# SECTION 8 ALTERNATIVES ANALYSIS AND RECOMMENDATIONS FOR OTHER LARGE RESERVOIRS

This section provides background information and discusses the analysis of sediment management alternatives and recommendations for the following reservoirs:

- Big Tujunga Reservoir
- Devil's Gate Reservoir *
- Pacoima Reservoir
- Puddingstone Reservoir
- San Dimas Reservoir
- Santa Anita Reservoir

As discussed in Sections 3 and 6, in general, these facilities are larger than some of the other reservoirs in respect to the size of the dam, reservoir, drainage area, and sediment accumulation. Additionally, all the reservoirs above except for Devil's Gate Reservoir are operated with a pool of water.

*This Strategic Plan only provides background information for Devil's Gate Reservoir because the Los Angeles County Flood Control District (Flood Control District) is currently in the process of preparing an Environmental Impact Report (EIR) for Devil's Gate Reservoir Sediment Removal and Management Project. Since the EIR will thoroughly discuss all possible alternatives to remove, transport, and place sediment for Devil's Gate Reservoir, this Strategic Plan does not include alternatives for the reservoir.

Similar to Section 7, discussion of the alternatives for each reservoir is organized based on the different phases of the cleanout process, specifically:

1. Staging and Temporary Sediment Storage Areas
2. Sediment Removal Alternatives
3. Transportation Alternatives
4. Placement Alternatives

After the individual alternatives are discussed, combined alternatives that address the entire sediment management process are presented. Combined alternatives were developed by grouping a removal alternative with a transportation alternative and a placement alternative. The total cost of implementing the combined alternative is presented along with a review of the impacts. This Strategic Plan provides recommendations that will guide development of specific cleanout plans for each one of the reservoirs. However, as specific cleanout plans are developed additional alternatives may be considered.

## 8.1 BIG TUJUNGA RESERVOIR

### 8.1.1 BACKGROUND

Big Tujunga Dam, shown in Figure 8-1, is a variable radius arch concrete dam that was constructed between 1930 and 1931 and had an original storage capacity at spillway of approximately 10.1 million cubic yards (MCY). In 2011, a retrofit project to ensure the dam's seismic stability and increase spillway capacity was completed. With a drainage area of approximately 82.3 square miles, Big Tujunga Dam is operated for flood risk management and water conservation purposes. Big Tujunga Reservoir is not accessible to the public and is not used for recreation.

**Figure 8-1 Big Tujunga Dam**

#### 8.1.1.1 LOCATION

Big Tujunga Reservoir is located within Federal land in the Angeles National Forest, in the Big Tujunga Canyon of the San Gabriel Mountains, approximately 8 miles east of the Sunland community of the City of Los Angeles. Big Tujunga Creek, Fox Creek, and a few unnamed, natural streams that traverse the San Gabriel Mountains flow into Big Tujunga Reservoir. The waterway downstream of the dam is known as Big Tujunga Wash. The wash flows through Big Tujunga Wash Mitigation Area and into Hansen Flood Control Basin, a U.S. Army Corps of Engineers (Army Corps of Engineers) facility used to manage the risk of floods. Figure 8- shows the location of Big Tujunga Reservoir and several key facilities. Figure 8-2 shows an aerial of the reservoir.

There are two sediment placement sites (SPSs) within the immediate vicinity of Big Tujunga Reservoir – Maple SPS and Big Tujunga SPS. Big Tujunga SPS has very little remaining capacity. As of 2012, Maple SPS had an estimated remaining capacity of approximately 4.4 MCY.

**Figure 8-2 Big Tujunga Reservoir Vicinity Map**

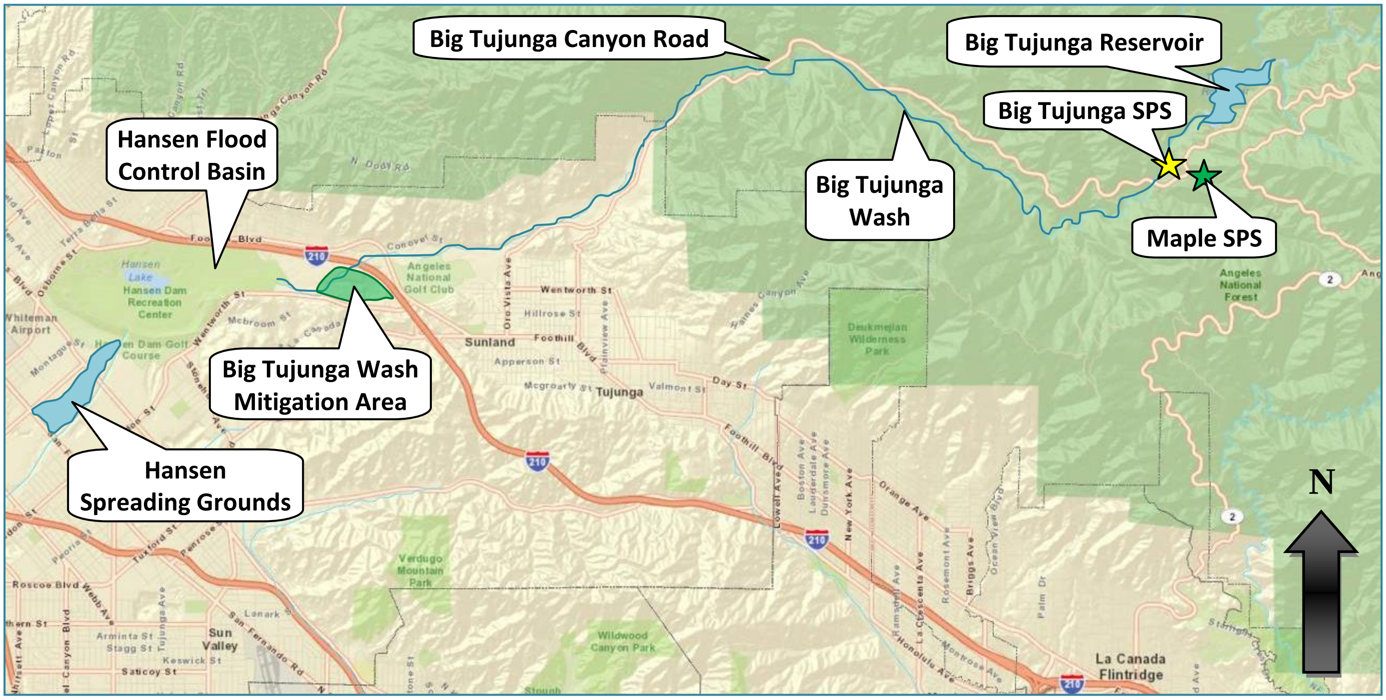
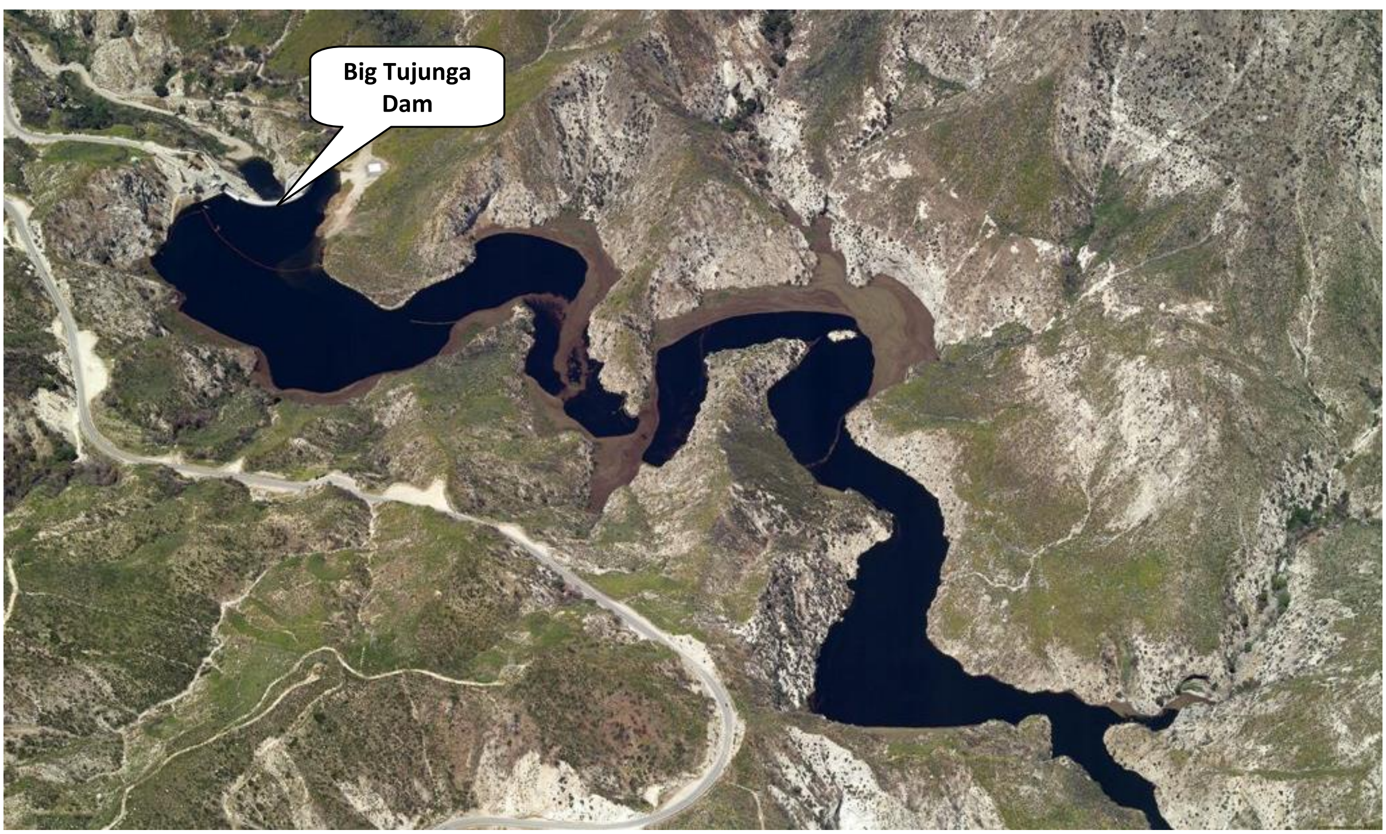



**Figure 8-2 Big Tujunga Reservoir Aerial Image**



#### 8.1.1.2 ACCESS

There are two access roads maintained by the Flood Control District that provide access to the Big Tujunga Dam and the body of the reservoir, as shown in Figure 8-3. One of the access roads is a fully paved two-way access road that runs to a parking area on the south abutment of the dam and continues pass the dam as an unpaved road, providing access to the body of the reservoir. The other access road is an unpaved access road that stems from the paved access road, partially travels along Big Tujunga Wash, passes by the north abutment, and provides a second access point to the body of the reservoir.

**Figure 8-3 Access roads to Big Tujunga Dam and Reservoir**


#### 8.1.1.3 DAM OUTLETS

In addition to being equipped with a variety of valves, Big Tujunga Dam is also equipped with a sluiceway controlled by a 5- by 5-foot sluice gate.

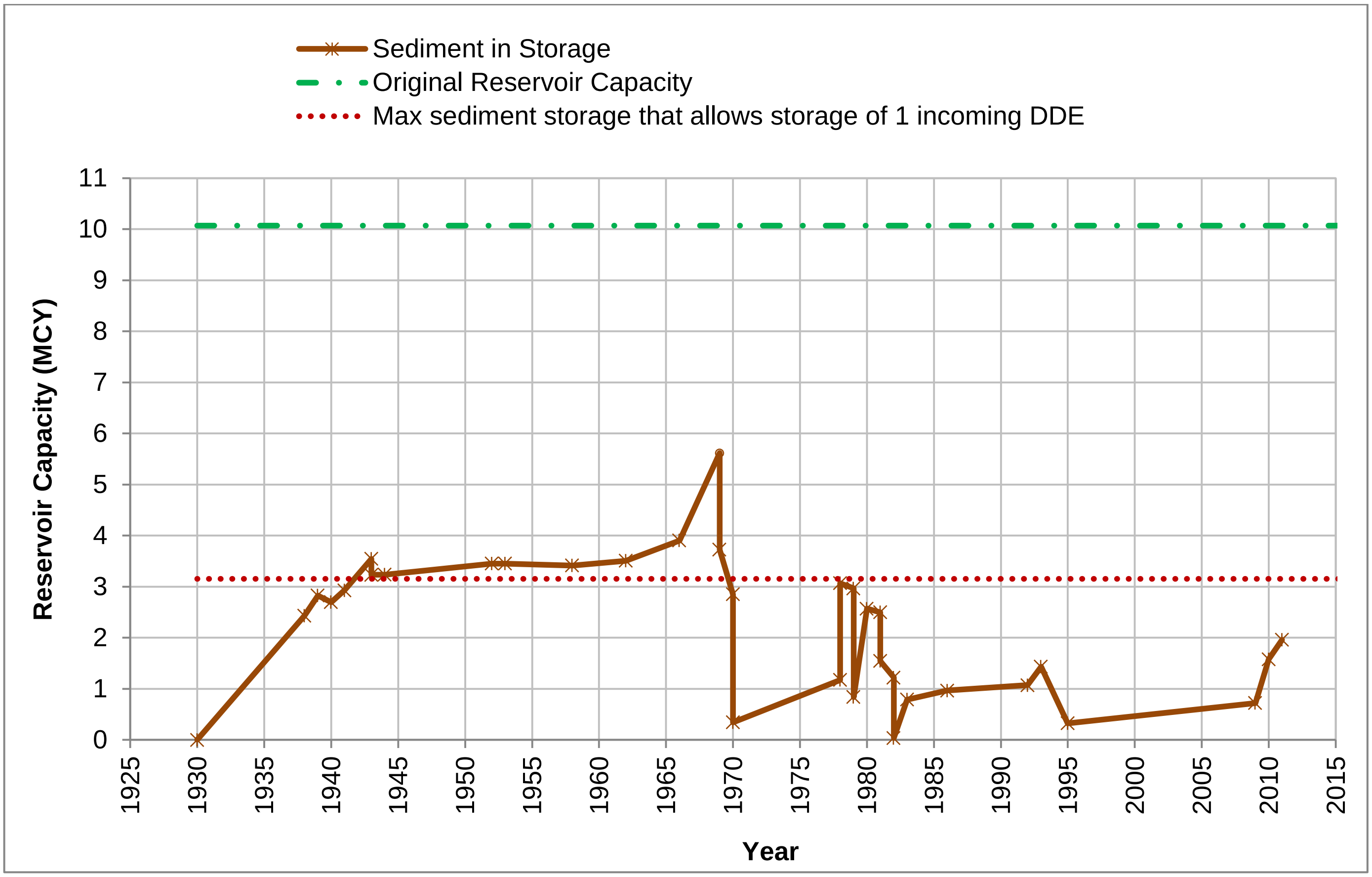
#### 8.1.1.4 DOWNSTREAM FLOOD CONTROL AND WATER CONSERVATION SYSTEM COMPONENTS

Water that passes through Big Tujunga Dam travels approximately 14 miles along Big Tujunga Wash to the Army Corps of Engineers' Hansen Flood Control Basin. Between the aforementioned facilities, the wash retains its natural characteristics and is augmented by numerous creeks. Downstream of Hansen Flood Control Basin water flows along Tujunga Wash, a concrete-lined channel. The channel passes by Hansen Spreading Grounds and Tujunga Spreading Grounds. Near Studio City, Tujunga Wash flows into the Los Angeles River.

### 8.1.1.5 SEDIMENT DEPOSITION AND REMOVAL HISTORY

Figure 8-4 shows the approximate sediment storage in Big Tujunga Reservoir since the reservoir's first debris season in the early 1930s. For reference purposes, the figure shows the original reservoir capacity at spillway lip and the maximum sediment storage that allows for the storage of one incoming design debris event (DDE). Due to the configuration of Big Tujunga Reservoir, capacity is not available for two DDEs at this location.

**Figure 8-4 Graph of Historical Sediment Storage at Big Tujunga Reservoir**




Per the Flood Control District's records, which are summarized in Table 8-1, between Big Tujunga Reservoir's first debris season and June 2012, sediment has been removed from the reservoir on 17 occasions. Sluicing operations have been conducted 10 times, starting with the first removal activity shown by the 1940 survey. Prior to 1969, sluicing was the only method used to remove sediment from the reservoir. After 1970, only one small sluicing operation was conducted in 1982. Since 1970, excavation has been the dominant mode of cleanout. Big Tujunga SPS and Maple SPS have been used for the placement of some of the material removed from the reservoir.

