SECTION 5 20-YEAR PLANNING QUANTITIES

Section 4 illustrated how sediment deposition varies by watershed and from year to year. This section describes how this Strategic Plan estimated how much sediment to anticipate and plan for over the 20-year planning period from 2012 to 2032.

5.1 METHODOLOGY

As indicated in Section 4, there are records of sediment accumulation and removal for each reservoir and debris basin. The records include periods with below-average rainfall, periods with above-average rainfall, periods with no fires, and periods following small and large fires affecting the watershed of the reservoirs and debris basins maintained by the Flood Control District. As a result, the records capture the variability of sediment deposition in the reservoirs and debris basins.

For the purpose of this Strategic Plan, it was assumed that rain and fire conditions in the future will be similar to those of the past and that the resulting future sediment accumulation in the reservoirs and debris basins will be similar to the sediment deposition of the past. Based on that assumption, 20-year planning quantities were projected using the Flood Control District's historical records.

The effects of climate change were not considered in the calculation of the 20-year planning quantities. However, as explained in Section 5.1.1, the approach used to develop the 20-year planning quantities offers a factor of safety over the average 20-year periods in the records.

5.1.1 RESERVOIRS

For the reservoirs, the planning quantities were determined with the goal of having no net increase in the amount of sediment accumulated in the reservoirs.

Because the reservoirs are surveyed on an as-needed basis and several years may pass between surveys, there are no records of how much sediment is accumulated in the reservoirs on a yearly basis. While typical sediment delivery is in the form of discrete storm events with large storms delivering most of the sediment, for planning purposes, it was assumed that approximate annual sediment accumulation values could be estimated by equally distributing the change in accumulated sediment among the years in between two surveys.

For example, based on the records, as of 1938 there were 136,000 cubic yards (CY) of sediment in Big Dalton Reservoir. By 1943, that quantity had grown to 161,000 CY. This indicates that during the 5 years between the surveys 25,000 CY of sediment accumulated in the reservoir. Dividing 25,000 CY by 5 years yields an estimated annual inflow of 5,000 CY between 1938 and 1943. The equations below illustrate this calculation.

$$Annual\ sediment\ accumulation\ between\ Survey\ 2\ and\ Survey\ 1 =$$

$$= \frac{(Quantity\ of\ sediment\ in\ reservoir\ during\ Survey\ 2) - (Quantity\ of\ sediment\ in\ reservoir\ during\ Survey\ 1)}{(Year\ of\ Survey\ 2) - (Year\ of\ Survey\ 1)}$$

$$= \frac{161{,}000\ CY - 136{,}000\ CY}{1943 - 1938}$$

$$= \frac{25{,}000\ CY}{5\ years} = 5{,}000\ CY/year$$

Once annual sediment accumulation values were determined, the values were added for each 20-year rolling period for the lifetime of each reservoir. For Big Dalton Reservoir this resulted in 60 individual 20-year periods

starting with 1930 to 1949 and ending with 1989 to 2008. The 80th percentile, i.e., the 20-year value below which 80 percent of the 20-year values fell, was selected as the quantity of sediment the Flood Control District should plan to manage during the 20-year period covered by this Strategic Plan.

The 80th percentile was selected for planning purposes because it offers a factor of safety over the average 20-year period yet it is not conservative to the point of planning for the worst 20-year periods. The impact of under-projection is that the Strategic Plan would last less than the 20-year planning period, which would require an updated Strategic Plan to be developed sooner than expected.

