Chapter 33

Terminal Lakes

"Half a dozen little mountain brooks flow into Mono Lake, but not a stream of any kind flows out of it. It neither rises nor falls, apparently, and what it does with its surplus water is a dark and bloody mystery" (Twain, 1872).

The Basin and Range extending across Nevada and much of Utah contains many terminal lakes. A terminal lake is a body of water that has streams flowing into it but no streams flowing out of the lake. Inputs to a terminal lake also include direct precipitation to the lake and possibly ground water discharging to the lake.

Many of the lakes in Nevada, Utah, and eastern California are terminal lakes. For example, Mono Lake, the Great Salt Lake, Walker Lake, Pyramid Lake, Carson Sink, and numerous small lakes that occur in valleys in central and eastern Nevada are all terminal lakes.

Mono Lake, California. Photograph by M.S. Lico.

The reason the Basin and Range has so many terminal lakes is because of the topography. Basins typically are surrounded by high ridges that create conditions that allow water to collect in low areas and form lakes.

So, why doesn't the water continue to rise until it overflows the basins and spills into other areas? The reason is that, under natural conditions, terminal lakes typically are in a state of long-term equilibrium. The amount of inflow from streams, direct precipitation, and ground water is equal to the amount lost to evaporation. Over the course of a year, gains are made in the spring during snowmelt and rainfall, followed by losses in the summer due to evaporation, but from year to year, the lakes typically maintain somewhat steady levels.

However, over many years, if there are periods of sustained drought or continual wet years, terminal lake levels can fluctuate a great deal. Geologic evidence indicates that many of the terminal lakes in Nevada have both gone dry and have risen significantly in the past due to changes in the climate.

Terminal lakes can be described using the same equation we used for the water budget, where input equals output, plus or minus change in storage. In other words, the amount of water going into the lake as streams, precipitation, and ground-water flow equals the amount of water being evaporated off of the lake and being lost as ground water. And if the flow into the lake is different than the evaporation, there is a change in storage, or rather a rise or fall in the lake level.

As one can imagine, the streams and ground water that contribute to a terminal lake carry dissolved constituents (calcium, sodium, carbonate, chloride, etc.). When water evaporates, it leaves the dissolved constituents behind. Therefore, dissolved constituents in the lake waters become concentrated over time as more enter the lake and the water gets removed. This is why many terminal lakes are very salty and have a difficult time supporting certain aquatic life.

Many terminal lakes are at risk because of human influences on the water budget. By decreasing the amount of inflow into a lake, the water level of the lake will decline until either a new balance is reached (surface area of the lake declines until the evaporation is once again equal to the inflow) or the lake goes dry.