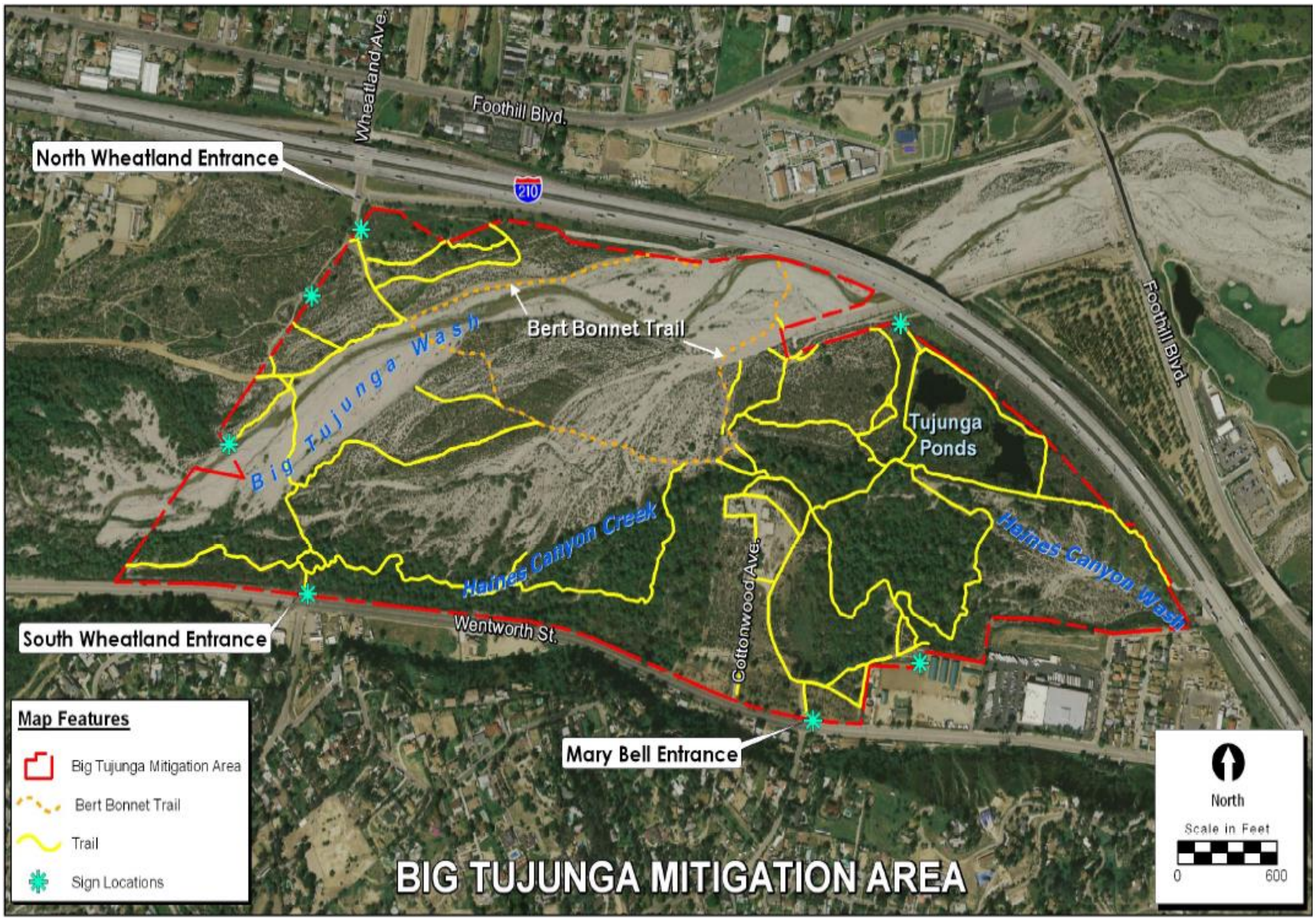
**Table 8-1 Big Tujunga Reservoir historical sediment accumulation and removal**

| Survey Date | | Reservoir Capacity (MCY) | Quantity Sluiced (MCY) | Quantity Excavated (MCY) | Sediment Accumulated Between Surveys (MCY) | Sediment in Storage (MCY) |
|---|---|---|---|---|---|---|
| October | 1930 | 10.07 | - | - | - | - |
| May | 1938 | 7.64 | - | - | 2.43 | 2.43 |
| October | 1939 | 7.24 | - | - | 0.40 | 2.83 |
| February | 1940 | 7.37 | 0.13 | - | - | 2.70 |
| July | 1941 | 7.14 | 1.24 | - | 1.47 | 2.93 |
| February | 1943 | 6.52 | - | - | 0.62 | 3.54 |
| April | 1943 | 6.83 | 0.31 | - | - | 3.23 |
| June | 1944 | 6.83 | 0.27 | - | 0.27 | 3.23 |
| September | 1952 | 6.61 | - | - | 0.22 | 3.45 |
| October | 1953 | 6.61 | - | - | - | 3.45 |
| June | 1958 | 6.65 | 0.21 | - | 0.18 | 3.42 |
| July | 1962 | 6.56 | 0.12 | - | 0.22 | 3.51 |
| October | 1966 | 6.16 | - | - | 0.40 | 3.91 |
| March | 1969 | 4.45 | 0.01 | 0.14 | 1.87 | 5.62 |
| November | 1969 | 6.34 | 0.53 | 1.36 | - | 3.72 |
| February | 1970 | 7.21 | - | 0.87 | - | 2.85 |
| October | 1970 | 9.72 | 0.30 | 2.21 | - | 0.34 |
| March | 1978 | 8.89 | - | - | 0.83 | 1.17 |
| April | 1978 | 7.00 | - | - | 1.89 | 3.07 |
| May | 1979 | 7.10 | - | 0.10 | - | 2.97 |
| December | 1979 | 9.23 | - | 2.13 | - | 0.84 |
| March | 1980 | 7.50 | - | - | 1.73 | 2.57 |
| May | 1981 | 7.57 | - | 0.07 | - | 2.50 |
| December | 1981 | 8.52 | - | 0.95 | - | 1.55 |
| May | 1982 | 8.85 | 0.03 | 0.30 | - | 1.22 |
| November | 1982 | 10.03 | - | 1.18 | - | 0.04 |
| April | 1983 | 9.28 | - | - | 0.75 | 0.79 |
| December | 1986 | 9.10 | - | - | 0.18 | 0.97 |
| July | 1992 | 9.00 | - | - | 0.10 | 1.07 |
| June | 1993 | 8.63 | - | - | 0.36 | 1.43 |
| November | 1995 | 9.74 | - | 1.11 | - | 0.33 |
| October | 2009 | 9.34 | - | - | 0.40 | 0.72 |
| August | 2010 | 8.49 | - | - | 0.86 | 1.58 |
| August | 2011 | 8.11 | - | - | 0.38 | 1.96 |

#### 8.1.1.6 Special Conditions

Big Tujunga Wash Mitigation Area is located downstream of Big Tujunga Reservoir, just upstream of Hansen Flood Control Basin. The site has a conservation easement and is partly owned by the Flood Control District. The conservation easement and use as a mitigation area prohibit certain activities within the property. Figure 8-5 shows an aerial view of Big Tujunga Wash Mitigation Area.

**Figure 8-5 Big Tujunga Wash Mitigation Area**




## 8.1.2 PLANNING QUANTITY AND APPROACH

As described in Section 5, the projected 20-year sediment accumulation at Big Tujunga Reservoir is 5.2 MCY. The Flood Control District is also planning to remove the sediment currently in the reservoir, which amounts to approximately 2 MCY and resulted largely from the Station Fire of 2009. Therefore, a total of approximately 7.2 MCY of sediment are planned for removal during the 20-year planning period.

Approximately two thirds of Big Tujunga Reservoir's total 7.2-MCY planning quantity consists of material with particle sizes that are small enough to be dredged or sluiced. Given this assumption, if dredging or sluicing was to be employed, approximately 4.8 MCY of sediment could potentially be dredged or sluiced while the remaining 2.4 MCY of larger-sized material would need to be excavated.

## 8.1.3 POTENTIAL STAGING AND TEMPORARY SEDIMENT STORAGE AREA

### 8.1.3.1 HANSEN FLOOD CONTROL BASIN

**Hansen Flood Control Basin – Background**

Hansen Flood Control Basin, shown in Figure 8-6, is a facility owned and operated by the Army Corps of Engineers that is located approximately 14 miles downstream of Big Tujunga Dam at the confluence of Big Tujunga Wash and Little Tujunga Wash, along the northeastern edge of the San Fernando Valley. The flood control basin reduces the risk from debris-laden floodwaters along Tujunga Wash between the facility and the Los Angeles River. A secondary use of the flood control basin is recreation. Hansen Dam directs flows from the flood control basin to the concrete-lined Tujunga Wash.

Hansen Flood Control Basin could potentially be suitable as the outlet of a slurry pipeline or the endpoint of a sluicing operation from Big Tujunga Reservoir. Based on discussions with the Army Corps of Engineers regarding the use of some of their other facilities in sediment management operations by the Flood Control District, it is assumed that the Flood Control District would need to preexcavate the expected amount of sediment to be delivered to Hansen Flood Control Basin. Assuming that all the material that could potentially be dredged or sluiced from Big Tujunga Reservoir could be temporarily stored at the flood control basin, that would mean a total of 4.8 MCY of sediment would have to be preexcavated and removed from Hansen Flood Control Basin. The entire 4.8 MCY would not be removed at one time; they would be distributed among the number of dredging or sluicing projects from Big Tujunga Reservoir.

**Figure 8-6 Hansen Flood Control Basin**

**Hansen Flood Control Basin – Environmental Impacts**

Hansen Flood Control Basin includes environmentally sensitive areas. Studies would be needed to identify specifically what is actually located within the flood control basin and how impacts to the existing habitats could be avoided, minimized, or mitigated.

Water quality would be impacted at Hansen Flood Control Basin if it were to serve as the outlet of a slurry pipeline or the endpoint of a sluicing operation.

Air quality impacts are possible as a result of removing sediment within Hansen Flood Control Basin and operations to transport it to another location.

**Hansen Flood Control Basin – Social Impacts**

Traffic and noise would increase near Hansen Flood Control Basin during removal of sediment from the flood control basin in preparation for deliveries of sediment from Big Tujunga Reservoir via a slurry pipeline or sluicing. The hours of operation at Hansen Flood Control Basin could be limited to minimize impacts.

The visual and scenic characteristics of the flood control basin would also be impacted by preexcavation operations and delivery of sediment via slurry pipeline or sluicing. Additionally, the sediment deliveries from Big Tujunga Reservoir could result in odor impacts and the attraction of vectors.

Deliveries of water and sediment to Hansen Flood Control Basin via a slurry pipeline from Big Tujunga Reservoir or via Tujunga Wash after a sluicing operation at the reservoir could impact recreational resources at the flood control basin. Impacts could possibly be minimized by adjusting flow rates or by placing berms to divert them to the least used areas.

**Hansen Flood Control Basin – Implementability**

The Flood Control District would need to coordinate with the Army Corps of Engineers for use of Hansen Flood Control Basin as a temporary sediment storage area. Coordination would involve issues such as preexcavation of material, permission to truck or place a conveyor within the flood control basin in order to remove the sediment, etc. The Flood Control District would also need to obtain environmental regulatory permits.

**Hansen Flood Control Basin – Performance**

Existing habitat within Hansen Flood Control Basin could potentially limit the capacity that could be made available at the flood control basin for sediment storage. This possibility needs to be considered.

Using Hansen Flood Control Basin as the endpoint of dredging and sluicing operations from Big Tujunga Reservoir would reduce the distance sediment would have to travel on other transportation methods. Sediment preexcavated from Hansen Flood Control Basin in preparation for the deliveries of sediment from Big Tujunga Reservoir could be trucked or transported via a conveyor belt to a pit in Sun Valley.

**Hansen Flood Control Basin – Cost**

The cost associated with using Hansen Flood Control Basin as a temporary sediment storage area depends on the amount of sediment to be stored at the flood control basin and the destination of the sediment needing to be preexcavated from the basin. The estimated cost to excavate sediment from a facility like Hansen Flood Control Basin is approximately $3 per cubic yard. Excavating 4.8 MCY of sediment from the flood control basin would cost approximately $14 million. Additionally, it is possible royalties would have to be paid to the Army Corps of Engineers for the sediment excavated and removed from Hansen Flood Control Basin.

### 8.1.4 REMOVAL ALTERNATIVES

The following section discusses the impacts and costs of sediment removal at Big Tujunga Reservoir by means of excavation, dredging, and sluicing. Discussion of the transportation and placement alternatives is presented in Sections 8.1.5 and 8.1.6, respectively. Combined alternatives that address all phases of the sediment management process are presented and discussed in Section 8.1.7.

#### 8.1.4.1 EXCAVATION

Under regular operating conditions, Big Tujunga Reservoir is never completely dry, even outside of the storm season. Therefore, in order to access and excavate sediment from the inundated area the reservoir must be drained. Nonetheless, excavation has been the primary sediment removal method used at Big Tujunga Reservoir since the late 1970s.

**Excavation - Environmental Impacts**

The U.S. Fish and Wildlife Service has designated Big Tujunga Wash (between Big Tujunga Dam and Hansen Flood Control Basin) as critical habitat for the Santa Ana sucker, a federally threatened species. In 2011, several biological surveys of Big Tujunga Reservoir and its vicinity were conducted. Downstream of Big Tujunga Dam, the three special status fish species native to the area – Arroyo chub, Santa Ana speckled dace, and Santa Ana sucker – were observed. The surveys also identified the existence of willow riparian forest downstream of the dam. The surveys revealed no special status fish species within Big Tujunga Reservoir. Habitat within Big Tujunga Reservoir would need to be studied further to identify specific impacts to plant and wildlife species as a result of draining the reservoir and excavating it.

Excavating the reservoir is not expected to have impact on water quality. As discussed in Section 6, dewatering a reservoir in order to excavate it could impact water conservation if the water is released faster than spreading facilities downstream of the reservoir can handle. Emissions during excavation of the reservoir could potentially impact air quality.

**Excavation - Social Impacts**

Due to the remote location of Big Tujunga Reservoir, excavation operations are not expected to impact the viewshed of any residences. However, the viewshed of visitors to the Angeles National Forest travelling in the vicinity of the reservoir would be impacted during completion of the excavation operations.

Since there are no permitted recreational uses within Big Tujunga Reservoir, excavation operations would not conflict with such use. Draining the reservoir in anticipation of excavation activities could potentially impact recreation or the viewshed along Big Tujunga Wash.

**Excavation - Implementability**

There are no right of way concerns related to excavating sediment from Big Tujunga Reservoir since the Flood Control District is authorized to access the dam and reservoir for the maintenance and operation purposes. However, an excavation operation would require environmental regulatory permits. Given the Flood Control District's experience, excavating sediment from Big Tujunga Reservoir under dry conditions is a technically certain method of sediment removal.

**Excavation - Performance**

Prior to excavation, the reservoir must be completely drained, a process that depends on the initial reservoir level, the amount of inflow into the reservoir, valve operations, and downstream channel conditions. Approximately two months would be required to drain the reservoir and begin excavating sediment. For additional performance discussion, refer to Section 6.

**Excavation - Cost**

The cost to excavate sediment from a reservoir is approximately $3 per cubic yard. Excavating 7.2 MCY of sediment would cost approximately $22 million.

#### 8.1.4.2 DREDGING

Approximately two thirds of Big Tujunga Reservoir's 7.2-MCY planning quantity consists of material with particle sizes that are small enough to be dredged or sluiced. Therefore, if dredging were employed at Big Tujunga Reservoir, another removal method would have to be employed to remove the larger-sized material. Excavation is the only feasible method to remove the larger-sized material from the reservoir. For the impacts associated with excavating material from Big Tujunga Reservoir, refer to Section **Error! Reference source not found.**.

**Dredging - Environmental Impacts**

As previously discussed, no special status fish species were observed within Big Tujunga Reservoir during previous biological surveys. However, in order to determine the potential impacts dredging would have on habitat, the specifics of the habitat within the reservoir would need to be determined. Furthermore, existing habitat in the area(s) considered for discharge and dewatering of dredged material would need to be determined.

Dredging could impact water quality within the reservoir by increasing turbidity. However, as discussed in Section 6, water quality concerns could be partially addressed with a silt curtain around the dredge. As discussed in Section 6, dredging sediment (and transporting it via a slurry pipeline) could affect water conservation.

**Dredging - Social Impacts**

Dredging Big Tujunga Reservoir is not expected to have any traffic impacts. Due to the reservoir's remote location, impacts on noise levels and visual resources would not be expected either. In addition, recreation would not be impacted because it is not permitted at Big Tujunga Reservoir.

**Dredging - Implementability**

No additional right of way is anticipated to be required for implementation of a dredging operation within Big Tujunga Reservoir. Concerns associated with dewatering of dredged material outside of the reservoir parcels are discussed in Section 8.1.3.

Similar to other operations within Big Tujunga Reservoir, dredging would require environmental regulatory permits.

As discussed in Section 6, while dredging is a technique that has been used in other areas of the country for decades, is not a technique that has been employed in the reservoirs under the Flood Control District's jurisdiction. Big Tujunga Reservoir's narrowness could be a maneuverability concern.

**Dredging - Performance**

Considering the capabilities of the dredging equipment and slurry pipelines discussed in Section 6, it would take approximately twelve (12) 6-month dredging operations to dredge the 4.8 MCY of sediment that could potentially be dredged from Big Tujunga Reservoir during the 20-year planning period.

Furthermore, as discussed in Section 6, as sediment is dredged water is also drawn by the dredge, which leads to water-sediment mixture with an approximated ratio of 9-to-1 that needs to be dewatered. This means that the Flood Control District would need to dewater approximately 4 MCY or 2,500 acre-feet of the water-sediment mixture for each of the 12 dredging operations. Given the assumed capabilities of the dredging equipment, the water-sediment mixture would flow into the dewatering area at a rate of approximately 15 cubic feet per second (cfs).

**Dredging - Cost**

Based on the estimated unit cost for dredging, dredging 4.8 MCY of sediment would cost approximately $50 million.

#### 8.1.4.3 SLUICING (AS A REMOVAL METHOD)

Approximately two thirds of Big Tujunga Reservoir's 7.2-MCY planning quantity consists of material with particle sizes small enough to be sluiced. Therefore, another removal method would have to be employed to remove the larger-sized material that cannot be sluiced. Excavation is the only feasible method to remove the larger-sized material from the reservoir.

This section focuses on sluicing as a sediment removal method and discusses the impacts of sluicing within Big Tujunga Reservoir only. For the impacts of sluicing downstream of the dam refer to Section 8.1.5 1.

**Sluicing (Removal) - Environmental Impacts**

Within Big Tujunga Reservoir itself, sluicing would be expected to impact the reservoir's habitat in a similar manner as excavating sediment from the reservoir would since in both cases the reservoir would need to be drained. See the discussion under Excavation (Section 8.1.4.1) for more information.

As discussed in Section 6, removing sediment from a reservoir by sluicing could affect water conservation.

Sluicing operations within Big Tujunga Reservoir would result in equipment emissions. However, given the Flood Control District's previous sluicing projects, only a few pieces of equipment would be necessary within the reservoir, so air quality impacts at the reservoir are not expected to be significant.

**Sluicing (Removal) - Social Impacts**

Removal of sediment from Big Tujunga Reservoir through sluicing would impact the view from ridges above the reservoir as the reservoir needs to be drained and there would be equipment within the reservoir. There are no permitted recreational activities in the reservoir, so no impacts on recreation are expected.

**Sluicing (Removal) - Implementability**

Access to Big Tujunga Reservoir and activities within the reservoir do not pose any right of way concerns. Similar to other sediment removal alternatives already discussed, sluicing Big Tujunga Reservoir would require environmental regulatory permits. Given that sluicing projects have been conducted in the past at Big Tujunga Reservoir, it is technically certain that sluicing can be used to remove sediment from the reservoir. However, it is important to note that the ability to sluice will be dependent on inflow into the reservoir, which is entirely dependent on the weather. In addition to inflow, another factor that limits sluicing is the availability of temporary storage areas and the rate at which they can receive the sluiced water-sediment mixture.

**Sluicing (Removal) - Performance**

As previously discussed, it has been assumed that approximately two thirds (4.8 MCY) of the 7.2-MCY planning quantity for Big Tujunga Reservoir could potentially be sluiced. Based on an analysis of the records of the previously sluiced quantities from Big Tujunga Reservoir, it has been assumed that an average 300,000 cubic yards

(CY) of sediment could potentially be sluiced from Big Tujunga Reservoir in a given year. Given this assumption, sluicing would have to be performed approximately 16 of the 20 years in the planning period in order to sluice 4.8 MCY of sediment from the reservoir.

**Sluicing (Removal) - Cost**

Based on the estimated unit cost for sluicing, sluicing 4.8 MCY of sediment would cost approximately $12 million.

