Appendix T. Hydrologic Characteristics of the Owens River Basin below the Upper Owens River

The hydrology of Mono Basin is described in detail in Chapter 3A. This appendix describes the Owens River basin hydrology that is indirectly affected by Mono Basin exports.

Lake Crowley Reservoir Watershed Runoff

The watershed of Lake Crowley reservoir includes the Upper Owens River and several tributary creeks (Figure 1-1). Mammoth Creek joins Hot Creek near the Hot Creek Hatchery, upstream of Hot Springs. Convict and McGee Creeks join just upstream of Lake Crowley reservoir. Hilton and Crooked Creeks flow directly into Lake Crowley reservoir. Excess streamflow from Rock Creek can be diverted to Lake Crowley reservoir.

The average annual runoff from Lake Crowley reservoir watershed (Long Valley) is about 118 thousand acre-feet per year (TAF/yr), not including the Hot Creek Hatchery and Hot Springs flow of 30 TAF/yr and the Mono Tunnel groundwater flow of 12 TAF/yr.

Because of significant geothermal activity, several large hot springs have formed in the basin. The largest is Hot Springs, located along Hot Creek. The average annual discharge from Hot Springs (and the cool springs at Hot Creek Hatchery located upstream) of about 30 TAF/yr (41.5 cfs) flows directly into Hot Creek, which joins the Owens River just above Lake Crowley reservoir.

Significant diversions are made from the Owens River and Hot Creek for irrigation of LADWP and private grazing pasturelands. LADWP records indicate that an average of 20 TAF/yr are diverted for irrigation of its lands. This represents significantly more than the actual evapotranspiration losses, however. Excess diverted water returns to the Owens River or recharges the groundwater flowing to Lake Crowley reservoir. LADWP records suggest that unaccounted gains that may include irrigation return flows upstream of Lake Crowley reservoir average 39 TAF/yr.

The LADWP station at Long Valley Dam (elevation 6,700 feet) measures average rainfall of about 10 inches, and a station at Lake Mary measures 28.8 inches. Snowpack water content on April 1 ranges from 20 to 42 inches in the surrounding watersheds at elevations of 8,300-9,500 feet and shows the increase in snowpack with elevation on the east side of the Sierra Nevada.

Evaporative losses at Lake Crowley reservoir are estimated from observations at an evaporation pan station located at Long Valley Dam, where records are kept only for ice-free months of the year. The average monthly evaporations for the land and lake pans are given in Table 3A-4.

Round Valley Runoff

The major Owens River tributaries in Round Valley are Rock, Pine, and Horton Creeks. The combined runoff from these creeks is approximately 66 TAF/yr. Birchim Canyon springs, located on Rock Creek just upstream of its confluence with the Owens River, has a long-term annual flow volume of about 17 TAF/yr. This spring discharge is not included in the runoff measurements used by LADWP to index water-year types.

Snow course measurements are available from three stations in Round Valley. Rock Creek 3 (elevation 10,000 feet) has an average April 1 water content of 15 inches. Rock Creek 2 (elevation 9,050 feet) has an average water depth of 10.4 inches, and Rock Creek 1 (elevation 8,700 feet) has an average water depth of 7.4 inches. These measurements illustrate the decrease in snowpack with decreasing elevation. Rainfall at Rock Creek averages 17.1 inches per year. Several other rainfall and snow course measurement stations are listed in Table 3A-2.

Major diversions are made from Rock, Pine, and Horton Creeks for irrigated pasturelands in Round Valley. LADWP records for 1970-1989 were used to estimate a total irrigation diversion of approximately 9 TAF/yr. Pine Creek joins Rock Creek at the bottom of Round Valley and flows through Birchim Canyon to the Owens River. Some of Horton Creek's runoff is diverted by Southern California Edison (SCE) to Bishop Creek for hydropower generation.

Middle Owens River Runoff

The Middle Owens River is the segment between Pleasant Valley Reservoir and the Los Angeles Aqueduct (LA Aqueduct) intake downstream of Tinemaha Reservoir. Because river diversions and groundwater pumping for irrigated pastureland and recreational uses are made in three distinct areas (Laws, Bishop, and Big Pine), these in-basin water use areas are considered separately in the Los Angeles Aqueduct Monthly Program (LAAMP) operations model.

Laws Area Runoff

Laws area runoff is the sum of several small creeks that flow out of the White Mountains, with an average annual volume of less than 4 TAF. Two White Mountain rainfall stations average 13.1 and 18.8

inches per year (Table 3A-2). Very little of the water actually flows into the Owens River, as most is diverted for irrigation use or infiltrates to groundwater. Fish Slough is a wetland and stream located in the Laws area with a relatively constant flow of approximately 6 TAF/yr.

