 14,000c | 22,000 | R49 |
| 179 | Steptoe V. | 70,000a | 70,000c | 50,000 | R42 |
| | | 120,000b | 120,000d | | |
| 180 | Cave V. | 14,000a | 2,000c | 10,000 | R13, B33 |
| 181 | Dry Lake V. | 5,000a | 2,500c | 28,000 | R16, B33 |
| 182 | Delamar V. | 6,000a | 3,000c | 12,000 | R16, B33 |
| 183 | Lake V. | 12,000a | 12,000c | 18,000 | R24 |
| 184 | Spring V. | 75,000a | 100,000c | 42,000 | R33 |
| | | 100,000b | 100,000d | | |

# GROUND WATER DATA

## Explanation of Table Headings

## Table 3

### Ground Water Recharge from Precipitation

Precipitation is so scarce on the valley floors that very little ever reaches ground water reservoirs; most of the valley recharge comes from precipitation in the adjacent mountains. Water reaches the ground water reservoir by seepage from streams on the alluvial apron and by underground flow from consolidated rocks. Yet even most of this precipitation evaporates before infiltration, while some adds to soil moisture, leaving only a small percentage to recharge the ground water reservoir.

A method* used to estimate recharge assumes that a percentage of the average annual precipitation will recharge the ground water reservoirs. But in some hydrographic areas, because of uncommonly large precipitation, some of this recharge (computed and listed in Table 3) may be rejected by the ground water system. This excess water remains in the streams and either flows out of the hydrographic area or accumulates on playas, where most of it evaporates. Recharge quantities preceded by an "a" in Table 3 probably are in part rejected; therefore the actual ground water recharge is somewhat less than computed.

The ground water budgets for some of the areas shown in the table do not balance and additional information will be required before the imbalances can be completely resolved. An example of such an imbalance is Honey Lake Valley (97). The ground water recharge from precipitation is estimated to be 1400 acre feet per year and the ground water subsurface inflow is nearly 600 acre feet for a total inflow of approximately 2000 acre feet (Table 3). The ground water evapotranspiration is estimated to be 7000 acre feet, thus an imbalance of approximately 5000 acre feet per year exists. The imbalance is probably due to a larger proportion of precipitation becoming recharge or, there is an unaccounted for routing of subsurface flow through the consolidated rocks to the valley-fill reservoir.

### Sub-surface Inflow

Sub-surface flow of ground water between hydrographic areas of Nevada is common. Ground water flow through alluvium and consolidated rocks was computed by means of a form of Darcy's law:

$$Q = 0.00112\, TIW$$

in which "Q" is the quantity of flow, in ac. ft. per year; "T" is the coefficient of transmissibility, in gallons per day per foot; "I" is the hydraulic gradient, in feet per mile; "W" is the width of the flow section in miles; and factor 0.00112 converts gallons per day to ac. ft. per year. The estimated quantity of inflow, as well as the source area, is listed in Table 3 and shown in Figure 5.

### Evaporation-Transpiration

In areas where ground water is close to the surface discharge occurs by evaporation from soil and by transpiration of plants that have roots to the water table. These plants which tap ground water are called "phreatophytes".

Ground water evaporates in some areas where the depth to water is as great as 15 feet. And some phreatophytes discharge ground water where the depth to water is as deep as 50 feet.

### Sub-surface Outflow

Ground water outflow is evaluated and estimated similar to sub-surface inflow, as discussed above. The estimated quantity of outflow, as well as the area receiving the flow, is listed in Table 3 and shown in Figure 5.

### Region, Basin and State Totals

Region, basin, and state totals for sub-surface inflow and outflow are not the sum of the individual areas because quantities of water circulate among hydrographic areas within regions, basins and within the state. All other water quantities in Table 3 generally are additive.

### Water Quality

Although ground water resources in Nevada are large, many factors reduce the amount of water which could economically be withdrawn. Some aquifers are very deep, may yield only small amounts of water to wells and are widely distributed, not concentrated as are the demands on them. Water quality is another important facet of water supply. In many cases, ground water quality is not adequate for drinking or other uses. Figure 3 shows some of the known areas of poor quality water. The information shown is largely based on analyses of waters from wells and springs.

*Described by T.E. Eakin in Nevada Water Resources Bulletin 12.