## 8.1.5 TRANSPORTATION ALTERNATIVES

The following section discusses the impacts and costs of transporting sediment removed from Big Tujunga Reservoir by means of sluicing, trucking, conveyor belt, and slurry pipeline. Discussion of the removal alternatives was presented in Section 8.1.4. The placement alternatives are presented in Section 8.1.6. Combined alternatives that address all phases of the sediment management process are presented and discussed in Section 8.1.7.

### 8.1.5.1 SLUICING (AS A TRANSPORTATION METHOD)

This section focuses on the impacts of utilizing sluicing as a transport method to move sediment downstream of Big Tujunga Dam along Big Tujunga Wash to Hansen Flood Control Basin. For the impacts of sluicing operations within Big Tujunga Reservoir, refer to the discussion of sluicing as a removal method in the previous section. Impacts at Hansen Flood Control Basin were discussed in Section 8.1.3.1.

**Sluicing (Transport) - Environmental Impacts**

Vegetation and wildlife surveys immediately downstream of Big Tujunga Dam have indicated the presence of three special status fish species native to the area – Arroyo chub, Santa Ana speckled dace, and Santa Ana sucker. The surveys also identified the existence of willow riparian forest downstream of the dam. Sluicing activities could be temporarily disruptive to the existing habitat. Farther downstream in Big Tujunga Wash Mitigation Area, sensitive species have been found in the prospective sluiceway during wet years. Sluice flows could impact the fish unless they are relocated prior to sluicing.

Water quality along Big Tujunga Wash would be impacted by sluicing. The increase concentration of sediment in the water would result in higher turbidity than normal. As discussed in Section 6, transporting sediment via sluicing could affect water conservation.

**Sluicing (Transport) - Social Impacts**

Sluicing sediment along Big Tujunga Wash is not expected to have impacts on traffic or noise levels. Visual impacts will consist of flows in Big Tujunga Wash with higher levels of sediment than normal. Recreation along Big Tujunga Wash and within Big Tujunga Wash Mitigation Area could be temporarily impacted by sluicing operations.

**Sluicing (Transport) - Implementability**

While sluicing sediment along Big Tujunga Wash would not require right of way agreements, possibly accessing the wash with equipment to manage the deposition of sediment along the wash would need them. Due to the conservation easement on Big Tujunga Wash Mitigation Area, equipment would not be able to access the portion of the wash that passes through the mitigation area.

The Flood Control District would need to obtain environmental regulatory permits in order to sluice sediment along Big Tujunga Wash.

**Sluicing (Transport) - Performance**

It was assumed that sluice flows would have an approximate 9-to-1 water-to-sediment ratio. Therefore, sluicing 300,000 CY of sediment from Big Tujunga Reservoir would mean that 3,000,000 CY or approximately 1,900 AF of the water-sediment mixture would be sent down Big Tujunga Wash. The ability of the stream course to handle said volumes will need to be considered. In addition, sediment deposition locations and the possibility of flushing the stream course to remove the deposits will need to be analyzed if sluicing is to be employed. If sediment deposits within the Big Tujunga Wash Mitigation Area were unable to be removed by flushing, the deposits could lead to flooding of the mitigation area.

**Sluicing (Transport) - Cost**

The cost of transporting sediment via sluicing is minimal.

### 8.1.5.2 TRUCKING

Trucking could be employed to transport sediment from Big Tujunga Reservoir, a staging area, and/or a temporary sediment storage area. This section focuses on the impacts associated with trucking sediment along the general routes shown in Figure 8-7 and the potential temporary route shown in Figure 8-8.

**Figure 8-7 Potential truck routes for Big Tujunga Reservoir's sediment**

**Figure 8-8 Potential truck route around Sunland**

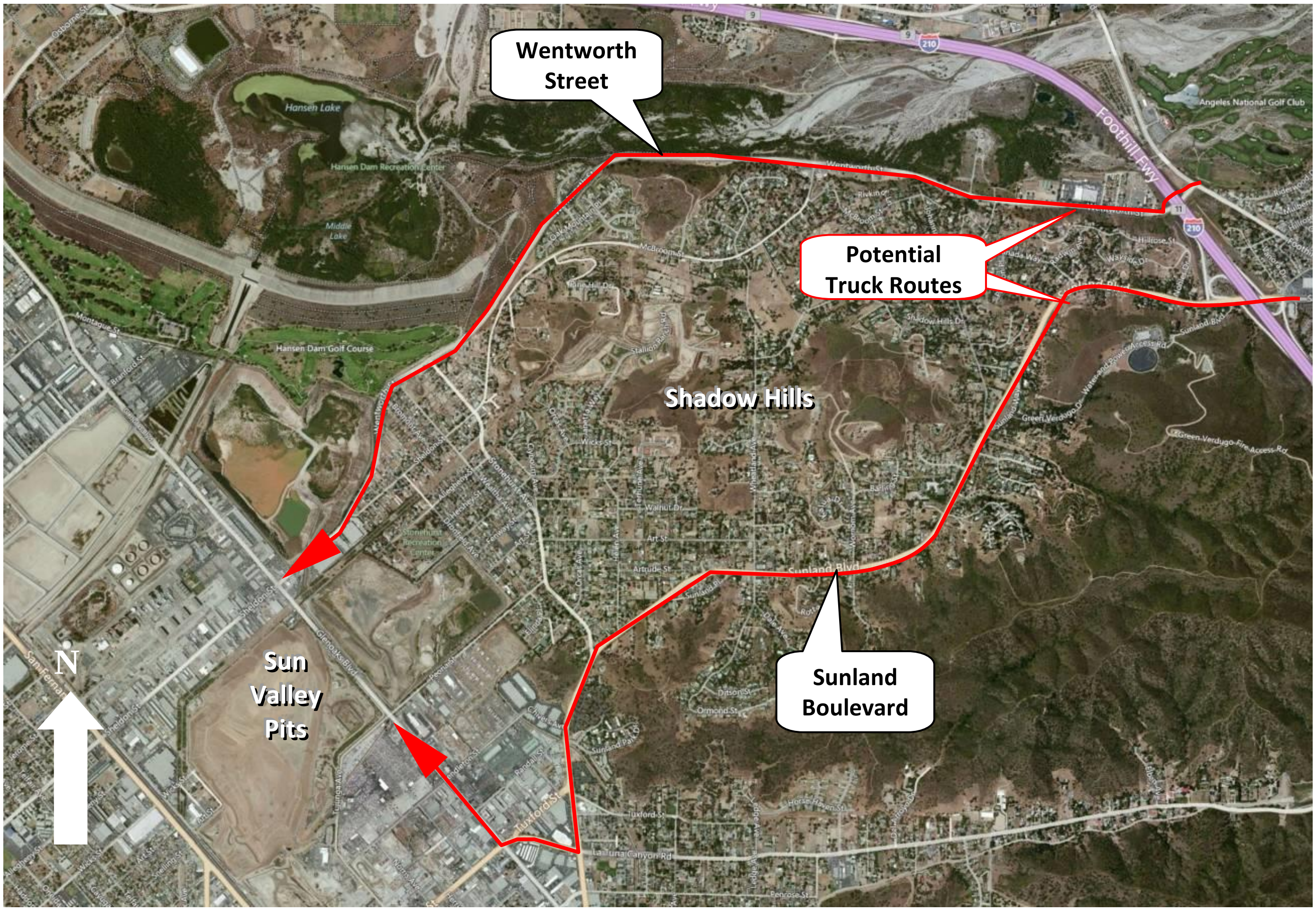

**Trucking - Environmental Impacts**

If existing roads were to be used to truck sediment along the general routes shown in Figure 8-7, no particular impacts would be expected on habitat or water quality. However, if the potential route shown in Figure 8-8 were used, there would be habitat impacts and potentially water quality impacts associated with the construction of the new roadway. The use of low emission trucks would reduce air quality impacts.

**Trucking - Social Impacts**

Employing trucks could significantly impact traffic, especially along the two-lane Big Tujunga Canyon Road. In turn, this could impact access to recreational resources along Big Tujunga Canyon Road as well as along other roads in the truck routes. Residents along Big Tujunga Canyon Road would be impacted by the increase in traffic. Additionally, it is possible that trucks traveling to the pits in Sun Valley would not be able to avoid travelling adjacent to the Shadow Hills' neighborhoods along Wentworth Street or Sunland Boulevard as shown in Figure 8-9. In order for trucks traveling to and from Big Tujunga Reservoir to avoid passing through residential neighborhoods along Oro Vista Avenue (or Mount Gleason Avenue) and Foothill Boulevard in Sunland, trucking along the potential temporary trucking route previously shown in Figure 8-8 would need to be explored.

**Figure 8-9 Potential truck route along Shadow Hills**




**Trucking - Implementability**

Available access at Big Tujunga Reservoir and the routes discussed in this section would allow the use of double dump trucks.

If truck routes were able to remain entirely on existing public roads, no right of way or permitting concerns would be expected.

Based on records from the County of Los Angeles Assessor's Office (Parcel Map 2548 Sheet 2 dated 2009 and Parcel Map 2551 Sheet 9 dated 2008), there are two unconnected road easements that appear to have been meant for the extension of Big Tujunga Canyon Road from Oro Vista Avenue to Foothill Boulevard. However, one of the easements is partially occupied by golf course improvements. Trucking along the potential temporary truck route shown in Figure 8-8 would require right of way agreements with the property owners of the parcels traversed by the route and removal of the golf course improvements within the road easement.

**Trucking - Performance**

The following assumptions were made while considering trucking as an alternative to transporting all or part of Big Tujunga Reservoir's 7.2-MCY planning quantity.

- Double dump trucks with a capacity of approximately 16 CY per truck would be used.

- Between Big Tujunga Reservoir and the pits in Sun Valley, trucks would travel at an average speed of 30 miles per hour. However, for trips between Big Tujunga Reservoir and Maple SPS and between Hansen Flood Control Basin and the pits in Sun Valley, trucks would travel at an average speed of 15 miles per hour.

Using these assumptions, estimates on the number of truck operations were determined, as shown in Table 8-2 (under the following cost section).

**Trucking - Cost**

The estimated cost to construct the temporary access road shown in Figure 8-8 is approximately $150,000 each time it is constructed. There could also be mitigation costs. These costs would need to be added, as appropriate, to the cost subsequently shown.

Trucking unit costs on double dump trucks were estimated to be $0.30 per CY per mile based on a loading time of 1 minute per truck. The cost of trucking will vary depending on the quantity to be trucked, the origin and destination, and the type of truck that can be used. The estimated trucking costs for the various scenarios range from $12 million to $73 million, as shown in Table 8-2.

**Table 8-2 Estimated trucking performance and costs for Big Tujunga Reservoir**

| Origin | Destination(s) | Roundtrip Distance (miles) | Quantity of Sediment (MCY) | Number of Separate Truck Operations Required | Estimated Cost (in millions) |
|---|---|---|---|---|---|
| Big Tujunga Reservoir | Pits in Sun Valley | 34 | 7.2 | 9 | $73 |
| | | | 2.8(a) | 4 | $29 |
| Big Tujunga Reservoir | Maple Canyon SPS | 4.5 | 4.4(b) | 6 | $6 |
| Hansen Flood Control Basin | Pits in Sun Valley | 8 | 4.8(c) | 6 | $12 |

Notes:

a. Difference between the planning quantity (7.2 MCY) and the expected remaining capacity at Maple SPS (4.4 MCY).

b. Estimated remaining capacity at Maple SPS.

c. Portion of the 7.2-MCY planning quantity that is estimated to be able to be dredge or sluiced

### 8.1.5.3 Conveyor Belts

This section discusses the impacts of utilizing a conveyor belt to transport sediment from Big Tujunga Reservoir to Maple SPS, from Big Tujunga Reservoir to the pits in Sun Valley, and from Hansen Flood Control Basin to the pits in Sun Valley. Sediment to be transported on a conveyor belt would have to be excavated from its location.

Figure 8-10 to Figure 8-12 show the general alignments of the conveyor routes. As Figure 8-10 shows, a conveyor from Big Tujunga Reservoir to Maple SPS could potentially be placed along the access road that passes by south abutment of the dam. Figure 8-11 shows a conveyor route that starts at the reservoir and travels along Big Tujunga Canyon Road, through Big Tujunga Wash Mitigation Area, and along Wentworth Street. This should not be taken to indicate feasibility of the alignment; potential conveyor alignments will need to be analyzed in the future if conveyors are to be employed. Figure 8-12 shows there is an existing private conveyor system that crosses Tujunga Wash just downstream of Hansen Flood Control Basin and connects the pits with each other. The possibility of developing an agreement with Vulcan Materials Company (Vulcan), which owns the conveyor belt and the pits in Sun Valley, should be explored.

**Figure 8-10 Potential conveyor alignment between Tujunga Reservoir to Maple SPS**

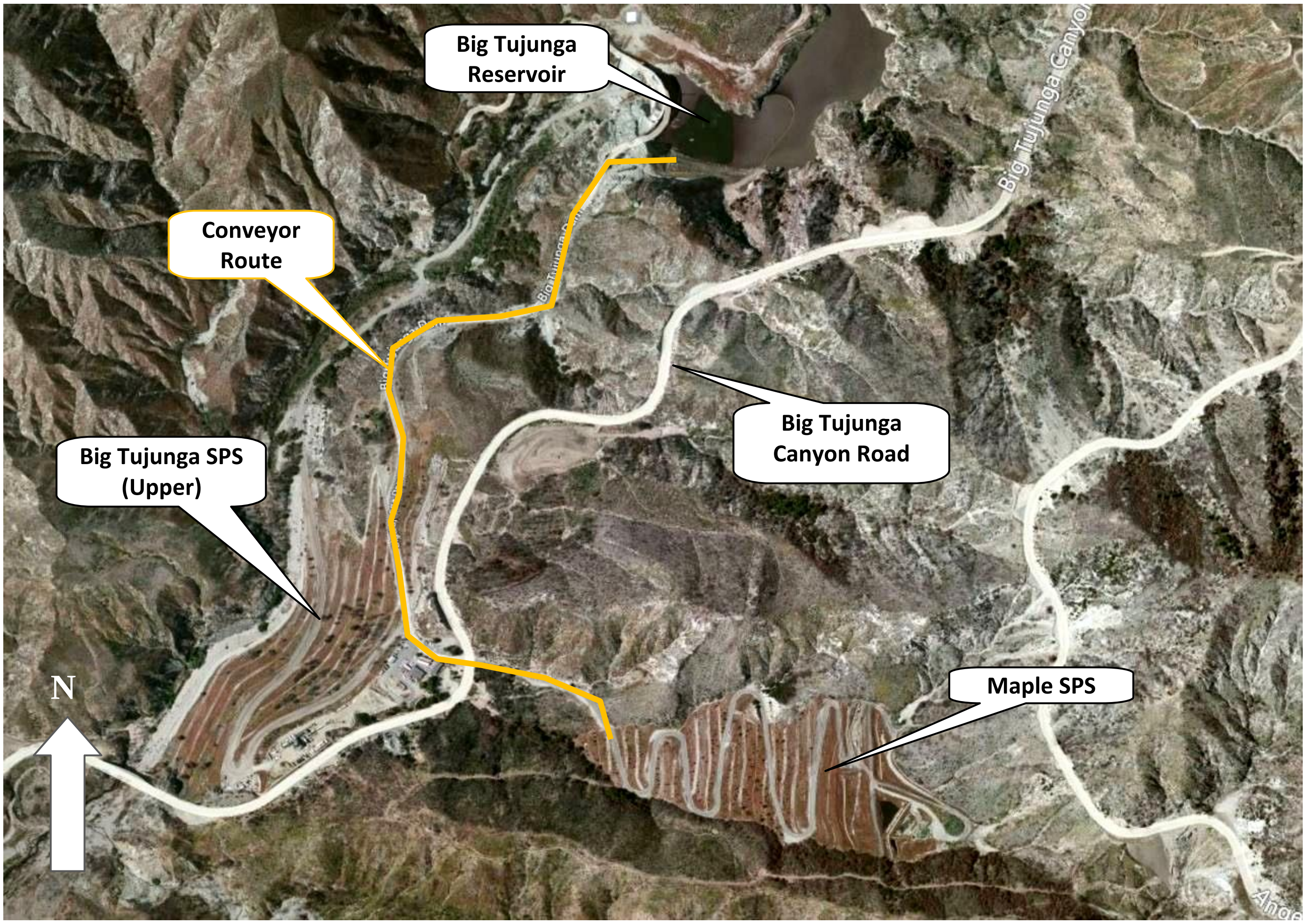



**Figure 8-11 Potential conveyor alignment between Big Tujunga Reservoir and pits in Sun Valley**

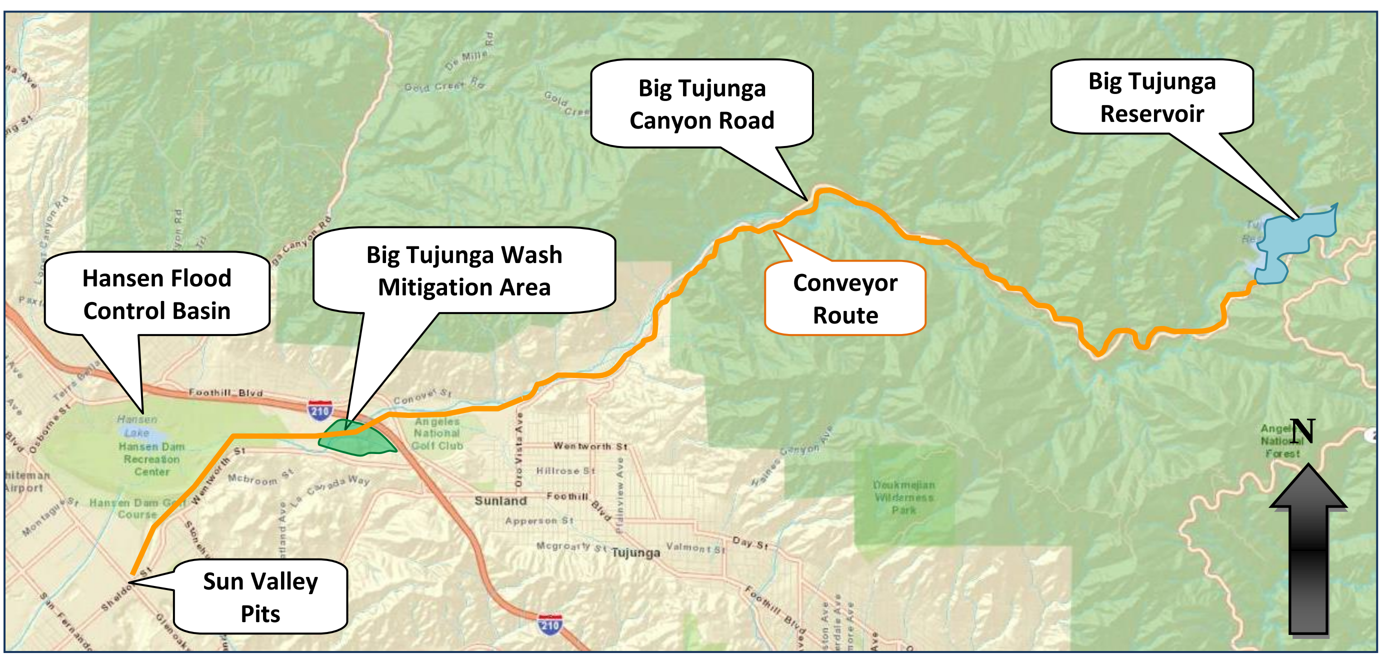


**Figure 8-12 Potential conveyor alignment between Hansen Flood Control Basin and pits in Sun Valley**


**Conveyor Belts - Environmental Impacts**

In order to identify and minimize the potential impacts of a conveyor operation, the habitat along the potential conveyor alignment would have to be studied. If the conveyor were able to be placed along existing roads, impact on habitat would be expected to be minimal. Water quality would not be expected to be impacted.