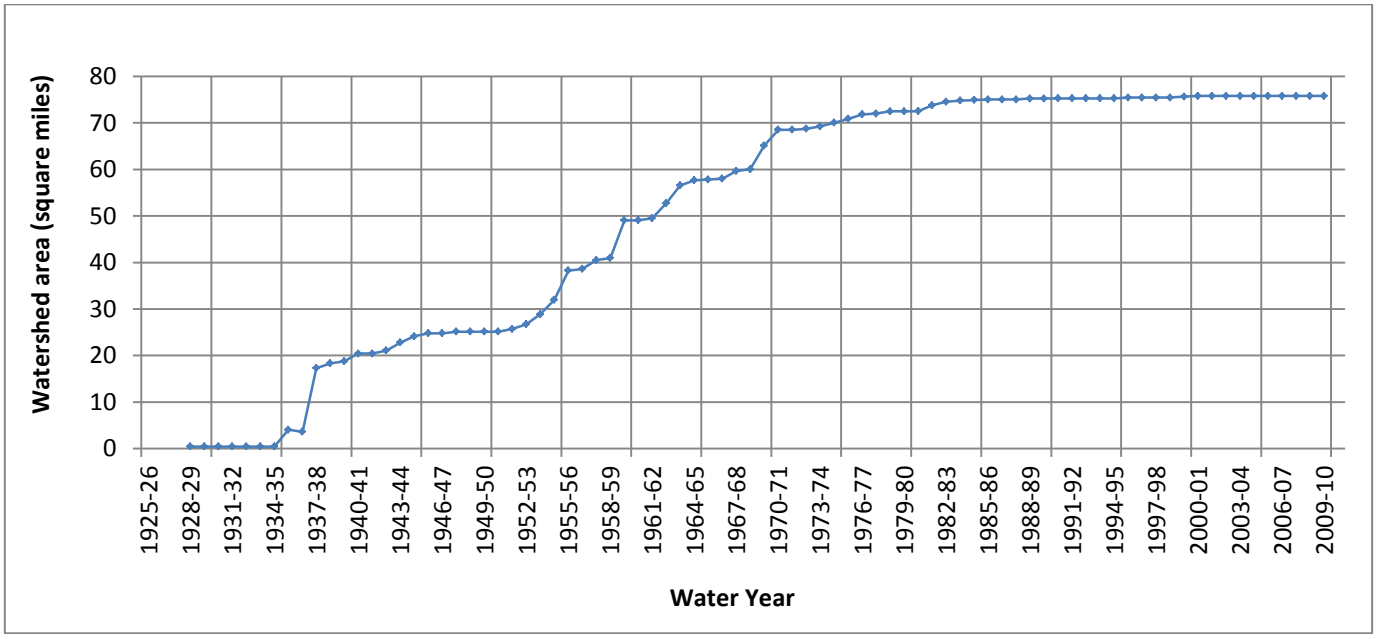
For the four reservoirs significantly impacted by the 2009 Station Fire – Big Tujunga, Cogswell, Devil's Gate, and Pacoima Reservoirs – the 20-year planning quantities also include sediment already in the reservoirs planned for removal as part of the reservoir sediment removal projects in the planning phase as of November 2012.

5.1.2 DEBRIS BASINS

For debris basins, the 20-year planning quantities follow the current sediment removal procedure.

As indicated in Section 4, sediment accumulation and removal records for the debris basins have been kept since Water Year 1935-36. The records show a significant increase in the number of debris basins maintained by the Flood Control District, the size of the watershed area contributing flows to those facilities, and the quantity of sediment needing to be managed. Figure 5-1 shows the watershed area covered by the debris basins managed by the Flood Control District from the late 1920 to the Water Year 2009-2010. As of the writing of this Strategic Plan, the watershed area of the Flood Control District's 162 debris basins was 75.8 square miles. According to the records, by Water Year 1954-55, the watershed area of the debris basins was approximately 32.0 square miles, which is approximately 40 percent of 75.8 square miles.

Figure 5-1 Total Watershed Area Covered by Debris Basins in a Given Year



In order to be able to use the historical records to determine planning quantity for the 162 debris basins, the change in number of debris basins and watershed area covered by them had to be addressed. Data prior to Water Year 1954-55 was not used because the quantity of debris basins and their geographic distribution was not similar enough to today's situation to warrant normalization. The records from Water Year 1954-55 and on were prorated based on the watershed area of the debris basins.

The following example discusses proration of the 1954-55 record. As mentioned previously, the debris basins that had been constructed as of Water Year 1954-55 covered a combined watershed area of 32.0 square miles. According to the records, a total of 14,557 CY were removed from debris basins that year. The ratio of the watershed area covered in 2012 and in 1954-55 was found by dividing the current watershed area (75.8 square miles) by the 1954-55 watershed area (32.0 square miles); the result was 2.37. The 14,557 CY value was then multiplied by 2.37; the result was approximately 34,500 CY, which is the normalized value. The following equations illustrate this calculation.