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 166 | Hidden Valley (South) | Minor | Minor | 165 | 0 | Minor | 167,212 |
| 167 | Eldorado V. | 1,100 | Minor | '66 | 0 | 1,100 | 213 |
| 168 | Three Lakes V. (Northern Part) | 2,000 | 6,000 | '69B | 0 | 8,000 | 161 |
| 169 | Tikapoo Valley | | | | | | |
| | a) Northern Part | 2,600 | 0 | | 0 | 2,600 | 169B |
| | b) Southern Part | 3,400 | 2,600 | 169A | 0 | 6,000 | 168 |
| 170 | Penoyer V. (Sand Springs V.) | 4,300 | 0 | | 6,400 | 0 | |
| 171 | Coal V. | 2,000 | 8,000 | 172 | Minor | 10,000 | 209 |
| 172 | Garden V. | 10,000 | 0 | | 2,000 | 8,000 | 171 |
| 173 | Railroad V. | | | | 50,000 | | |
| | a) Southern Part | 6,000 | | | | 1,000 | 157 |
| | b) Northern Part | 46,000 | Some | 155C,156 | | 0 | |
| 174 | Jakes V. | 17,000 | 8,000 | 175 | 0 | 25,000 | 207 |
| 175 | Long V. | 10,000 | 0 | | 2,200 | 8,000 | 174 |
| 176 | Ruby V. | a 68,000 | 10,800 | 47, 178A | 53,000 | 0 | |
| 177 | Clover V. | a 21,000 | 0 ? | | 19,000 | Minor | 188 |
| 178 | Butte V. | | | | | | |
| | a) Northern Part | 3,900 | 0 | | 6,900 | 800 | 176 |
| | b) Southern Part | a 15,000 | 0 | | 11,000 | ? | ? |
| 179 | Steptoe V. | a 85,000 | 0 | | 70,000 | Some | 187 |
| 180 | Cave V. | a 14,000 | 0 | | 200 | 14,000 | 207 |
| 181 | Dry Lake V. | 5,000 | 0 | | Minor | 5,000 | 182 |
| 182 | Delamar V. | 1,000 | 5,000 | 181 | Minor | 6,000 | 209 |
| 183 | Lake V. | 13,000 | 0 | | 8,500 | 3,000 | 202 |
| 184 | Spring V. | a 75,000 | 2,000 | 185 | 70,000 | 4,000 | 196 |
| 185 | Tippett V. | 6,900 | 0 | | 0 | 7,000 | 184,186A,193 |
| 186 | Antelope V. (White Pine & Elko) | | | | | | |
| | a) Southern Part | 1,500 | 3,000 | 185 | 0 | 4,500 | 192 |
| | b) Northern Part | 3,200 | 300 | 187 | 100 | 3,400 | 192 |
| 187 | Goshute V. | 11,000 | Some | 179 | 10,000 | 2,300 | 186B,191,192 |
| 188 | Independence V. (Pequop V.) | 9,300 | Minor | 177 | 9,500 | 0 | |
| | REGION TOTAL | a 770,000 | 21,000 | | 630,000 | 140,000 | |

## COLORADO RIVER BASIN, continued

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 207 | White River V. | 38,000 | 39,000 | 174,180 | 37,000 | 40,000 | 208 |
| 208 | Pahroc V. | 2,200 | 40,000 | 207 | 0 | 42,000 | 209 |
| 209 | Pahranagat V. | 1,800 | 58,000 | 171,182,208 | 20,000 | 35,000 | 210 |
| 210 | Coyote Spring V. | 1,900 | >35,000 | 206,209 | Minor | 37,000 | 219 |
| 211 | Three Lakes V. (Southern Part) | 6,000 | 4,700 | 212 — 165 | 0 | 10,700 | 161 |
| → 212 | Las Vegas V. | 25,000 | Minor | 105,166 | 24,000 | 5,100 | 211,215 |
| 213 | Colorado River V. | 200 | 1,300 | 167,214 | Large | 200 | Colorado River |
| 214 | Piute V. | 1,100 | 0 | | 0 | 1,100 | Calif. |
| 215 | Black Mountains Area | < 100 | 400 | 212,218 | 1,200 | < 100 | Lake Mead |
| 216 | Garnet V. | 400 | 400 | 217 | 0 | 800 | 218 |
| 217 | Hidden V. (North) | 400 | 0 | | 0 | 400 | 216 |
| 218 | California Wash | < 100 | 7,800 | 205,216,219 | 1,700 | Minor | 218,220 |
| 219 | Muddy River Springs Area (Upper Moapa V.) | < 100 | 37,000 | 210 | Some | Minor | 218 |
| 220 | Lower Moapa V. | < 50 | Minor | 218 | 11,000 | 1,100 | Lake Mead |
| 221 | Tule Desert | 2,100 | 0 | | Minor | 2,100 | 222 |
| 222 | Virgin River V. | 3,600 | 3,000 | 221, Ariz. | 30,000 | 40,000 | Lake Mead |
| 223 | Gold Butte Area | 1,000 | 0 | | Minor | 1,000 | Lake Mead |
| 224 | Grease Wood Basin | 600 | 0 | | Minor | 600 | Arizona |
| BASIN TOTAL | | a 110,000 | 50,000 | | > 130,000 | 55,000 | |

## DEATH VALLEY BASIN

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 225 | Mercury V. | 250 | 16,000 | 160 | 0 | 17,000 | 230 |
| 226 | Rock V. | 30 | 17,000 | 160,227A | 0 | 17,000 | 230 |
| 227 | Forty Mile Canyon | | | | | | |
| | a) Jackass Flats | 900 | 7,200 | 227B | 0 | 8,100 | 230 |
| | b) Buckboard Mesa | 1,400 | 5,800 | 147,157 | 0 | 7,200 | 227A |
| 228 | Oasis V. | 1,000 | 2,500 | 147 | 2,000 | 1,500 | 229 |
| 229 | Crater Flat | 220 | 1,500 | 228 | 0 | 1,700 | 230 |
| 230 | Amargosa Desert | 600 | 44,000 | 225,226,227A,229 | 24,000 | 19,000 | Death Valley |
| 231 | Grapevine Canyon | 50 | 500 ? | 146 | Minor | 400 | Death Valley |
| 232 | Oriental Wash | 300 | 0 | | 0 | 300 | Death Valley |
| BASIN TOTAL | | 4,800 | 40,000 | | 26,000 | 20,000 | |
| STATE TOTAL (Rounded) | | a2,200,000 | > 3,000 | | >1,600,000 | >150,000 | |
| | | Estimated Net Groundwater Inflow – 2,000,000 | | | Estimated Net Groundwater Outflow – 2,000,000 | | |