**Conveyor Belts - Social Impacts**

There would be some visual disturbances during the life of a conveyor operation. A conveyor from Big Tujunga Reservoir to Maple SPS would not impact recreation as neither site is open to the public for recreational use. On the other hand, placing a conveyor along Big Tujunga Canyon Road from Big Tujunga Reservoir to the pits in Sun Valley, adjacent to Big Tujunga Wash Mitigation area, or within Hansen Flood Control Basin and over Hansen Dam could impact recreation resources or access to them.

**Conveyor Belts - Implementability**

Right of way and permitting issues associated with placement of a conveyor system within Maple SPS would be addressed as part of the U.S Forest Special Use Permit required use of Maple SPS. Placement of a conveyor belt across and along Big Tujunga Canyon road would need to ensure roadway safety issues are taken into account. As a result of the conservation easement on Big Tujunga Wash Mitigation Area, a conveyor would not be able to be placed through the mitigation area. Therefore, a feasible conveyor alignment between the end of Big Tujunga Canyon Road (at Oro Vista Avenue) and the pits in Sun Valley would need to be determined. Agreement by the

Army Corps of Engineers would be required for placement of a conveyor system within Hansen Flood Control Basin and over Hansen Dam. Use of the existing conveyor system connecting the pits in Sun Valley would need to be arranged with Vulcan.

**Conveyor Belts - Performance**

For conveyor operations beginning in Big Tujunga Reservoir, it was assumed that operations would last approximately six months during a given year since that is the approximate number of months that sediment can be excavated out of the reservoir. Conveyor operations from Hansen Flood Control Basin could be conducted for a longer period, possibly up to nine months per year. Using these assumptions, estimates on the number of conveyor operations were determined, as shown in Table 8-3 (under the following cost section).

**Conveyor Belts - Cost**

Based on the unit cost for a new conveyor and use of an existing conveyor belt, the following estimates were determined.

**Table 8-3 Estimated performance and costs for conveyors for Big Tujunga Reservoir**

<table>
<tr><th>Origin</th><th>Destination(s)</th><th>Conveyor Length (miles)</th><th>Quantity of Sediment (MCY)</th><th>Number of Conveyor Operations Required</th><th>Estimated Cost (in millions)</th></tr>
<tr><td rowspan="2">Big Tujunga Reservoir</td><td rowspan="2">Maple Canyon SPS</td><td rowspan="2">1.3</td><td>4.4(a)</td><td>6</td><td rowspan="2">$8</td></tr>
<tr><td>2.4</td><td>3</td></tr>
<tr><td rowspan="2">Big Tujunga Reservoir</td><td rowspan="2">Pits in Sun Valley</td><td rowspan="2">15</td><td>7.2</td><td>9</td><td rowspan="2">$86</td></tr>
<tr><td>2.8(b)</td><td>4</td></tr>
<tr><td>Hansen Flood Control Basin</td><td>Existing conveyor downstream of Hansen Dam</td><td>1.6</td><td>4.8(c)</td><td rowspan="2">4</td><td>$7</td></tr>
<tr><td>Existing conveyor “pick up” point</td><td>Pits in Sun Valley</td><td>1.5</td><td>4.8(c)</td><td>$1</td></tr>
</table>

Notes:

a. Estimated remaining capacity at Maple SPS.
b. Difference between the planning quantity (7.2 MCY) and the expected remaining capacity at Maple SPS (4.4 MCY).
c. Portion of the 7.2-MCY planning quantity that is estimated to be able to be dredged or sluiced

### 8.1.5.4 Slurry Pipeline

As discussed in Section 6, slurry pipelines would be used in conjunction with dredging. This section discusses the impacts of constructing a slurry pipeline to transport to Hansen Flood Control Basin the 4.8 MCY of smaller-sized material that could potentially be dredged at Big Tujunga Reservoir.

If a dredging and slurry pipeline alternative was to be employed at Big Tujunga Reservoir, a feasible slurry pipeline alignment would have to be determined. For planning purposes, the alignment shown in Figure 8-13 was assumed to be feasible. The subsequent discussion is based on this assumption.

**Figure 8-13 Big Tujunga Reservoir slurry pipeline alignment used for planning purposes**


**Slurry Pipeline - Environmental Impacts**

In order to identify and minimize the potential environmental impacts of placing and operating a slurry pipeline from Big Tujunga Reservoir to Hansen Flood Control Basin, the habitat along the potential alignments would have to be studied. No impacts are expected on water quality and air quality.

**Slurry Pipeline - Social Impacts**

If placed above ground, construction of the slurry pipeline would cause some visual disturbances. Access to recreational resources, such as Big Tujunga Wash Mitigation Area, could be impacted along the conveyor alignment.

**Slurry Pipeline - Implementability**

Placement of a slurry pipeline would present both right of way and permitting issues. If the slurry pipeline was to be placed along Big Tujunga Canyon Road, roadway impacts would need to be considered while determining the best alignment.

**Slurry Pipeline - Performance**

A slurry pipeline would be permanently installed and used at the frequency at which material would be dredged. Based on the assumptions that a dredge could remove approximately 200 CY of sediment per hour and a water-to-sediment ratio of 9-to-1, the slurry pipeline would need to be able to transport approximately 2,0000 CY of the water-sediment slurry per hour (or approximately 15 cubic feet of the slurry per second). The slurry pipelines discussed in Section 6 are able to handle flow of this magnitude.

The approximately 14-mile slurry pipeline from Big Tujunga Dam to Hansen Flood Control Basin may require 14 booster pumps.

**Slurry Pipeline - Cost**

Based on the estimated unit cost for a slurry pipeline presented in Section 6, the estimated cost of constructing a slurry pipeline of approximately 14 miles from Big Tujunga Dam to Hansen Flood Control Basin is approximately $3 million. Given an installation and operation cost of $1 per CY of sediment per booster pump, the cost of installing and operating 14 booster pumps to transport 4.8 MCY of sediment was estimated to be $101 million.

## 8.1.6 PLACEMENT ALTERNATIVES

This section discusses the potential placement alternatives for sediment removed from Big Tujunga Reservoir. Specifically, this section discusses the placement of sediment at pits and the existing Maple Sediment Placement Site. Discussion of the removal and transportation was presented in Sections 8.1.4 and 8.1.5, respectively. Combined alternatives that address all phases of the sediment management process are presented and discussed in Section 8.1.7.

### 8.1.6.1 PITS

The general impacts of employing pits for sediment placement were discussed in Section 6. There are multiple pits in Sun Valley. Figure 8-14 shows the location of the pits in relation to the Big Tujunga Reservoir and Hansen Flood Control Basin. From Big Tujunga Reservoir to the pits, the distance is approximately 15 to 17 miles, depending on the route, which can vary according to the mode of transportation used. From Hansen Flood Control Basin, the distance is approximately 3 to 4 miles.

**Figure 8-14 Location of Sun Valley Pits**


It was assumed that one third of Big Tujunga's 7.2-MCY planning quantity, or 2.4 MCY, would be marketable. Given that assumption and other assumptions discussed in Section 6, it was assumed that pits operated by the gravel industry would accept a total of 4.8 MCY of sediment from Big Tujunga Reservoir free of charge. Depending on the type of truck used to deliver sediment to the third-party owned pits, tipping fees of $10 to $15 per cubic yard would have to be paid for the remaining 2.4 MCY of sediment.

As discussed in Section 6, the acquisition of pits for the placement of sediment from facilities under the jurisdiction of the Flood Control District should be pursued. Acquisition of a quarry in Sun Valley would be most desirable for sediment management operations related to Big Tujunga Reservoir. It would cost a total of $3 per cubic yard to acquire and place the 2.4 MCY of sediment at the Flood Control District-owned pit.

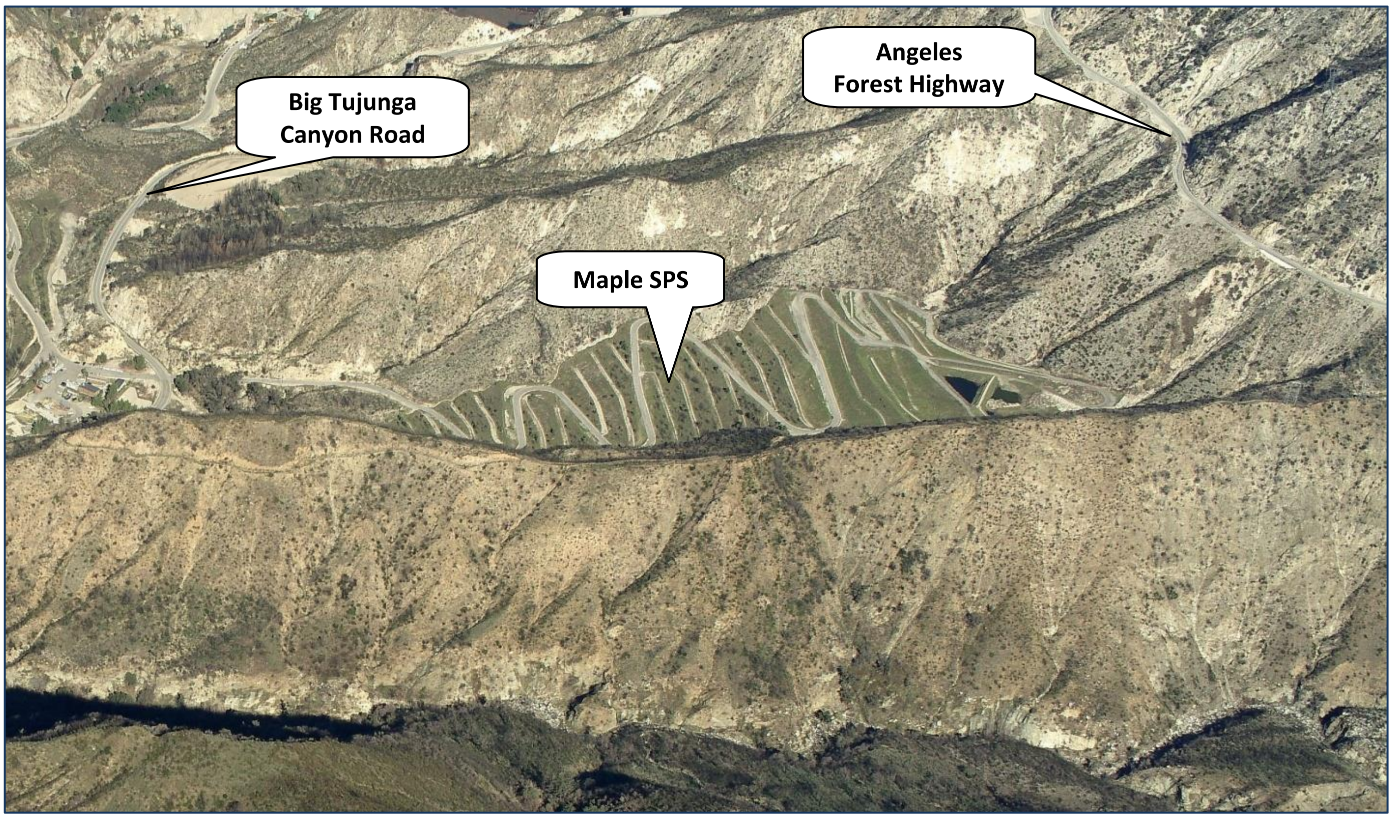
### 8.1.6.2 Maple Sediment Placement Site

This section discusses the impacts associated with employing the remaining capacity at Maple SPS for the permanent placement of sediment from Big Tujunga Reservoir. This placement alternative could potentially be used for sediment excavated from the reservoir and transported either by trucks or by a conveyor system to the SPS.

**Maple SPS – Background**

Maple SPS, shown in Figure 8-15, is located just south of Big Tujunga Dam and Reservoir, across Big Tujunga Canyon Road. The SPS is located on Federal land and has been used previously for the placement of sediment from Big Tujunga Reservoir under a Special Use Permit from the Forest Service. As previously mentioned, as of 2012 the site has an estimated remaining capacity for approximately 4.4 MCY of sediment.

**Figure 8-15 Maple Sediment Placement Site**




**Maple SPS – Environmental Impacts**

Maple SPS was burned during the Station Fire of 2009. During biological surveys conducted after the fire, the vegetation observed to be present within the SPS included chaparral, California annual grassland, and California sycamore woodland. There is also a coast live oak stand along the access road to the SPS. The stand is not expected to be impacted by the operations. On the other hand, the rest of habitat would be impacted by placement of sediment at the SPS. Subsequent to filling the SPS, the site would be revegetated with native species.

Water quality and quantity would not be impacted by temporary storage of sediment Maple SPS. Air quality would be affected by emissions of equipment used at the site.

**Maple SPS – Social Impacts**

During placement of sediment in Maple SPS, there could be localized traffic impacts on Big Tujunga Canyon Road if trucks were used to transport sediment from the reservoir to the SPS. Impacts on recreation, if any, would be in the form of travel delays. Placing sediment at the SPS would alter the scenic characteristics of the area. Due to the remote location of the SPS, any noise associated with placing sediment at Maple SPS is not considered to have significant impact.

**Maple SPS – Implementability**

In order to be able to use Maple SPS, the Flood Control District would need to obtain a Special Use Permit from the U.S. Forest Service. As of June 2012, the Flood Control District is seeking to renew its previous Special Use Permit for the site.

**Maple SPS – Performance**

Maple SPS' capacity is sufficient to address approximately 60 percent of Big Tujunga Reservoir's 7.2-MCY planning quantity.

**Maple SPS - Cost**

Given the assumed costs to place sediment at an SPS, the cost to place 4.4 MCY of sediment at Maple SPS was estimated to be $9 million. The cost to place only the 2.8 MCY of sediment that would not be able to be dredged or sluiced was estimated to be $5 million.

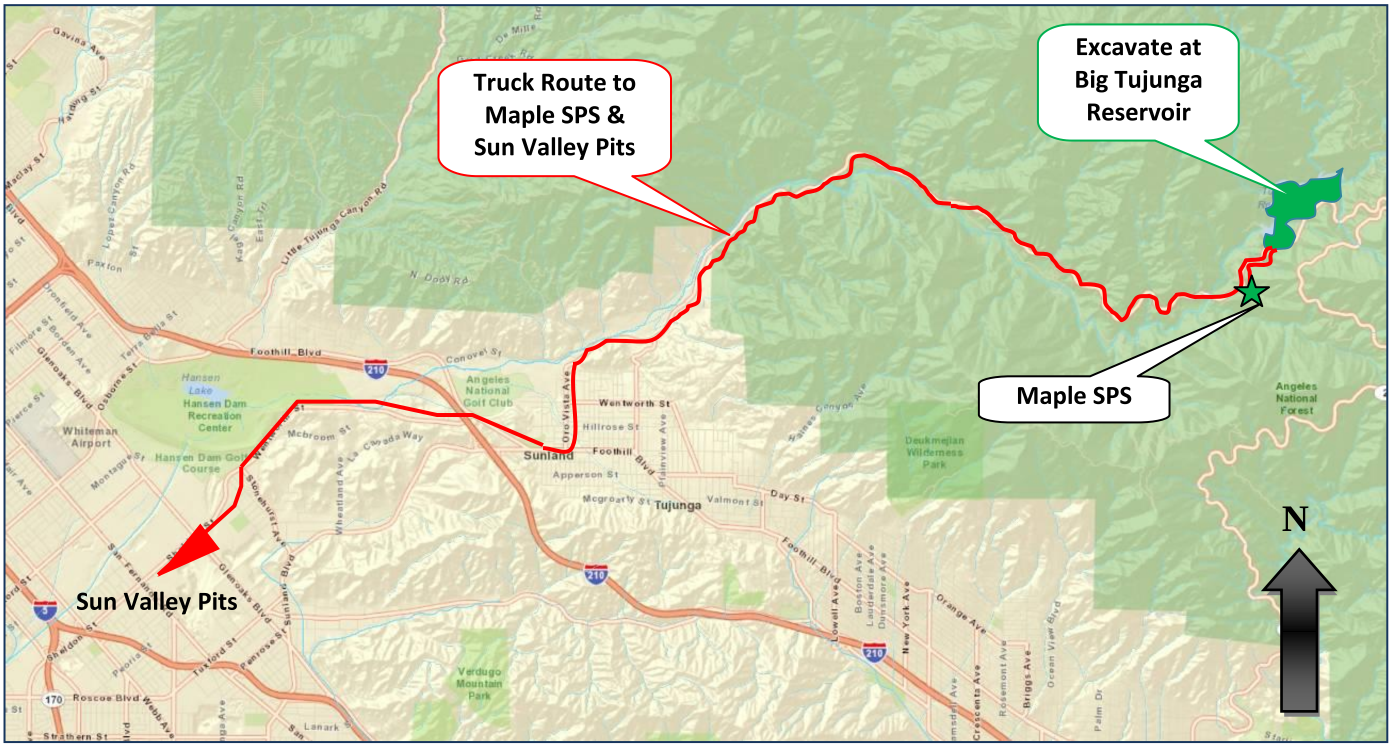
## 8.1.7 COMBINED SEDIMENT MANAGEMENT ALTERNATIVES

The following presents six sets of combined sediment management alternatives for Big Tujunga Reservoir. A description of each of these and the combined impacts and costs are subsequently provided. For specific details regarding environmental impacts, social impacts, feasibility, implementability, and cost for the individual removal, transportation, and placement components refer to Sections 8.1.3 to 8.1.6. Please note that combined alternatives that include dredging and sluicing assume two thirds of Big Tujunga Reservoir's 7.2-MCY planning quantity, or 4.8 MCY, could potentially be dredged or sluiced and that the remainder would have to be excavated and transported out of the reservoir by another means.

### 8.1.7.1 COMBINED ALTERNATIVE 1A: EXCAVATE (7.2 MCY) → TRUCKS → MAPLE SPS (4.4 MCY, CAPACITY EXHAUSTED) & SUN VALLEY PITS (2.8 MCY)

This alternative involves draining the reservoir, excavating the sediment under dry conditions, and trucking it to Maple SPS and the pits in Sun Valley. Due to the need to fully drain the reservoir, this alternative would be implementable approximately six months during a given year. Exhausting Maple SPS' capacity would mean 4.4 MCY of sediment would be permanently placed at the SPS while the rest would be placed at the pits in Sun Valley. Figure 8-16 illustrates this alternative.