Laws area irrigation diversions from the Owens River are made from upper and lower McNally canals in normal and wet years. Irrigation requirements of approximately 5 TAF/yr are satisfied with groundwater pumping in dry years. The McNally canals are used to divert Owens River flow for spreading to allow groundwater recharge in the Laws area during wet years. The combined capacity of the canals is approximately 100 cubic feet per second (cfs), allowing about 6,000 acre-feet (af) of spreading per month of available excess flow. LADWP records indicate that the unaccounted-for losses in the Laws area total 5 TAF/yr. These surface water losses presumably infiltrate and recharge groundwater.

Groundwater pumping in the Laws area is often greater than the irrigation requirements. The wellfield capacity is limited by the Long-Term Groundwater Management Plan for the Owens Valley and Inyo County (Inyo County and City of Los Angeles 1990) to approximately 38 TAF/yr, including several "enhancement and mitigation" wells that pump water to be used at other locations within the Owens Valley. The excess pumping is conveyed in the McNally canals to Laws Ditch, which flows into the Owens River just north of the town of Bishop.

Bishop Area Runoff

Bishop area runoff averages 82 TAF/yr and is dominated by runoff from Bishop Creek (69 TAF/yr). Seasonal storage by SCE for hydropower generation occurs in Lake Sabrina, with a maximum storage capacity of about 20 TAF. Diversions are made from Horton, McGee, and Birch Creeks. Several SCE hydropower plants are located along Bishop Creek. The releases from the lowest hydropower plant, which include diversions from several nearby creeks, average 80.5 TAF/yr. Bishop Creek splits into several distributaries as it flows across the alluvial fan deposits and through the town of Bishop toward the Owens River.

Artesian groundwater wells along the Owens River discharge approximately 4.5 TAF/yr into the Owens River in the Bishop area. These wells were drilled by LADWP during the 1920s to supplement Owens River flows. They essentially discharge the excess groundwater recharge from Bishop Creek. Additional inflow of groundwater seepage occurs along the Middle Owens River, but a net loss of streamflow in the Owens River between the towns of Bishop and Big Pine is caused by evapotranspiration and infiltration of streamflow to groundwater.

Bishop area irrigation diversions from the Owens River are made just downstream of Horton Creek into the Bishop Canal. The canal capacity is approximately 80 cfs, and average annual diversions are about 25 TAF/yr. Diversions are greater in dry years (30 TAF/yr) and less in wet years (15 TAF/yr) when Bishop Creek runoff supplies more of the Bishop area irrigation requirements. Irrigation diversions are made from a network of canals and drains that connect with Bishop Creek. The major return for excess

runoff or unused canal diversions is the A-drain, located several miles south of the town of Bishop, just downstream from the Big Pine canal diversion from the Owens River. LADWP records indicate that the unaccounted-for losses in the Bishop area total about 23 TAF/yr. These losses presumably recharge the groundwater.

Groundwater pumping in the Bishop area is limited to irrigation requirements within the Bishop area, according to the Bishop Cone Settlement Agreement. The wellfield capacity is approximately 20 TAF/yr, although annual pumping is limited to 12 TAF/yr (Inyo County and City of Los Angeles 1990).

Irrigation requirements in the Bishop area are approximately 21 TAF/yr, with an additional recreation and wildlife use of 4.5 TAF/yr, and uses of 3.25 TAF/yr on Indian lands. All these uses are seasonal, with peak usage in summer.

Precipitation averages 16.8 inches per year at Lake Sabrina (elevation 9,065 feet) but only 5.7 inches per year at Bishop (elevation 4,108 feet). Bishop Pass (elevation 11,200 feet) has an average April 1 snow pack water content of 33.2 inches (Table 3A-2).

Big Pine Area Runoff

Big Pine area runoff totals approximately 52 TAF/yr. Most of this is from Big Pine Creek. LADWP operates a hydropower plant on Big Pine Creek. Tinemaha Creek flows directly into Tinemaha Reservoir. The runoff from these creeks is natural; no seasonal storage facilities are located upstream.

Big Pine canal diverts water from the Owens River to supply water for irrigation and recreation (including water for use on Indian lands) in the Big Pine area, and to allow spreading for groundwater recharge. The total requirement for irrigation and recreational use is approximately 15 TAF/yr. The canal capacity for spreading is about 4.5 TAF per month (75 cfs). LADWP records indicate that unaccounted-for losses in the Big Pine area total about 20 TAF/yr, including Tinemaha Reservoir evaporation.

Fish Springs Hatchery, located south of the town of Big Pine, was originally supplied by natural springflow. As groundwater pumping for irrigation and export was increased, however, the natural springflow was reduced. The hatchery supply was augmented by two wells that now supply most of the water (24 TAF/yr) for the hatchery. Once used in the hatchery, the water flows down the Fish Springs canal to the Owens River just upstream of Tinemaha Reservoir.

The combination of releases and storage changes at Tinemaha Reservoir provides a complete record of Owens River streamflow there. The net losses along the Middle Owens River between Pleasant Valley and Tinemaha Reservoirs is estimated at approximately 37 TAF/yr.

