INTRODUCTION

With an average annual growth rate between five and ten percent per year, the Las Vegas Valley (Valley), located in southern Nevada, has one of the fastest growing populations in the United States. One issue facing the Southern Nevada Water Authority (SNWA), and all water purveyors in southern Nevada, is how to best meet the water needs of the growing population.

Water supply for the Valley is from two sources: ground water from the principal alluvial-fill aquifer and surface water from the Colorado River. The importance of defining other water sources is reinforced by the fact that the ground-water basin has been overdrafted for decades, and Nevada's allotment from the Colorado River is nearing full utilization.

Also, the continued growth in southern Nevada, combined with high summer water demands, has placed a strain on the distribution system. The escalating water-supply requirements that accompany the growing southern Nevada population have led to the question, "What are the alternatives for augmenting the future water supply?"

One option is to consider water that is available, but not now utilized. Examples include the shallow, or perched ground-water aquifer or surface water from washes tributary to Las Vegas Wash. One of the consequences of the rapid population growth has been the continued contribution of water to the shallow ground-water system and the development of perennial flow in the major washes in the Las Vegas Valley. It is believed that the flow in the washes and the presence of a shallow perched aquifer system is, in part, the result of over-irrigation of landscapes.

While this supply, which is present over the majority of the urbanized portion of the Valley, consists of non-potable water high in total dissolved solids, it may represent a suitable source of irrigation water for large turfed areas. Using the shallow aquifer for large-scale turf irrigation was first discussed by Brothers and Katzer (1988). The authors identified several locations, including golf courses and parks, throughout the Valley that might benefit from the substitution of non-potable water for potable water.

Currently, almost all of the turf irrigation needs in the Valley are met by the potable water supply. For example, of the total amount of water used by the Las Vegas Valley Water District's (District) service area, about 20,000 acre-feet per year, or about 8% of the potable water supply is applied to non-residential turfed areas like golf courses and parks (Joe Fortier, Las Vegas Valley Water District, oral communication, 1995).

Dr. Dale Devitt, an associate professor at the University of Nevada, Reno, in cooperation with the Las Vegas Valley Water District, conducted a study using shallow ground water for turf irrigation at Horseman Park located in the southeast part of the Valley. Dr. Devitt used various blends of shallow ground water and potable water to determine the response of turfgrass irrigated with water with elevated salt concentrations. The study indicated that it was possible, through the blending of shallow ground water and potable water to maintain a healthy stand of turfgrass (Devitt, oral communication, 1995).

Shallow ground water and wash water have traditionally been viewed as a nuisance in the Valley. Occasionally there is an unpleasant odor, usually the result of organic decay, that emanates from the washes. The vegetative growth is also a nuisance because it restricts flood flows along the natural sections of the channels, presents safety concerns, and is not aesthetically pleasing. For these reasons, excessive vegetative growth along the natural sections of the channels is occasionally removed.

Shallow ground water creates geologic hazards in some parts of the Valley by foundation degradation, soil compaction, and dissolution of minerals in soils. As a result, in 1986, Nevada water law (NRS 534.025) was revised to allow for utilization of the shallow aquifer system for beneficial use when the ground water creates a geologic hazard. Also, since eventually both shallow ground water and surface water terminate in Las Vegas Wash, which discharges into Lake Mead, there is a concern that increased salinity loading into Lake Mead may present a problem in the future.

There would potentially be several benefits from using alternative water sources (water not delivered through the distribution system) for large-scale turf irrigation. First, more potable water would be available in the distribution system, which is especially beneficial in the peak demand months of June, July, and August. Second, is the financial benefit to operators of turfed areas, who invest the capital cost of converting from potable to non-potable water use, but then realize a substantial long-term cost savings by not purchasing as much potable water for turf irrigation.

The purpose of this report is to provide a general background on the availability, quality, and location of non-potable water sources (surface water and shallow ground water) in the Las Vegas Valley.

DESCRIPTION OF LAS VEGAS VALLEY

Las Vegas Valley encompasses nearly 1,550 square miles in southern Nevada. The eastern edge of the Valley is located approximately five miles west of Lake Mead, an impoundment on the Colorado River (Figure 1). The Valley occupies a structural basin in the Basin and Range Province of the northern Mojave Desert, and most ground water and all surface flows are tributary to Lake Mead through Las Vegas Wash (Brothers and Katzer, 1988).

The Valley is bounded on virtually all sides by mountain ranges that reach a maximum elevation of almost 12,000 feet above sea level in the Spring Mountains to the west. The Valley floor elevation ranges from about 3,000 feet in the west at the mountain front to 1,500 feet in the east at the outflow of the Valley.

The climate on the Valley floor is considered arid, while higher elevations are considered sub-humid. Precipitation on the Valley floor averages about 4.17 inches per year while annual potential evapotranspiration exceeds 86 inches (Dale Devitt, Associate Professor, University of Nevada, Reno, oral communication, 1995). Most precipitation occurs during the months of July and August and during the winter (Wild, 1990). The mountains surrounding the basin may receive up to 20 inches of precipitation per year, usually the result of snow fall (Brothers and Katzer, 1988).

Major towns and entities located in Las Vegas Valley include Las Vegas, North Las Vegas, Henderson, and Nellis Air Force Base. The population in the Valley has nearly doubled since 1985. As of July 1995, the population was estimated at more than one million people (Clark County Conservation District, 1995).

HYDROGEOLOGY

Las Vegas Valley is located in a transition zone between the Great Basin physiographic Province and the northern Mojave Desert. The Valley occupies a structural basin in an area that underwent greater than 100 percent extension in the Mid-Miocene of the Cenozoic Era (Wernicke, 1988). The Valley is approximately 30 miles wide and 50 miles long and consists primarily of erosional sediments that in some locations are up to 5000 feet thick (Plume, 1989). Basin-fill sediments range from coarse cobbles to fine-grained silts and clays. The coarse material generally act as aquifers, while the presence of silts, clays and highly cemented alluvium (caliche) often act as confining layers.

The hydrogeology is complex. As discussed in both Harrill (1976) and Bernholtz (1993), the boundaries between the aquifers and confining units (aquitards) in the alluvial-basin fill are difficult to map. As a result, there have been several different descriptions of the hydrogeology of the Las Vegas Valley. One common observation among all recent (post 1978) researchers is the presence of low quality ground water within a few feet of land surface throughout the east and southeast part of the Valley, and is generally referred to as the shallow aquifer (Kaufmann, 1978). Below the shallow system is a confining unit defining the top of the near-surface reservoir. The bottom of the near-surface reservoir, approximately 250-300 feet below land surface, was defined in 1976 by Harrill as the top of the first significant water producing gravel zone. Depending upon the researcher, the principal water-producing zone is composed of anywhere from one aquifer (Harrill, 1976) to three aquifers (Maxey and Jameson, 1948 and Donovan, 1996). Below the principal aquifer(s) is bedrock. For the purposes of this discussion, the zones referred to as "shallow" and "near-surface" are of primary interest.