**Figure 8-16 Big Tujunga Reservoir Combined Alternative 1A**




This alternative requires that the Flood Control District obtain the Forest Service Special Use Permit required to place sediment at Maple SPS.

Air quality would be impacted by the use of excavation equipment and trucks. Habitat would be impacted by the permanent placement of sediment in Maple SPS.

In order to remove Big Tujunga Reservoir's entire 7.2-MCY planning quantity during the 20-year planning period, sediment removal operations involving excavation in conjunction with trucking would need to occur approximately 8 times. This equates to a cleanout approximately every two to three years.

Trucks travelling between Big Tujunga Reservoir and Maples SPS would only have localized impacts on traffic. For the most part, trucks directly transporting sediment from Big Tujunga Reservoir to a site in Sun Valley would travel along nonresidential roads. However, the route would pass along Sunland and Shadow Hills, as previously shown on Figure 8-7 and Figure 8-9. If the trucking route previously shown in Figure 8-8 could be arranged, trucking through Sunland would be avoided.

Implementation of this alternative could cost an estimated $65 million. The breakdown of the estimated costs is provided in Table 8-4.

**Table 8-4 Estimated costs for Big Tujunga Reservoir's Combined Alternative 1A**

| Activity | Quantity (MCY) | Estimated Cost (in millions) |
|---|---|---|
| Excavate sediment from Big Tujunga Reservoir | 7.2 | $22 |
| Truck to Maple SPS | 4.4 | $6 |
| Place at Maple SPS | | $9 |
| Truck sediment that does not fit in Maple SPS to pits in Sun Valley | 2.8 | $29 |
| Place at pits in Sun Valley | | $0[(a)] |
| **Total** | **7.2** | **$65** |

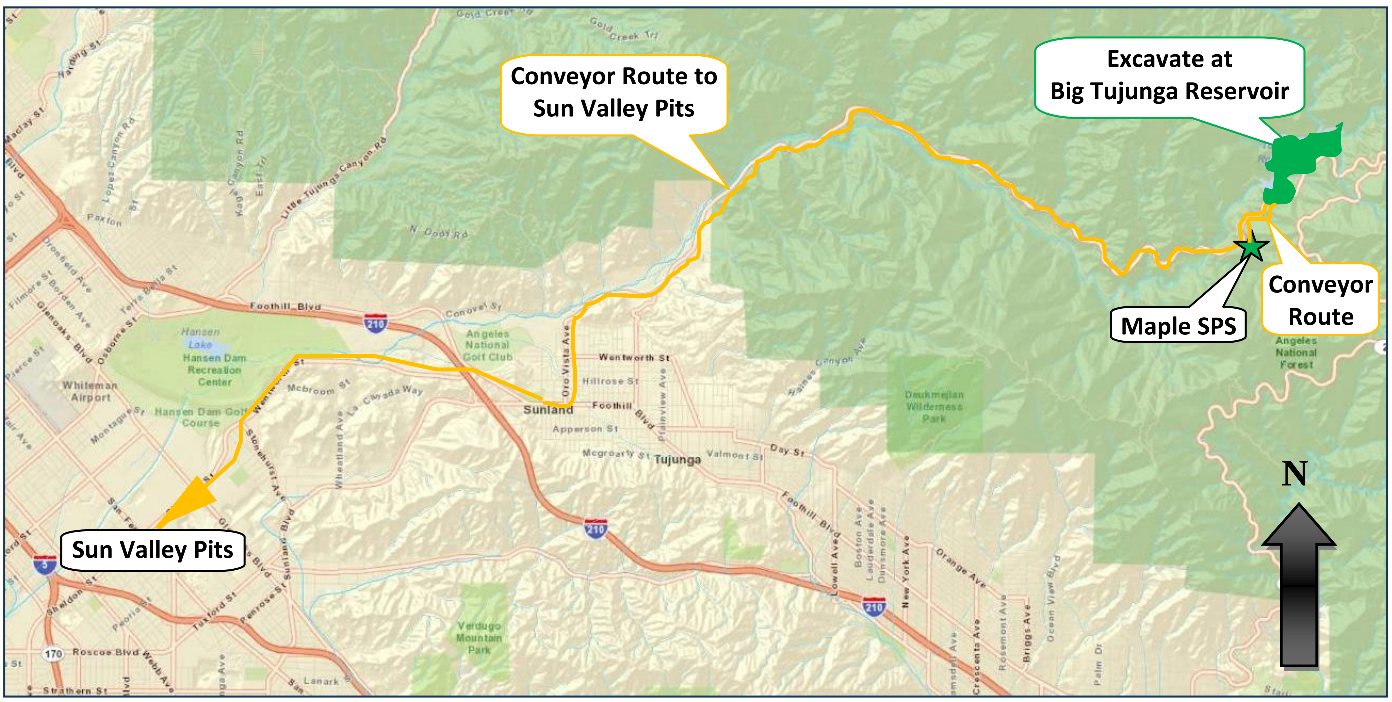
Note:

a. This assumes that most of the 2.8 MCY of sediment taken to third-party pits is marketable and that no tipping fees would have to be paid for the small fraction that would not be marketable.

#### 8.1.7.2 COMBINED ALTERNATIVE 1B: EXCAVATE (7.2 MCY) → CONVEYOR → MAPLE SPS (4.4 MCY) & SUN VALLEY PITS (2.8 MCY)

This alternative is basically the same as Combined Alternative 1A, except that conveyors would be used instead of trucks. Figure 8-17 shows a representation of this alternative.

**Figure 8-17 Big Tujunga Reservoir Combined Alternative 1B**




Using conveyor belts would result in different air quality impacts and traffic impacts than using trucks. Placement of a conveyor belt along Big Tujunga Canyon Road from Big Tujunga Reservoir to the pits in Sun Valley would require working out an alignment that considers roadway impacts.

In order to remove Big Tujunga Reservoir's entire 7.2 MCY planning quantity during the 20-year planning period, sediment removal operations involving excavation in conjunction with the use of conveyor would need to occur approximately 9 times.

Implementation of this alternative could cost an estimated $125 million. The breakdown of the estimated costs is provided in Table 8-5.

**Table 8-5 Estimated costs for Big Tujunga Reservoir's Combined Alternative 1B**

| Activity | Quantity (MCY) | Estimated Cost (in millions) |
|---|---|---|
| Excavate sediment from Big Tujunga Reservoir | 7.2 | $22 |
| Convey to Maple SPS | 4.4 | $8 |
| Place at Maple SPS | | $9 |
| Convey sediment that does not fit in Maple SPS to the pits in Sun Valley | 2.8 | 86 |
| Place sediment at ___ | | $0[(a)] |
| **Total** | **7.2** | **$125** |

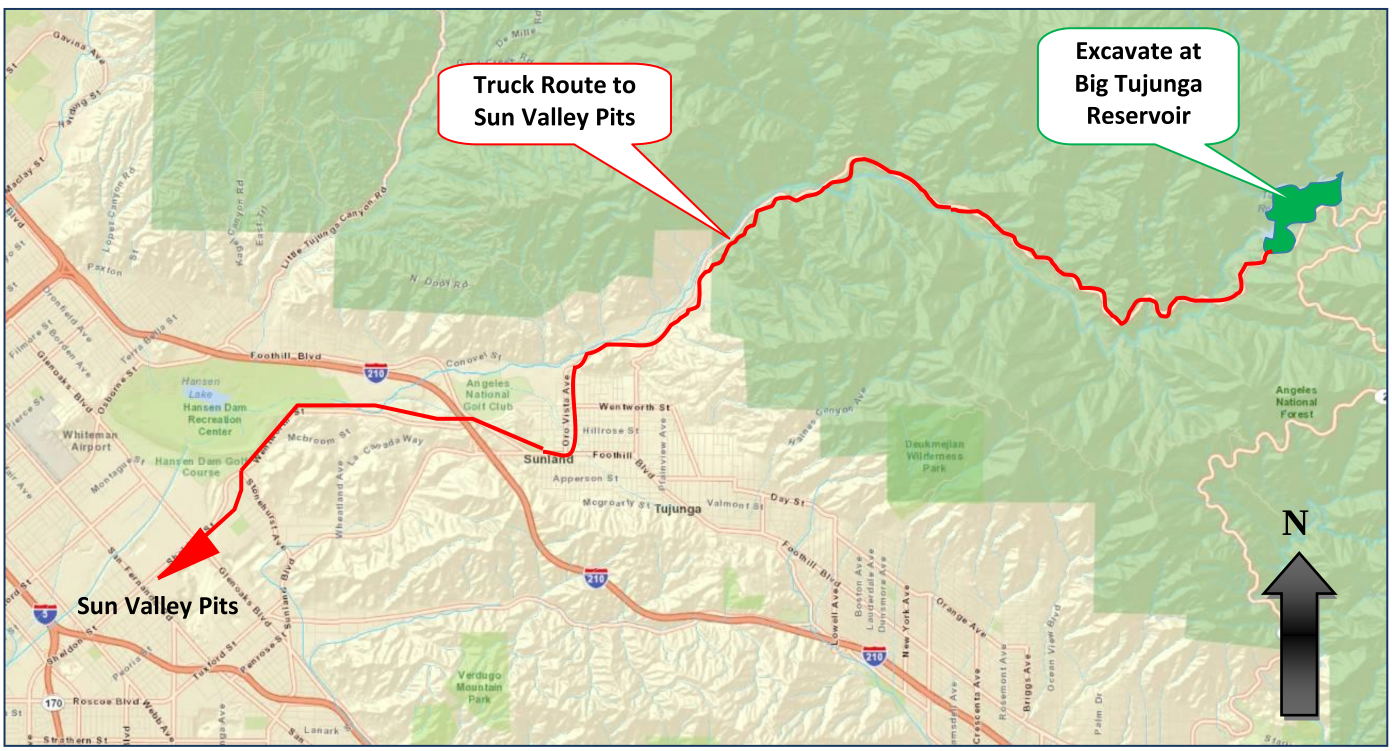
Note:

a. This assumes that most of the 2.8 MCY of sediment taken to third-party pits is marketable and that no tipping fees would have to be paid for the small fraction that would not be marketable.

#### 8.1.7.3 COMBINED ALTERNATIVE 2A: EXCAVATE → TRUCKS → SUN VALLEY PITS

This alternative consists of transporting all sediment excavated from Big Tujunga Reservoir by truck and placing it at the pits in Sun Valley. Figure 8-18 shows a representation of this alternative.

**Figure 8-18 Big Tujunga Reservoir Combined Alternative 2A**



As discussed under Alternative 1A, for the most part, trucks directly transporting sediment from Big Tujunga Reservoir to a site in Sun Valley would travel along nonresidential roads. However, the route would pass along Sunland and Shadow Hills, as previously shown on Figure 8-7 and Figure 8-9. If the trucking route previously shown in Figure 8-8 could be arranged, trucking through Sunland would be avoided.

Employing Combined Alternative 2A to manage Big Tujunga Reservoir's 7.2-MCY planning quantity could require approximately 9 separate excavation and trucking operations, each which would last approximately 6 months and would consist of approximately 400 truck trips per weekday.

The estimated costs associated with this alternative total $100 million to $120 million, as shown in Table 8-6.

**Table 8-6 Estimated costs for Big Tujunga Reservoir's Combined Alternative 2A**

| Activity | Quantity (MCY) | Estimated Cost (in millions) |
|---|---|---|
| Excavate sediment from Big Tujunga Reservoir | 7.2 | $22 |
| Truck to pits in Sun Valley | | $73 |
| Place sediment at pit in Sun Valley | | $7-24[a] |
| **Total** | **7.2** | **$100-120** |

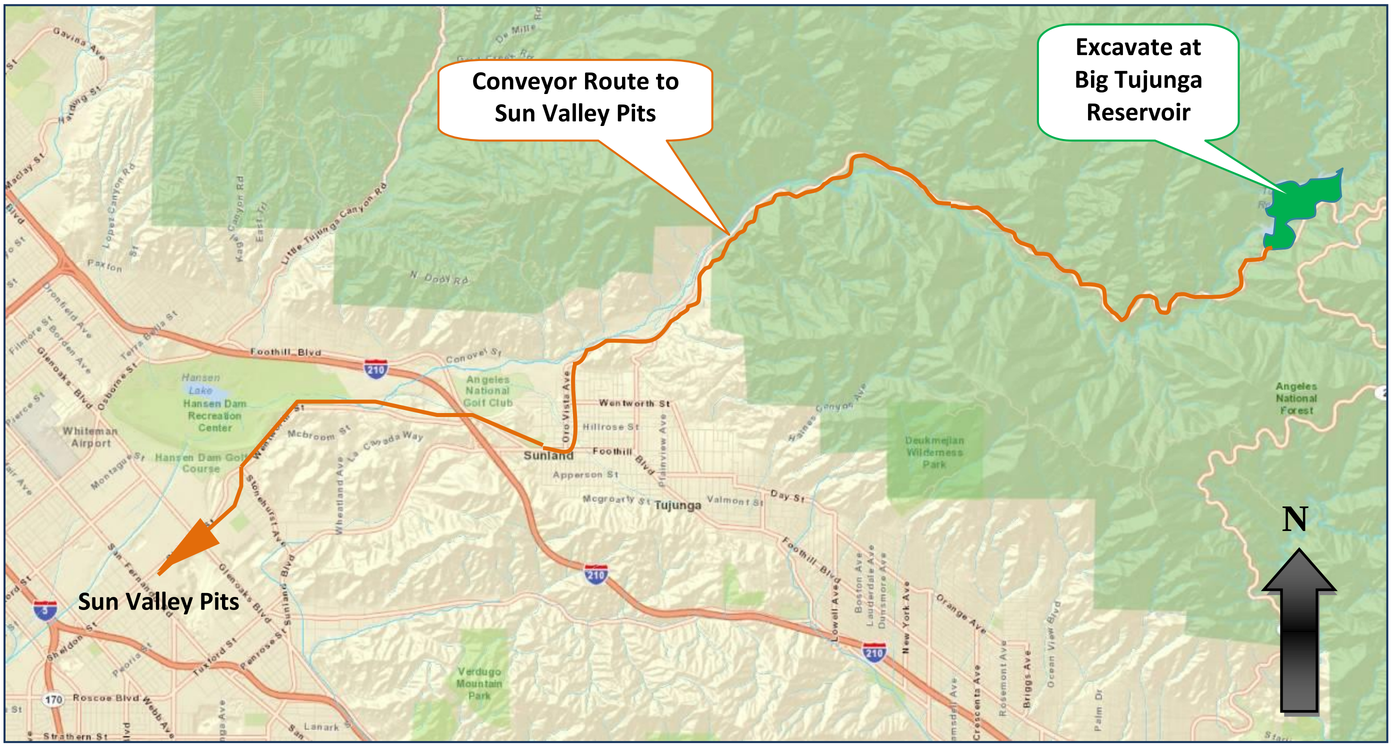
Note:

a. This assumes 33.3 percent of the sediment is marketable and would be accepted free of charge, that another 33.3 percent would also be accepted free of charge. The lower cost assumes the remainder of the material would be placed at a pit acquired by the Flood Control District. The higher cost pertains to the scenario in which the Flood Control District was not able to acquire a pit and had to pay tipping fees would have to be paid on the remainder 33.4 percent.

### 8.1.7.4 COMBINED ALTERNATIVE 2B: EXCAVATE → CONVEYOR → SUN VALLEY PITS

This alternative is basically the same as Combined Alternative 2A, except that conveyors would be used instead of trucks. Figure 8-19 shows a representation of this alternative. Placement of a conveyor belt along Big Tujunga Canyon Road from Big Tujunga Reservoir to the pits in Sun Valley would require working out an alignment that considers roadway impacts.

**Figure 8-19 Big Tujunga Reservoir Combined Alternative 2B**




Given the assumed conveyor efficiency and 6-month long operations per year, approximately 9 excavation and conveyor operations would have to be employed to remove the 7.2-MCY planning quantity from Big Tujunga Reservoir.

The estimated costs associated with this alternative total $115 million to $130 million, as shown in Table 8-7.

**Table 8-7 Estimated costs for Big Tujunga Reservoir's Combined Alternative 2B**

| Activity | Quantity (MCY) | Estimated Cost (in millions) |
|---|---|---|
| Excavate sediment from Big Tujunga Reservoir | 7.2 | $22 |
| Convey to pits in Sun Valley | | $86 |
| Place sediment at pits in Sun Valley | | $7-24[(a)] |
| Total | 7.2 | $115-130 |

Note:

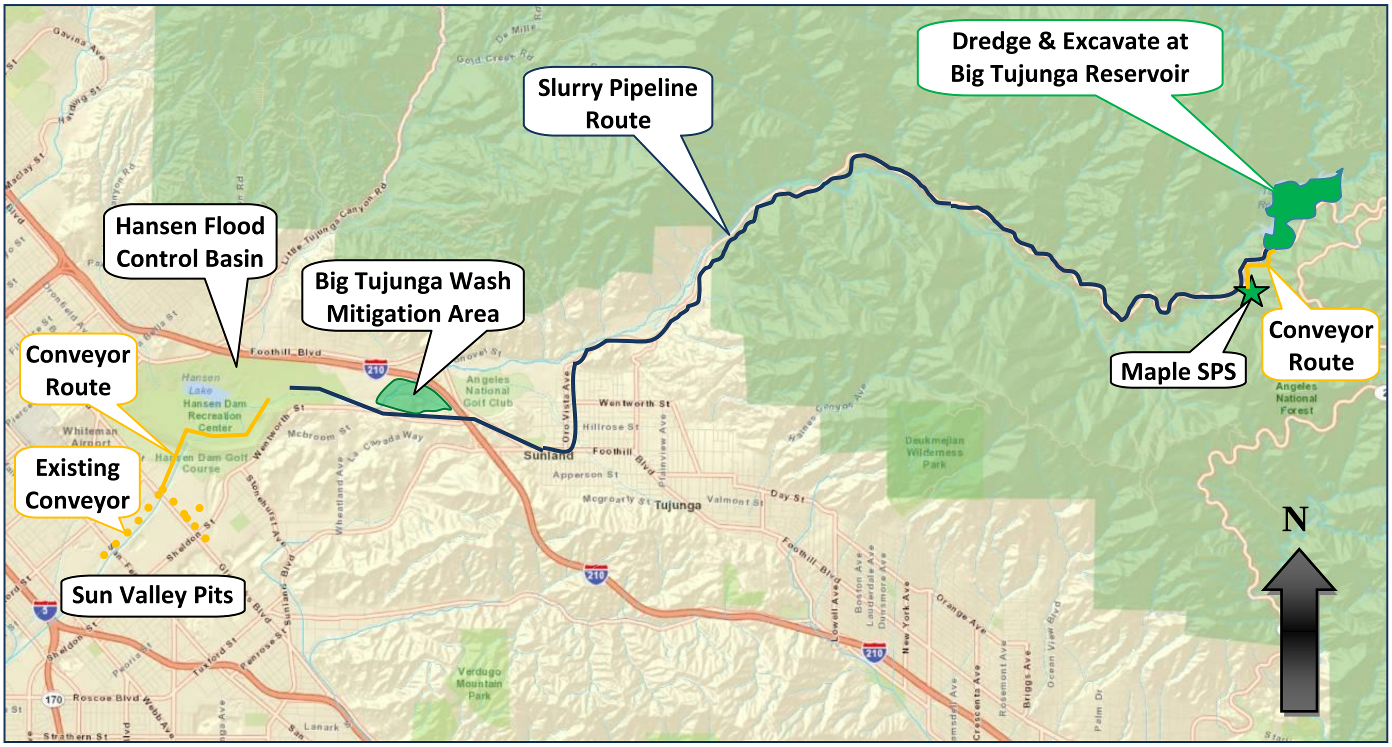
a. This assumes 33.3 percent of the sediment is marketable and would be accepted free of charge, that another 33.3 percent would also be accepted free of charge. The lower cost assumes the remainder of the material would be placed at a pit acquired by the Flood Control District. The higher cost pertains to the scenario in which the Flood Control District was not able to acquire a pit and had to pay tipping fees would have to be paid on the remainder 33.4 percent.