The total wellfield capacity in the Big Pine area is approximately 42 TAF/yr. Most of the water is used for the hatchery supply and so is not lost to evapotranspiration. The excess pumping and return from the Big Pine canal and Big Pine Creek diversions flow to the Owens River in the Fish Springs canal.

Rainfall at Tinemaha Reservoir is 6.6 inches per year. Rainfall at Big Pine Power Plant has averaged 9.0 inches per year. Snow course measurements made in the Big Pine Creek watershed range from 15.2 to 22.7 inches (Table 3A-2).

Tinemaha Reservoir

Tinemaha Reservoir was constructed by LADWP to provide short-term regulation of Owens River flows, to allow the maximum amount of flow to be diverted into the LA Aqueduct. The maximum storage is approximately 16 TAF, although earthquake safety concerns have limited the usable storage to 10 TAF in recent years. The monthly pattern of evaporation of Tinemaha Reservoir is given in Table 3A-4.

Releases from Tinemaha Reservoir are usually diverted into the LA Aqueduct intake at Aberdeen, but excess water occasionally flows down the Owens River channel toward Owens Lake, south of Lone Pine.

Tinemaha-to-Haiwee Area Runoff

The remainder of the Owens Valley runoff occurs in the segment of the basin between Tinemaha Reservoir and Haiwee Reservoir. The LA Aqueduct intake from the Owens River is located just downstream of Tinemaha Reservoir near Aberdeen. Runoff from several eastern Sierra Nevada creeks, from Taboose Creek in the north to Haiwee Creek in the south, are intercepted by the LA Aqueduct. Lone Pine Creek drains the eastern slopes of Mount Whitney. LADWP has hydropower plants that divert water from Division Creek and Cottonwood Creek. The combined runoff from these creeks is about 105 TAF/yr. Springs and artesian wells along the aqueduct supply additional flow during wet periods but are limited in dry years.

Diversions from the creeks and releases from the aqueduct total approximately 23 TAF/yr, including water for Indian lands and recreation and enhancement uses. Some returns from irrigation west of the aqueduct may be captured by the aqueduct or groundwater pumping, but releases and returns from uses east of the aqueduct flow toward Owens Lake and are not returned to the LA Aqueduct.

Groundwater pumping occurs in several wellfields between Tinemaha and Haiwee Reservoirs, with a total annual limit of about 100 TAF/yr (Inyo County and City of Los Angeles 1990). Most of this groundwater is pumped directly into the LA Aqueduct for export to Los Angeles. The Black Rock

Hatchery is supplied by groundwater pumping. Pumping is lowest during the runoff period in wet years and increases in fall and winter to help maintain a constant water supply for the aqueduct.

Spreading of excess Tinemaha-to-Haiwee runoff is used to recharge groundwater for later pumping into the aqueduct. The spreading capacity in the Tinemaha-to-Haiwee area is about 20 TAF per month (335 cfs) and is accomplished with diversions from several of the creeks over the alluvial fans at the base of the mountains west of the aqueduct. During periods of excess runoff, operational spills must also be made east of the aqueduct toward Owens Lake. In most cases the creek runoff bypasses the aqueduct diversions. At other times releases are made from the aqueduct. LADWP estimates that unaccounted-for losses in the Tinemaha-to-Haiwee segment of the Owens River basin average 32.5 TAF/yr.

Haiwee Reservoir

Located south of Owens Lake, North and South Haiwee Reservoirs provide a combined storage volume of 60 TAF. Dam earthquake safety concerns have limited the usable storage to 15 TAF in recent years. Releases from Haiwee Reservoir flow down the LA Aqueduct conduits to Los Angeles. A series of power plants is located along the aqueduct conduits (see Chapter 3M, "Power Generation", for a description of these aqueduct power plants).

Rainfall, measured at South Haiwee Reservoir (elevation 3,825 feet), averages 6.5 inches per year (Table 3A-2). The monthly evaporation rates are given in Table 3A-4.

Other Los Angeles Aqueduct Facilities

Bouquet Reservoir is located west of Palmdale in the Sierra Madre Mountains north of San Fernando. The reservoir provides storage for short-term regulation and for emergency supply should something interrupt the aqueduct between it and Haiwee Reservoir (the San Andreas fault crosses the LA Aqueduct north of Bouquet Reservoir). The aqueduct terminates at the Van Norman Reservoir in the northern San Fernando Valley. The LA Aqueduct filtration plant is now located just north of the Van Norman Reservoir.

These aqueduct facilities south of Haiwee Reservoir are not considered in the aqueduct operations model. The hydrologic effects of the EIR alternatives are traced only to the Haiwee Reservoir exports to Los Angeles.

CITATIONS

Printed Reference

Inyo County and City of Los Angeles. 1990. Green book for the long-term groundwater management plan for the Owens Valley and Inyo County. June. Inyo County and Los Angeles, CA.