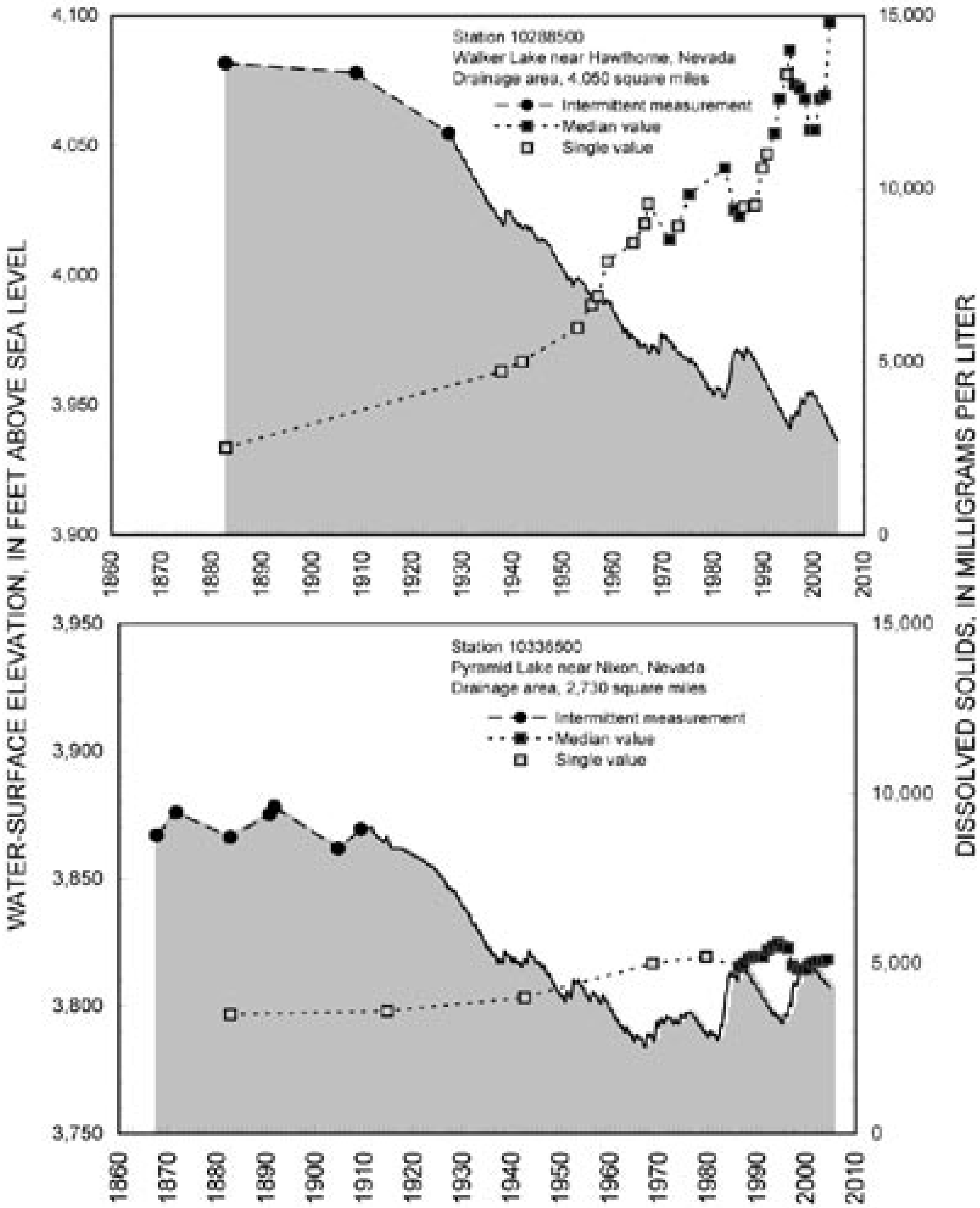
A good example of human impact on a terminal lake is again Mono Lake, California. Mono Lake is fed by streams, direct precipitation, and ground water, and losses are to evaporation. In 1941, when the lake was at a level of 6,410 feet above sea level, four of the five major streams feeding Mono Lake were diverted via the Los Angeles Aqueduct to southern California. The lake dropped to a level of 6,372 feet above sea level by 1981 (a drop of 38 feet over 40 years) and the surface area went from 53,500 acres in 1941 to about 40,000 acres in 1981 (Fetter, 1988). The salinity in the lake increased with the lowering of the lake level.

Terminal lakes in Nevada and Utah also are impacted by human influences. Water levels in many lakes have declined because of diversions of inflow to support agricultural and municipal needs. In many cases, diversions are limited and managed in order to maintain certain lake levels to support aquatic life, recreational activities, and salinity levels.

Walker Lake, north of Hawthorne, has been receding overall since the 1800s because of diversions of surface-water inflows and ground-water pumping in the watershed. USGS data illustrates that Walker Lake has declined about 143 feet between 1882 and 2003, which resulted in a steady rise in the dissolved solids in the lake. The concern for Walker Lake, as well as other desert terminal lakes, prompted Congress to approve $200 million in 2002 to address the issue. Presently, the BOR is examining the hydrology of desert terminal lakes and considering means to protect the lakes and their aquatic habitat from risk of continued water-level declines.

Pyramid Lake, north of Reno, is mainly fed by the Truckee River. Diversions of Truckee River water as part of the Newlands Project to support agriculture in western Nevada and withdrawals for municipal uses in the Reno area resulted in declines to Pyramid Lake. USGS data indicates that Pyramid Lake has declined about 58 feet between 1867 and 2003, with a similar associated rise in dissolved solids as seen in Walker Lake. These water-level declines greatly concerned the Pyramid Lake Paiute Tribe, who rely on the lake for food and resources, and other groups concerned with fishing, recreation, and other uses. Because of these concerns, flow and diversions in the Truckee River are now strongly regulated to insure adequate lake levels in Pyramid Lake.

Terminal lakes are an important part of the environment and history of the Basin and Range. They are a good example of how changes in one part of the water budget can affect the entire system.



Graph showing declining water levels in Pyramid and Walker Lakes.