#### 8.1.7.5 COMBINED ALTERNATIVE 3: DREDGE (4.8 MCY) → SLURRY PIPELINE → HANSEN FLOOD CONTROL BASIN → EXCAVATE → CONVEYOR → SUN VALLEY PITS + EXCAVATE (2.4 MCY) → CONVEYOR → MAPLE SPS

This alternative would involve sediment removal operations at the Army Corps of Engineers' Hansen Flood Control Basin in addition to sediment removal operations at Big Tujunga Reservoir. First, in order to create capacity for the material to be delivered to Hansen Flood Control Basin, sediment would be excavated from the basin and trucked to a privately or Flood Control District owned quarry in Sun Valley. Subsequently, sediment would be dredged from

Big Tujunga Reservoir and the sediment-water mixture transported to the basin through a slurry pipeline. Additionally, because the large material in Big Tujunga Reservoir would not be able to be dredged, the large material would have to be excavated. It was assumed the large material would be excavated and transported to Maple SPS on a conveyor. Figure 8-20 shows a representation of this alternative.

**Figure 8-20 Big Tujunga Reservoir Combined Alternative 3**




Implementation of this alternative is highly dependent on the ability to obtain permission from the Army Corps of Engineers to use Hansen Flood Control Basin as a dewatering and temporary sediment storage area for the dredged material and the ability to create enough capacity for the operations.

Given the assumptions made regarding dredging operations and assuming capacity at Hansen Flood Control Basin would not limit the dredging operations, it could take 12 dredging operations during the 20-year planning period to remove the 4.8-MCY of smaller sediment from the Big Tujunga Reservoir. Conveying the 4.8 MCY of sediment that would need to be preexcavated from Hansen to the pits in Sun Valley was approximated to be able to be done in 6 conveyor operations. The 2.4 MCY of larger material remaining in Big Tujunga Reservoir after dredging could be excavated and conveyed to Maple SPS in approximately 3 conveyor operations.

Implementation of this alternative could cost from an estimated \$210 million to \$245 million, depending on the destination of the sediment. The breakdown of the estimated costs is provided in Table 8-8.

**Table 8-8 Estimated costs for Big Tujunga Reservoir's Combined Alternative 3**

| Activity | Quantity (MCY) | Estimated Cost (in millions) |
|---|---|---|
| Excavate material at Hansen Flood Control Basin to create capacity | 4.8 (Sediment that could potentially be dredged) | $14 |
| Convey material on new conveyor from Hansen Flood Control Basin to existing conveyor downstream of Hansen Dam | | $7 |
| Convey material on existing conveyor to the pits in Sun Valley | | $1 |
| Place sediment at pits in Sun Valley | | $14-48[a] |
| Dredge sediment from Big Tujunga Reservoir | | $50 |
| Construct and operate slurry pipeline from Big Tujunga Reservoir to Hansen Flood Control Basin | | $104 |
| Excavate larger material that cannot be dredged | 2.4 (Sediment too large to be dredged) | $7 |
| Convey larger material that cannot be dredge to Maple SPS | | $8 |
| Place at Maple SPS | | $5 |
| **Total** | **7.2** | **$210-245** |

Note:

a. This assumes 33.3 percent of the sediment is marketable and would be accepted free of charge, that another 33.3 percent would also be accepted free of charge. The lower cost assumes the remainder of the material would be placed at a pit acquired by the Flood Control District. The higher cost pertains to the scenario in which the Flood Control District was not able to acquire a pit and had to pay tipping fees would have to be paid on the remainder 33.4 percent.

#### 8.1.7.6 COMBINED ALTERNATIVE 4A: SLUICE (4.8 MCY) → HANSEN FLOOD CONTROL BASIN → EXCAVATE → CONVEYOR → SUN VALLEY PITS + EXCAVATE (2.4 MCY) → CONVEYOR → MAPLE SPS

This alternative is very similar to Combined Alternative 3 except for the part that for this alternative sediment would be sluiced from Big Tujunga Reservoir to Hansen Flood Control Basin along Big Tujunga Wash as opposed to dredging the reservoir and transporting the sediment in an enclosed slurry pipeline. Employing this alternative would result in habitat impacts along Big Tujunga Wash while Combined Alternative 3 would not. Figure 8-21 shows a representation of this alternative.

**Figure 8-21 Big Tujunga Reservoir Combined Alternative 4A**


Given the assumptions made regarding sluicing operations and assuming capacity at Hansen Flood Control Basin would not limit the sluicing operations, it could take 16 sluicing operations during the 20-year planning period to remove the 4.8 MCY of smaller sediment from the Big Tujunga Reservoir. Excavating and conveying the remaining 2.4 MCY to Maple SPS would require approximately 3 conveyor operations.

Implementation of this alternative could cost from an estimated $70 million to $100 million, depending on the destination of the sediment. The breakdown of the estimated costs is provided in Table 8-9.

**Table 8-9 Estimated costs for Big Tujunga Reservoir's Combined Alternative 4A**

| Activity | Quantity (MCY) | Estimated Cost (in millions) |
|---|---|---|
| Excavate material at Hansen Flood Control Basin to create capacity | 4.8 (Sediment that could potentially be sluiced) | $14 |
| Convey material on new conveyor from Hansen Flood Control Basin to existing conveyor downstream of the basin | | $7 |
| Convey material on existing conveyor to the pits in Sun Valley | | $1 |
| Place sediment at pits in Sun Valley | | $14-48[a] |
| Sluice sediment from Big Tujunga Reservoir | | $12 |
| Excavate larger material that cannot be sluiced | 2.4 (Sediment too large to be sluiced) | $7 |
| Convey to Maple SPS the larger material that cannot be sluiced | | $8 |
| Place at Maple SPS | | $5 |
| **Total** | **7.2** | **$70-100** |

Note:

a. This assumes 33.3 percent of the sediment is marketable and would be accepted free of charge, that another 33.3 percent would also be accepted free of charge. The lower cost assumes the remainder of the material would be placed at a pit acquired by the Flood Control District. The higher cost pertains to the scenario in which the Flood Control District was not able to acquire a pit and had to pay tipping fees would have to be paid on the remainder 33.4 percent.

### 8.1.7.7 COMBINED ALTERNATIVE 4B: SLUICE (4.8 MCY) → HANSEN FLOOD CONTROL BASIN → EXCAVATE → CONVEYOR → SUN VALLEY PITS + EXCAVATE (2.4 MCY) → TRUCKS → MAPLE SPS

This alternative is very similar to Combined Alternative 4A except that the larger-sized sediment that would not be able to be sluiced would be excavated from Big Tujunga Reservoir and trucked to the pits in Sun Valley. Figure 8-22 shows a representation of this alternative.

**Figure 8-22 Big Tujunga Reservoir Combined Alternative 4B**


Given the assumptions made regarding sluicing operations and assuming capacity at Hansen Flood Control Basin would not limit the sluicing operations, it could take 16 sluicing operations during the 20-year planning period to remove the 4.8-MCY of smaller sediment from the Big Tujunga Reservoir. Excavating and conveying the remaining 2.4 MCY to Maple SPS would require approximately 3 conveyor operations.

Implementation of this alternative could cost from an estimated $70 million to $90 million, depending on the destination of the sediment. The breakdown of the estimated costs is provided in Table 8-10.

**Table 8-10 Estimated costs for Big Tujunga Reservoir's Combined Alternative 4B**

| Activity | Quantity (MCY) | Estimated Cost (in millions) |
|---|---|---|
| Excavate material at Hansen Flood Control Basin to create capacity | 4.8 (Sediment that could potentially be sluiced) | $14 |
| Convey material on new conveyor from Hansen Flood Control Basin to existing conveyor downstream of the basin | | $7 |
| Convey material on existing conveyor to the pits in Sun Valley | | $1 |
| Sluice sediment from Big Tujunga Reservoir | | $12 |
| Excavate larger material that cannot be sluiced | 2.4 (Sediment too large to be sluiced) | $7 |
| Truck the larger material that cannot be sluiced to the pits in Sun Valley | | $24 |
| Place sediment at pits in Sun Valley | 7.2 | $7-24[a] |
| **Total** | **7.2** | **$70-90** |

Note:

a. This assumes 33.3 percent of the sediment is marketable and would be accepted free of charge, that another 33.3 percent would also be accepted free of charge. The lower cost assumes the remainder of the material would be placed at a pit acquired by the Flood Control District. The higher cost pertains to the scenario in which the Flood Control District was not able to acquire a pit and had to pay tipping fees would have to be paid on the remainder 33.4 percent.

## 8.1.8 SUMMARY AND RECOMMENDATIONS

### 8.1.8.1 SUMMARY

Over the next 20 years, 7.2 MCY of sediment are planned to be removed Big Tujunga Reservoir including the 2 MCY currently accumulated in the reservoir. The different management alternatives are briefly explained below and the impacts are shown in Table 8-11.

**Sediment Management Alternatives**

1A Excavate (7.2 MCY) → Trucks → Maple SPS (4.4 MCY) & Sun Valley Pits (2.8 MCY)
This alternative involves draining the reservoir, excavating the sediment under dry conditions, and trucking it to Maple SPS and the pits in Sun Valley. Maple SPS would be filled; the rest of the sediment would be placed at the pits in Sun Valley. Habitat would be impacted along Big Tujunga Wash due to draining of the reservoir.

1B Excavate (7.2 MCY) → Conveyor → Maple SPS (4.4 MCY) & Sun Valley Pits (2.8 MCY)
This alternative is similar to Alternative 1A, but instead of trucks, this alternative involves a conveyor over 10 miles in length. Habitat could be impacted depending on the conveyor route.

2A Excavate → Trucks → Sun Valley Pits
This alternative consists of transporting all sediment excavated from Big Tujunga Reservoir by truck and placing it at the pits in Sun Valley. Maple Canyon SPS would not be used.

2B Excavate → Conveyor → Sun Valley Pits
This alternative is the same as Alternative 2A, except that conveyors would be used. Placement of a conveyor along Big Tujunga Canyon Road from Big Tujunga Reservoir to the pits in Sun Valley would require designing an alignment that considers roadway impacts.

3 Dredge (4.8 MCY) → Slurry Pipeline → Hansen Flood Control Basin → Excavate → Conveyor → Sun Valley Pits + Excavate (2.4 MCY) → Conveyor → Maple SPS

Smaller-sized material would be dredged and transported via slurry pipeline to Hansen Flood Control Basin (Hansen FCB). The larger-sized material would be excavated and transported to Maple SPS on a conveyor. This alternative is highly dependent on the ability to obtain permission from the Army Corps of Engineers to use Hansen FCB and the ability to create enough capacity for the operations.

4A Sluice (4.8 MCY) → Hansen Flood Control Basin → Excavate → Conveyor → Sun Valley Pits + Excavate (2.4 MCY) → Conveyor → Maple SPS

This alternative is very similar to Alternative 3 except sediment would be sluiced rather than dredged and the larger material would be placed at the pits in Sun Valley. Employing this alternative would result in habitat impacts along Big Tujunga Wash. Additionally, this alternative would require designing a conveyor alignment that considers roadway impacts.

4B Sluice (4.8 MCY) → Hansen Flood Control Basin → Excavate → Conveyor → Sun Valley Pits + Excavate (2.4 MCY) → Trucks → Maple SPS

This alternative is basically the same as Alternative 4A, except that transportation of the larger materials would be via trucks as opposed to a conveyor.

**Table 8-11 Summary of Sediment Management Alternatives for Big Tujunga Reservoir**

| Alternative | | Quantity Removed (MCY) | Environmental | | | | Social | | | Implementability | Performance | | Cost |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Habitat | Water Quality | Groundwater Recharge | Air Quality[a] | Traffic | Visual | Noise | Special Permit/ Agreement Required[b] | Previous Experience | # of operations required in next 20 years | $ Millions |
| **1A** | Excavation | 7.2 | ◑ | | ○ | ◑ | | ○ | ○ | | Yes | 9 | 65 |
| | Trucks | | | | | ● | ● | ◑ | ◑ | | | | |
| | Maple Canyon SPS | 4.4 | ◑ | | | | | ◑ | | Yes | | | |
| | Pits in Sun Valley | 2.8 | | | | | | | | Yes | | | |
| **1B** | Excavation | 7.2 | ◑ | | ○ | ◑ | | ○ | ○ | | Yes | 9 | 125 |
| | Conveyor | | ◑ | | | | | ◑ | ○ | | | | |
| | Maple Canyon SPS | 4.4 | ◑ | | | ○ | | ◑ | | Yes | | | |
| | Pits in Sun Valley | 2.8 | | | | | | | | Yes | | | |
| **2A** | Excavation | 7.2 | ◑ | | ○ | ◑ | | ○ | ○ | | Yes | 9 | 100-120 |
| | Trucks | | | | | ● | ● | ◑ | ◑ | | | | |
| | Pits in Sun Valley | | | | | | | | | Yes | | | |
| **2B** | Excavation | 7.2 | ◑ | | ○ | ◑ | | ○ | ○ | | Yes | 9 | 115-130 |
| | Conveyor | | ◑ | | | | | ◑ | ○ | | | | |
| | Pits in Sun Valley | | | | | | | | | Yes | | | |
| **3** | Dredge | 4.8 | ○ | ◑ | ○ | | | ○ | ○ | | No | 12 | 210-245 |
| | Slurry Pipeline to Hansen FCB | | ◑ | | | | | | | Yes | | | |
| | Hansen FCB | | ◑ | ● | ○ | ◑ | | ◑ | ◑ | | | | |
| | Conveyor from Hansen FCB to Pits in Sun Valley | | ○ | | | | | ◑ | ○ | Yes | | | |
| | Pits in Sun Valley | | | | | | | | | Yes | | | |
| | Excavation | 2.4 | ◑ | | ○ | ◑ | | ○ | ○ | | Yes | 3 | |
| | Conveyor | | | | | | | ◑ | ○ | | | | |
| | Maple Canyon SPS | | ◑ | | | | | ◑ | | Yes | | | |
| **4A** | Sluice to Hansen FCB | 4.8 | ● | ● | ◑ | | | ◑ | | Yes | Yes | 16 | 70-100 |
| | Hansen FCB | | ◑ | ● | ○ | ◑ | | ◑ | ○ | Yes | | | |
| | Conveyor from Hansen FCB to Pits in Sun Valley | | ○ | | | | | ◑ | ○ | | | | |
| | Pits in Sun Valley | | | | | | | | | Yes | | | |
| | Excavation | 2.4 | ◑ | | ○ | ◑ | | ○ | ○ | | | 3 | |
| | Conveyor | | ◑ | | | | | ◑ | ○ | | | | |
| | Maple Canyon SPS | | ◑ | | | | | ◑ | | Yes | | | |
| **4B** | Sluice to Hansen FCB | 4.8 | ● | ● | ◑ | | | ◑ | | Yes | Yes | 16 | 70-90 |
| | Hansen FCB | | ◑ | ● | ○ | ◑ | | ◑ | ○ | Yes | | | |
| | Conveyor from Hansen FCB to Pits in Sun Valley | | ○ | | | | | ◑ | ○ | | | | |
| | Pits in Sun Valley | | | | | | | | | Yes | | | |
| | Excavation | 2.4 | ◑ | | ○ | ◑ | | ○ | ○ | | | 3 | |
| | Trucks | | | | | ● | ● | ◑ | ◑ | | | | |
| | Pits in Sun Valley | | | | | | | | | | | | |

Legend:

| | |
|---|---|
| ● | significant impact |
| ◑ | some impact |
| ○ | possible impact |
| | no impact |

Notes:

(a) Use of low-emission trucks would reduce air quality impacts from significant impact (●) to some impact (◑).

(b) All options require environmental regulatory permits.

#### 8.1.8.2 RECOMMENDATIONS

It is recommended that all the alternatives detailed here, except Alternative 3, be considered for future sediment removal projects at Big Tujunga Reservoir. Additionally, combining the alternatives should be taken into consideration. Alternative 3 should be considered only after all other alternatives are deemed infeasible. This recommendation is based on the high estimated cost.

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## 8.2 DEVIL'S GATE RESERVOIR

### 8.2.1 BACKGROUND

Devil's Gate Dam, shown in Figure 8-23, is an arched concrete gravity dam that was constructed in 1920 by the Flood Control District and had an original storage capacity of approximately 7.4 MCY. With a drainage area of 31.9 square miles, Devil's Gate Dam is operated for flood risk management as well as used for recreational purposes.

**Figure 8-23 Aerial of Devil's Gate Reservoir**

#### 8.2.1.1 LOCATION

Devil's Gate Dam and Reservoir are located in between the cities of La Cañada Flintridge (approximately 2.2 miles southeast) and Altadena (approximately 2.6 miles west) in the City of Pasadena, as shown in Figure 8-24. The dam and reservoir are part of the Hahamongna Watershed Park. Located just off Interstate 210, this dam and reservoir are surrounded by residential buildings. While the reservoir looks to be relatively dry at most times, the water captured in the reservoir is released into the Arroyo Seco concrete channel just downstream of the dam and sent downstream into the Los Angeles River. The reservoir is long and broad, with a length of approximately 1.1 miles and an average width of 850 feet with relatively flat-side slopes. Figure 8-25 shows the topography of Devils Gate Reservoir.