$$\text{Prorated Amount of Sediment Removed from Debris Basins in Water Year 1954-55} =$$

$$= \text{Sediment quantity removed in Water Year 1954-1955} \times \left(\frac{\text{Watershed Area in Water Year 2009-2010}}{\text{Watershed Area in Water Year 1954-55}}\right)$$

$$= 14{,}557\ CY \times \left(\frac{75.8\ square\ miles}{32.0\ square\ miles}\right)$$

$$= 14{,}557\ CY \times 2.37 = 34{,}500\ CY$$

In order to arrive at planning quantities for each flood maintenance area, the debris basin data was separated by Flood Maintenance Area. Similar to the estimation process for reservoirs, the sediment inflow data for debris basins was used to calculate a removal quantity for each 20-year rolling period. The 80th percentile of each Flood Maintenance Area's data set was selected as the 20-year planning quantity for the subject Flood Maintenance Area.

While the number of debris basins maintained by the Flood Control District may increase as a result of development during the 20-year planning period, this is expected to only have minimal impact on the quantity of sediment needing to be managed because new development will likely only occur in areas of low debris potential. Therefore, the 20-year planning quantities were not prorated to reflect a potential increase due to future development.

5.2 PLANNING QUANTITIES

The total 20-year planning quantity for this Strategic Plan is 67.5 MCY, with approximately 57.9 MCY resulting from the reservoirs and 9.6 MCY from the debris basins, as shown in Table 5-1 and graphically shown in Figure 5-2. This includes the projected 20-year sediment accumulation as well as sediment already in storage at Big Tujunga, Cogswell, Devil's Gate, and Pacoima Reservoirs also planned for removal.

Table 5-1 20-Year Planning Quantities by Flood Maintenance Area

Facilities	20-Year Planning Quantity (MCY)
Reservoirs – East Area	43.1
Reservoirs – West Area	14.8
Subtotal	**57.9**
Debris Basins – East Area	4.9
Debris Basins – West Area	4.5
Debris Basins – South Area	0.2
Subtotal	**9.6**
Total	**67.5**

5.2.1 EAST FLOOD MAINTENANCE AREA

As previously discussed, the East Area maintains 12 reservoirs and 51 debris basins. The 20-year planning quantity for the 12 reservoirs in the East Area is approximately 43.1 MCY, as shown in Table 5-2. The East Area debris basins have a projected 20-year sediment deposition of approximately 4.9 MCY.

Table 5-2 East Area Reservoirs Planning Quantities

Facility	Projected 20-Year Sediment Accumulation (MCY)	Sediment Already in Storage Also Planned for Removal (MCY)	Total 20-Year Planning Quantity (MCY)
Big Dalton Reservoir	0.8	-	0.8
Cogswell Reservoir	2.4	3.3	5.7
Devil's Gate Reservoir	4.3	Up to 4.0	8.3
Eaton Wash Reservoir	1.6	-	1.6
Live Oak Reservoir	0.2	-	0.2
Morris Reservoir	1.3	-	1.3
Puddingstone Diversion Dam	0.6	-	0.6
Puddingstone Reservoir	0.8	-	0.8
San Dimas Reservoir	1.9	-	1.9
San Gabriel Reservoir	20.4	-	20.4
Santa Anita Reservoir	1.2	-	1.2
Thompson Creek Reservoir	0.3	-	0.3
Total	**35.8**	**7.3**	**43.1**

5.2.2 WEST FLOOD MAINTENANCE AREA

The total 20-year planning quantity for the 2 reservoirs within the West Area is approximately 14.8 MCY, as shown in Table 5-3. The West Area debris basins have a projected 20-year sediment accumulation of approximately 4.5 MCY.

Table 5-3 West Area Reservoirs Planning Quantities

Facility	Projected 20-Year Sediment Accumulation (MCY)	Sediment Already in Storage Also Planned for Removal (MCY)	Total 20-Year Planning Quantity (MCY)
Big Tujunga Reservoir	5.2	2.0	7.2
Pacoima Reservoir	2.4	Up to 5.2	7.6
Total	**7.6**	**7.2**	**14.8**

5.2.3 SOUTH FLOOD MAINTENANCE AREA

As previously discussed, there are no reservoirs located within the South Area. The South Area debris basins have a projected 20-year sediment accumulation of approximately 0.2 MCY.

Figure 5-2 20-Year Planning Quantities and Remaining Capacity at Sediment Placement Sites