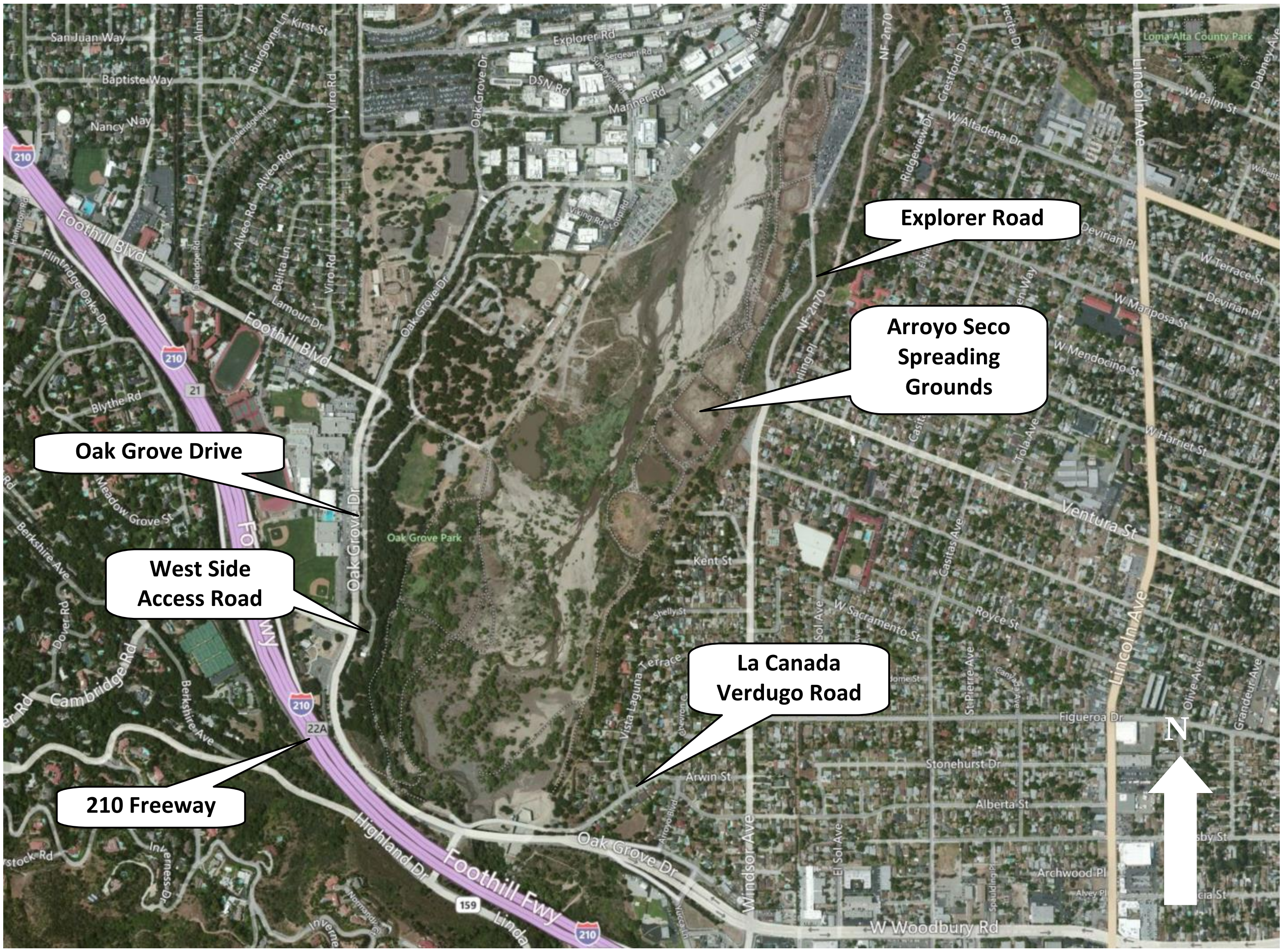
**Figure 8-24 Vicinity Map of Devil's Gate Reservoir**


**Figure 8-25 Devil's Gate Reservoir Topography**

#### 8.2.1.2 ACCESS

Access to the dam and reservoir is available on all sides, as shown in Figure 8-26. The dam can be accessed through the west side access road off Oak Grove Drive or La Canada Verdugo Road while the upstream end of the reservoir can be accessed through various access roads off of Explorer Road. All of these roads can accommodate two-way traffic for their entire lengths.

**Figure 8-26 Devil's Gate Dam and Vicinity**




#### 8.2.1.3 DAM OUTLETS

In addition to being equipped with a variety of valves, Devil's Gate Dam is also equipped with two 7-foot by 10-foot slide gates and a 5-foot by 5-foot sluice gate.

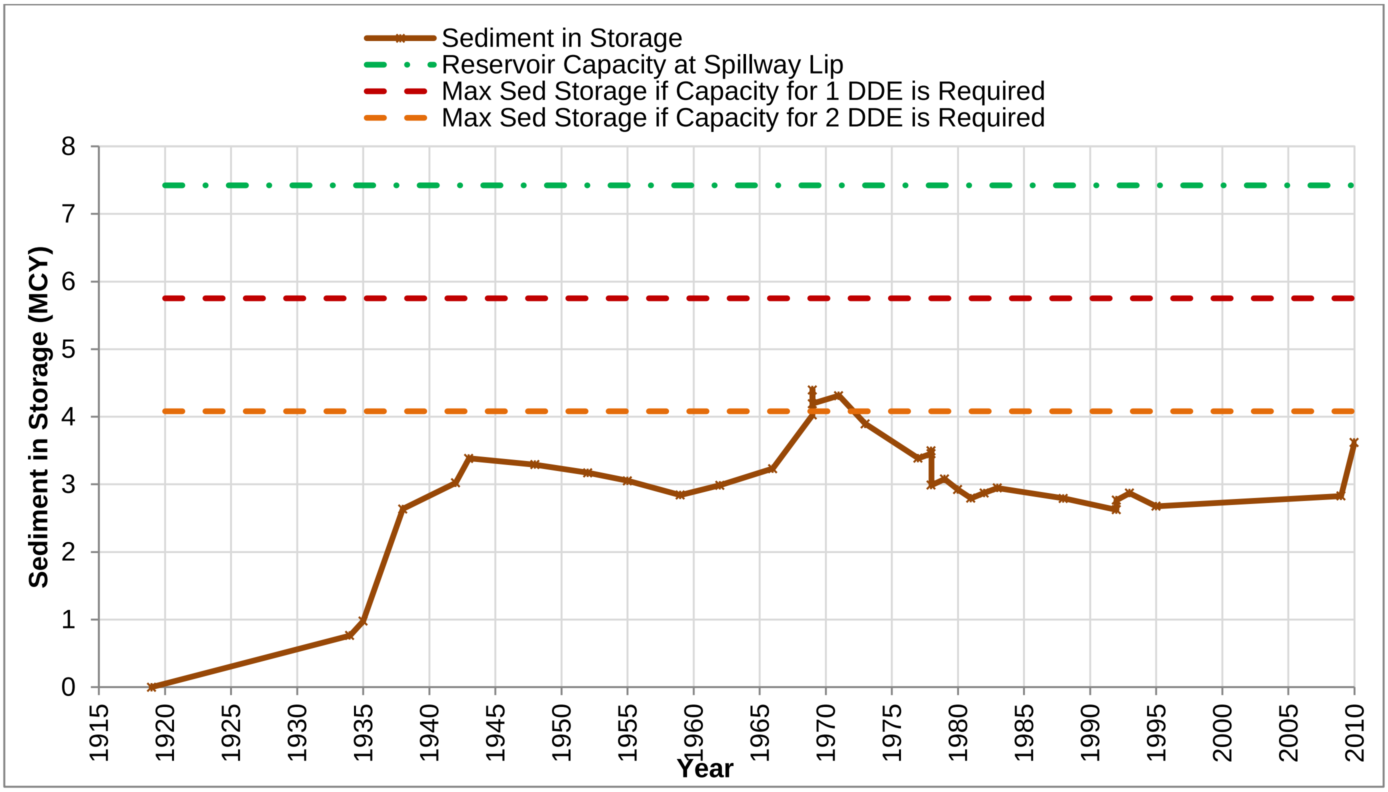
#### 8.2.1.4 DOWNSTREAM FLOOD CONTROL AND WATER CONSERVATION SYSTEM COMPONENTS

Water that passes through the Arroyo Seco can be diverted to the Arroyo Seco Spreading Grounds, upstream and east of Devil's Gate Reservoir. Devil's Gate Reservoir is not designed to store water during dry months as there are no groundwater recharge facilities immediately downstream of the reservoir. The dam discharges to the Arroyo Seco, which eventually joins the Los Angeles River downstream.

### 8.2.1.5 SEDIMENT DEPOSITION AND REMOVAL HISTORY

Figure 8-27 shows the approximate sediment storage in Devil's Gate Reservoir. It is the Flood Control District's policy to retain enough storage capacity within a reservoir for two DDEs, which are calculated and determined for each specific reservoir. The graph shows that the Flood Control District has reduced the quantity of sediment in storage at Devil's Gate Reservoir on numerous occasions, even before reaching the threshold capacity.

**Figure 8-27 Graph of Historical Sediment Storage at Devil's Gate Reservoir**




Sediment has been removed 32 times in the 92-year life of the reservoir as shown in Table 8-12. Table 8-12 shows that both excavation and sluicing have been used to remove sediment from Devils Gate Reservoir in the past. The majority of the sediment (73 percent) has been removed through excavation.

**Table 8-12 Devils Gate Reservoir historical sediment accumulation and removal**

| Survey Date | | Reservoir Capacity @ Elevation 1,054 ft (MCY) | Quantity Sluiced (MCY) | Quantity Excavated (MCY) | Sediment Accumulated Between Surveys (MCY) | Sediment in Storage (MCY) |
|---|---|---|---|---|---|---|
| October | 1919 | 7.42 | - | - | - | - |
| September | 1934 | 6.66 | - | 0.08 | 0.84 | 0.76 |
| June | 1935 | 6.45 | - | - | 0.21 | 0.98 |
| June | 1938 | 4.79 | - | - | 1.66 | 2.64 |
| January | 1942 | 4.40 | 1.04 | 0.04 | 1.46 | 3.02 |
| December | 1943 | 4.04 | 0.10 | 0.03 | 0.50 | 3.38 |
| Fall | 1948 | 4.13 | 0.12 | 0.07 | 0.10 | 3.29 |
| July | 1952 | 4.25 | 0.41 | 0.14 | 0.43 | 3.17 |
| September | 1955 | 4.37 | - | 0.12 | - | 3.05 |
| December | 1959 | 4.58 | - | 0.28 | 0.07 | 2.84 |
| May | 1962 | 4.44 | - | 0.70 | 0.84 | 2.99 |
| September | 1966 | 4.19 | 0.08 | 0.60 | 0.92 | 3.23 |
| February | 1969 | 3.40 | - | 0.03 | 0.83 | 4.03 |
| March | 1969 | 3.02 | - | - | 0.37 | 4.40 |
| November | 1969 | 3.23 | 0.19 | 0.01 | - | 4.19 |
| December | 1971 | 3.11 | - | 0.23 | 0.35 | 4.31 |
| October | 1973 | 3.53 | - | 0.47 | 0.06 | 3.90 |
| March | 1977 | 4.04 | - | 0.75 | 0.24 | 3.39 |
| March | 1978 | 3.97 | - | 0.24 | 0.31 | 3.45 |
| July | 1978 | 3.93 | - | - | 0.04 | 3.50 |
| December | 1978 | 4.43 | - | 0.51 | - | 2.99 |
| February | 1979 | 4.34 | 0.25 | 0.12 | 0.47 | 3.08 |
| March | 1980 | 4.50 | - | 0.45 | 0.30 | 2.92 |
| July | 1981 | 4.63 | - | 0.32 | 0.19 | 2.79 |
| September | 1982 | 4.55 | - | 0.10 | 0.18 | 2.87 |
| April | 1983 | 4.48 | - | 0.05 | 0.13 | 2.95 |
| June | 1988 | 4.63 | - | 0.20 | 0.05 | 2.79 |
| February | 1992 | 4.80 | - | 0.17 | - | 2.62 |
| July | 1992 | 4.66 | - | - | 0.14 | 2.77 |
| April | 1993 | 4.68 | - | - | 0.10 | 2.87 |
| November | 1995 | 4.94 | - | 0.19 | - | 2.68 |
| April | 2009 | 4.79 | - | 0.02 | 0.18 | 2.83 |
| April | 2010 | 3.99 | - | - | 0.79 | 3.62 |
| March | 2011 | 3.72 | - | - | 0.27 | 3.89 |

### 8.2.2 PLANNING QUANTITY AND ASSUMED SEDIMENT CHARACTERISTICS

As described in Section 5, the 20-year planning quantity for sediment deposition into Devil's Gate Reservoirs is 4.3 MCY. The Flood Control District is also planning to remove the sediment currently in the reservoir, which amounts to approximately 4 MCY. Therefore, a total of approximately 8.3 MCY of sediment are planned for removal over the next 20 years.

### 8.2.3 DISCUSSION

During the Station Fire of 2009, almost all the undeveloped portion of the watershed tributary to Devil's Gate Reservoir was burned, making increased sediment accumulation at the reservoir inevitable during subsequent storm events. As a result, the reservoir's capacity was reduced significantly. As of June 2012, the reservoir did not have capacity to contain another major debris event safely and the outlet works have a risk of becoming clogged and inoperable. In order to maintain the proper functionality of the reservoir, the sediment accumulated in it has to be removed.

As of the June 2012, the Flood Control District was actively planning the Devil's Gate Reservoir Sediment Removal and Management Project and preparing an Environmental Impact Report (EIR) for the project. The Notice of Preparation for the Devil's Gate Reservoir Sediment Removal and Management Project EIR was issued in September 2011. The EIR will thoroughly discuss all feasible alternatives to remove, transport, and place sediment for Devil's Gate Reservoir. Please refer to www.LASedimentMangement.com for updates on the EIR.

# 8.3 PACOIMA RESERVOIR

## 8.3.1 BACKGROUND

Pacoima Dam, shown in Figure 8-28, is a concrete constant-angle arch dam that was constructed between 1925 and 1929 and had an original storage capacity at spillway of approximately 9.8 million cubic yards (MCY). With a drainage area of 28.2 square miles, Pacoima Dam is operated for flood risk management and water conservation purposes. Water impounded during the storm season behind the dam is gradually released and diverted into downstream spreading grounds to recharge groundwater. Pacoima Reservoir is not accessible to the public and is not used for recreation.

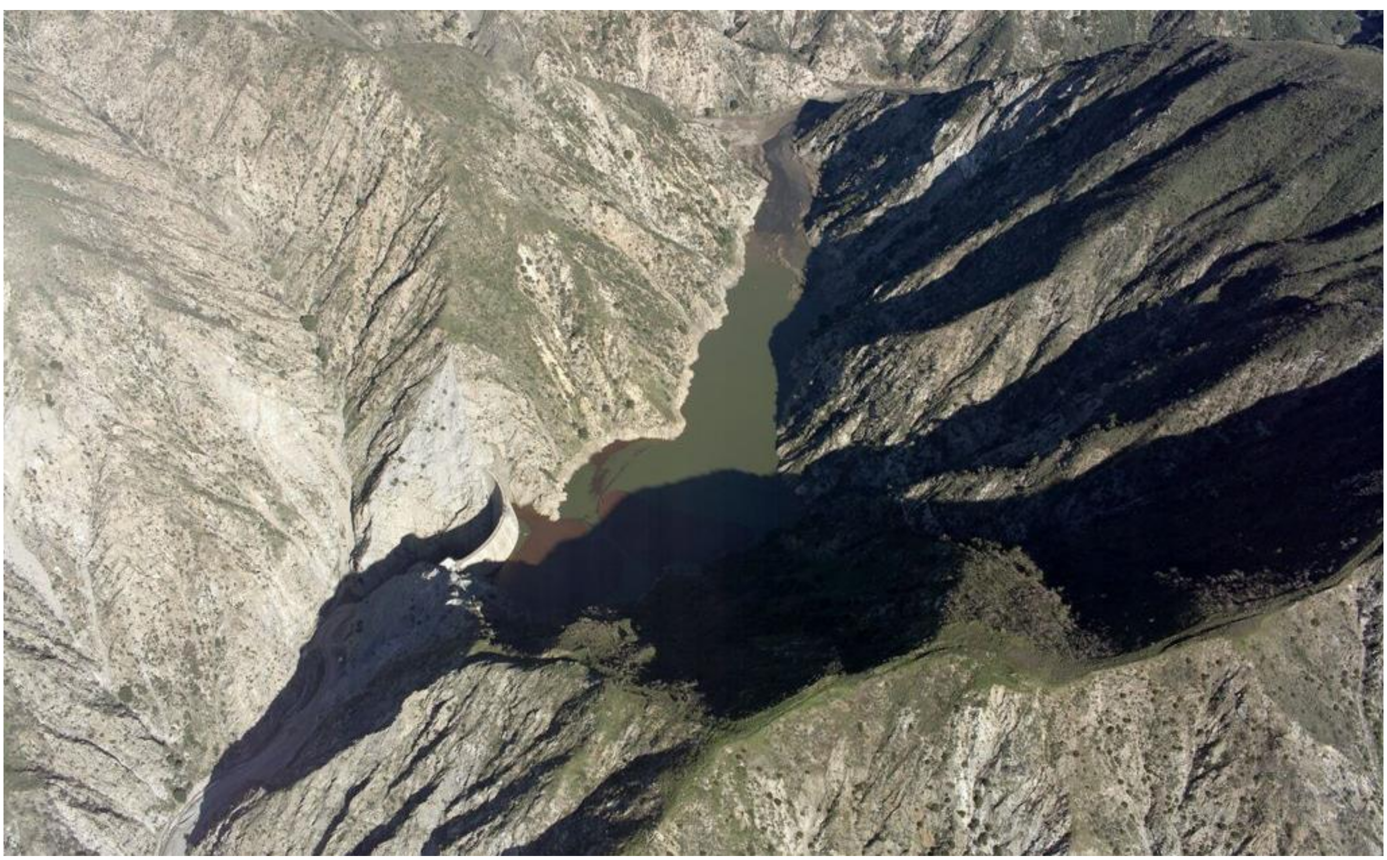
**Figure 8-28 Pacoima Dam**

### 8.3.1.1 LOCATION

Pacoima Dam and Reservoir are located in the Pacoima Canyon of the San Gabriel Mountains, approximately four miles north of the Cities of Los Angeles and San Fernando. The dam and reservoir are located within Flood Control District easements. Pacoima Creek and a few unnamed, natural streams that traverse the San Gabriel Mountains flow into Pacoima Reservoir. The waterway downstream of the dam is known as Pacoima Wash. The wash flows into Lopez Flood Control Basin, an Army Corps of Engineers facility used to manage the risk of floods. Figure 8-29 shows Pacoima Reservoir and the surroundings. Figure 8-30 shows an aerial of Pacoima Reservoir.

Figure 8-29 Pacoima Reservoir Vicinity Map


Figure 8-30 Pacoima Reservoir Topography

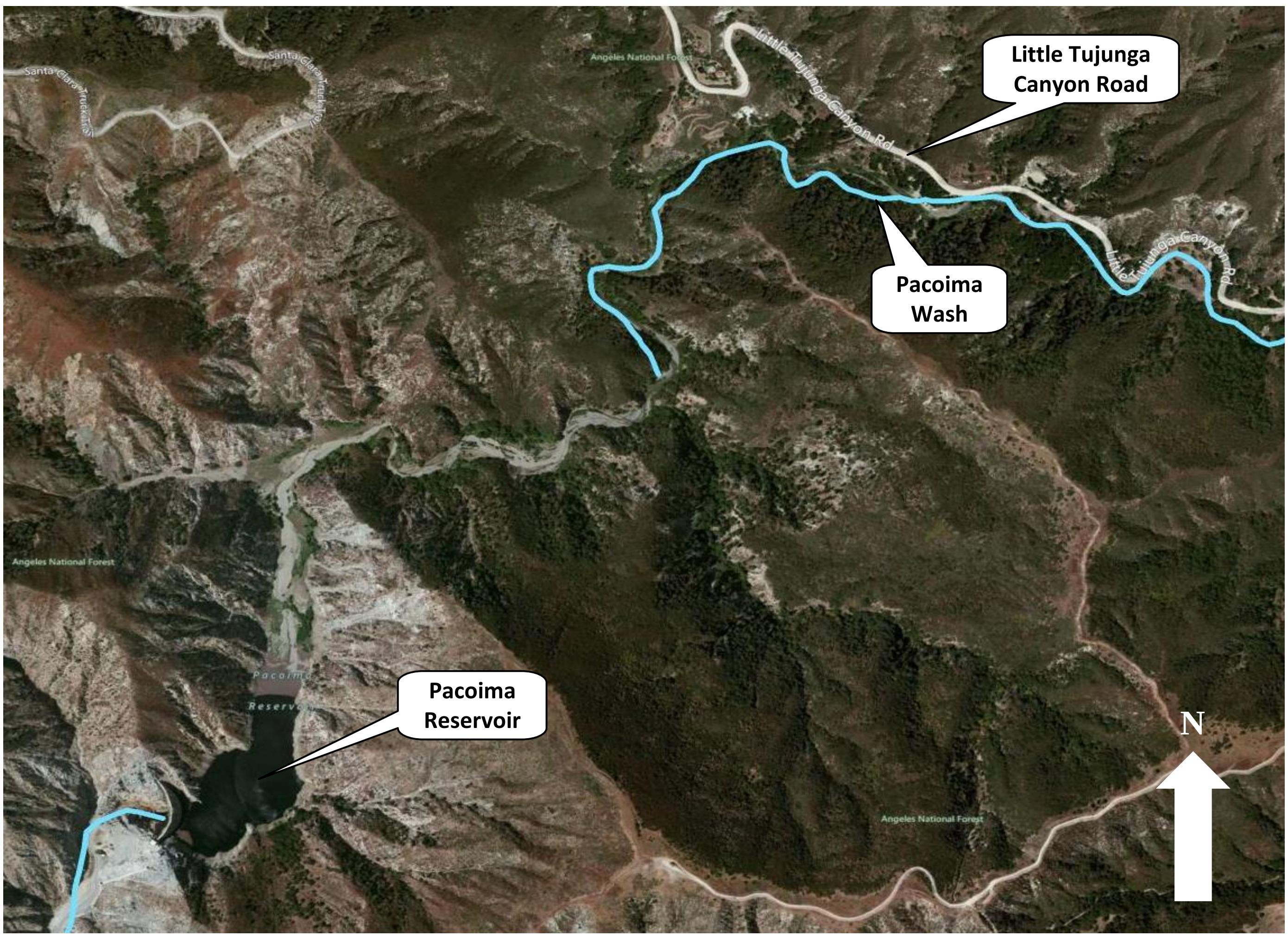


### 8.3.1.2 Access

Vehicular access to the downstream area of the dam is available on Pacoima Canyon Road, an access road maintained by the Flood Control District and located on an easement through private property. The unpaved road begins at Gavina Avenue, a public local road, and runs northward along the east side of Pacoima Canyon. While Pacoima Canyon Road varies in width, it can accommodate two-way traffic for the majority of its length. The access road ends approximately 250 feet from the downstream toe of the dam. There is no vehicular access to the crest of the dam.

The Flood Control District owns a property that can be used to establish access from Little Tujunga Canyon Road to the back of Pacoima Reservoir. In the past, the back of the reservoir was connected to Little Tujunga Canyon Road through an easement along Pacoima Wash, which is shown on Figure 8-31.

**Figure 8-31 Upstream end of Pacoima Reservoir**




### 8.3.1.3 Dam Outlets

In addition to being equipped with a variety of valves, Pacoima Dam is also equipped with a sluiceway controlled by 5- by 5-foot slide gate.

### 8.3.1.4 Downstream Flood Control and Water Conservation System Components

Water that passes through Pacoima Dam travels along Pacoima Wash to the Army Corps of Engineers' Lopez Flood Control Basin. Downstream of Lopez Flood Control Basin, the water flows through the concrete-lined Pacoima Wash Channel and passes by Lopez Spreading Grounds and Pacoima Spreading Grounds. Pacoima Wash Channel flows into the Los Angeles River downstream.

### 8.3.1.5 Sediment Deposition and Removal History

Figure 8-32 shows the approximate quantities of sediment accumulated in Pacoima Reservoir since the reservoir's first debris season in the mid-1920s. At Pacoima Reservoir as well as other reservoirs, it is the Flood Control District's practice to retain enough capacity within a reservoir for two incoming design debris events (DDEs), which are calculated and determined for each specific reservoir. For reference purposes, Table 8-13 shows Pacoima Reservoir's original reservoir capacity at spillway lip and the maximum sediment accumulation that allows for the storage of both one and two incoming DDEs. The graph shows that the Flood Control District has reduced the quantity of accumulated sediment at Pacoima Reservoir on numerous occasions, even before reaching the threshold capacity. Per the Flood Control District's records, which are summarized in Table 8-13, between Pacoima Reservoir's first debris season and June 2012, seven sediment removal projects were conducted at the reservoir, all of which were accomplished via sluicing.

**Figure 8-32 Graph of Historical Sediment Accumulation at Pacoima Reservoir**

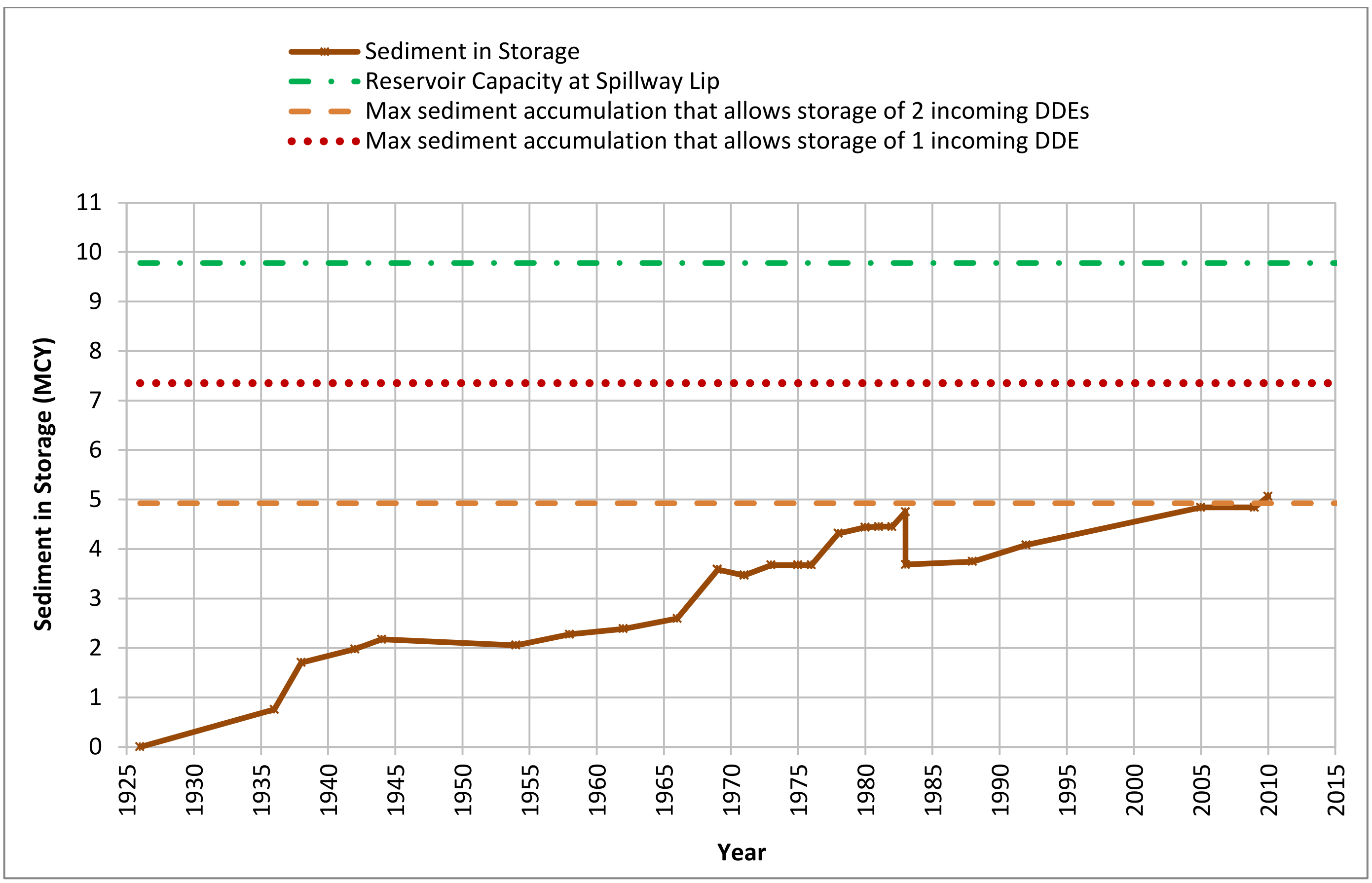


**Table 8-13 Pacoima Reservoir Historical Sediment Accumulation and Removal**

| Survey Date | | Reservoir Capacity (MCY) | Quantity Sluiced (MCY) | Quantity Excavated (MCY) | Sediment Accumulated Between Surveys (MCY) | Sediment in Storage (MCY) |
|---|---|---|---|---|---|---|
| October | 1926 | 9.78 | - | - | - | - |
| January | 1936 | 9.02 | - | - | 0.76 | 0.76 |
| March | 1938 | 8.07 | - | - | 0.95 | 1.70 |
| October | 1942 | 7.80 | - | - | 0.27 | 1.97 |
| December | 1944 | 7.61 | 0.09 | - | 0.29 | 2.17 |
| October | 1954 | 7.72 | 0.18 | - | 0.07 | 2.05 |
| June | 1958 | 7.50 | 0.29 | - | 0.51 | 2.27 |
| May | 1962 | 7.39 | 0.08 | - | 0.20 | 2.39 |
| August | 1966 | 7.18 | - | - | 0.21 | 2.59 |
| March | 1969 | 6.20 | - | - | 0.99 | 3.58 |
| August | 1969 | 6.19 | 0.36 | - | 0.37 | 3.59 |
| February | 1971 | 6.31 | 0.12 | - | - | 3.47 |
| October | 1971 | 6.34[a] | - | - | - | 3.47 |
| May | 1973 | 6.10 | - | - | 0.24 | 3.67 |
| August | 1975 | 6.11 [b] | - | - | - | 3.67 |
| December | 1976 | 6.10 [b] | - | - | - | 3.67 |
| May | 1978 | 5.46 | - | - | 0.64 | 4.31 |
| March | 1980 | 5.34 | - | - | 0.13 | 4.44 |
| December | 1981 | 5.32 | - | - | 0.01 | 4.45 |
| October | 1982 | 5.33 [b] | - | - | - | 4.45 |
| March | 1983 | 5.03 | - | - | 0.30 | 4.75 |
| August | 1983 | 6.09 | 1.07 | - | - | 3.68 |
| March | 1988 | 6.03 | - | - | 0.06 | 3.75 |
| July | 1992 | 5.70 | - | - | 0.33 | 4.08 |
| December | 2005 | 4.94 | - | - | 0.76 | 4.84 |
| January | 2009 | 4.95 [b] | - | - | - | 4.84 |
| September | 2010 | 4.73 | - | - | 0.22 | 5.06 |

Notes:

a. An earthquake in 1971 caused compaction of materials in the reservoir. There are no sluicing or excavation records between the February and October 1971 surveys.

b. Survey accuracy is responsible for the apparent change in reservoir capacity. No sediment removal project was conducted.

### 8.3.1.6 Past Sluicing Projects

As of 2012, the most recent and largest sluicing project at Pacoima Reservoir was an 8-week effort conducted in 1983. The project involved sluicing approximately 1 MCY of sediment from Pacoima Reservoir to Lopez Flood Control Basin; that is, approximately 1 MCY of sediment from Pacoima Reservoir were transported to Lopez Flood Control Basin through sediment-laden waters that flowed downstream along Pacoima Wash. Lopez Flood Control Basin was used as the dewatering site for the sediment-laden water from Pacoima Reservoir. Then the sediment was removed from Lopez Flood Control Basin by truck. The sediment was placed at the site of a new development near the flood control basin that needed fill material. The sluicing operation cost approximately $895,000 in 2011 dollars. Additionally, approximately $625,000 in 2011 dollars was spent on repairs needed after the sluicing operation. Removal of the sluiced sediment at Lopez Flood Control Basin totaled approximately $5.2 million in 2011 dollars. Therefore, the total cost of the 1-MCY sluicing project of 1983 was approximately $6.7 million in 2011 dollars.

The second largest sluicing project conducted at Pacoima Reservoir removed approximately 360,000 CY of sediment. While detailed records of the 1969 sluicing effort are not available, it was determined sluicing was accomplished using flows as low as 10 cubic feet per second (cfs).

## 8.3.2 PLANNING QUANTITY AND APPROACH

As described in Section 5, the projected 20-year sediment accumulation at Pacoima Reservoir is 2.4 MCY. The Flood Control District is also planning to remove up to an additional 5.2 MCY of sediment. As a result, the total 20-year planning quantity for Pacoima Reservoir is 7.6 MCY of sediment.

As discussed in Section 6, smaller-sized sediment can be removed from a reservoir by any of the removal alternatives considered. However, larger-sized sediment cannot be dredged or sluiced; this leaves excavation as the only removal alternative for larger-sized sediment. It was assumed that approximately 60 percent of Pacoima Reservoir's 7.6-MCY planning quantity, or 4.6 MCY, could potentially be dredged or sluiced. Given this assumption, if dredging or sluicing was to be employed, approximately 3.0 MCY of sediment would have to be excavated from Pacoima Reservoir during the 20-year planning period in order to address the reservoir's entire planning quantity.

## 8.3.3 POTENTIAL STAGING AND TEMPORARY SEDIMENT STORAGE AREAS

### 8.3.3.1 LOPEZ FLOOD CONTROL BASIN

**Lopez Flood Control Basin – Background**

Lopez Flood Control Basin, shown in Figure 8-33, is a facility under the jurisdiction of the Army Corps of Engineers that is approximately 2.2 miles downstream of Pacoima Dam. Lopez Flood Control Basin reduces the risk of debris-laden floodwaters between the facility and the Los Angeles River. It also serves as an inlet structure to direct flows into the Pacoima Wash Channel. A limited secondary use of Lopez Flood Control Basin is passive and low-impact recreation.

As discussed in Section 8.3.1.6, Lopez Flood Control Basin was used as a temporary sediment storage area for the sediment sluiced from Pacoima Reservoir in 1983. The Flood Control District recently engaged in discussions with the Army Corps of Engineers regarding the use of Lopez Flood Control Basin as a temporary sediment storage area for future sluicing operations from Pacoima Reservoir. Due to limited available storage capacity at the basin, the Army Corps of Engineers would require the Flood Control District to preexcavate the expected amount of sediment to be sluiced to their facility. Based on this requirement and a limitation due to the existing willow habitat in Lopez Flood Control Basin, a maximum capacity of approximately 500,000 CY would be available for temporary sediment storage.

Lopez Flood Control Basin could also be suitable for the temporary storage of dredged material and material transported via a conveyor belt from Pacoima Dam to the basin.

**Figure 8-33 Lopez Flood Control Basin**


**Lopez Flood Control Basin – Environmental Impacts**

As previously mentioned, as of 2012, a portion of Lopez Flood Control Basin contained willow habitat. Several special status animal and plant species are known to be present within or near Lopez Flood Control Basin, including willow flycatchers, Olive-sided flycatchers, yellow warblers, yellow-breasted chat, and Least Bell's Vireo. Special requirements to avoid impact to protected birds limit activity during the nesting season, which extends from February 1st to August 15th.

Water quality would be impacted at Lopez Flood Control Basin if it were to serve as the outlet of a slurry pipeline or the endpoint of a sluicing operation.

Air quality impacts are possible as a result of removing sediment within Lopez Flood Control Basin and transporting it to a permanent placement location. The most likely method would be excavating the basin under dry conditions and trucking the sediment out to a location yet to be determined.

**Lopez Flood Control Basin – Social Impacts**

Traffic and noise would increase near Lopez Flood Control Basin during removal of sediment from the basin. The hours of operation could be limited to minimize disturbance to residents.

The scenic and visual characteristics of Lopez Flood Control Basin and the view from neighboring communities would also be impacted by operations in the basin. However, it is expected that the actual storage of sediment at Lopez Flood Control Basin would minimally alter the visual characteristics of the basin as the temporary sediment storage area is expected to be very similar to the existing conditions (as of 2012).

Using Lopez Flood Control Basin as a temporary sediment storage area could potentially interfere with existing and future recreational features (e.g., trails and model aircraft flying area) in the basin. However, it may be possible to minimize interference by placing berms to divert flows away from recreational areas.

**Lopez Flood Control Basin – Performance**

The limited capacity at Lopez Flood Control Basin is a concern that needs to be analyzed further. While not preferred, increasing the size of the temporary sediment storage area and impacting existing habitat may need to be considered.

**Lopez Flood Control Basin – Implementability**

As has been discussed in this section, the Flood Control District would need to coordinate with the Army Corps of Engineers for use of Lopez Flood Control Basin as a staging or temporary sediment storage area. Coordination would involve issues such as preexcavation of material, permission to truck or place a conveyor within the flood control basin in order to remove the sediment, etc. The Flood Control District would also need to obtain environmental regulatory permits.

There is high technical certainty that once capacity has been made available at Lopez Flood Control Basin and the necessary permits are obtained, Lopez Flood Control Basin would be able to capture incoming flows of sediment from Pacoima Reservoir since it has been used previously for this purpose.

**Lopez Flood Control Basin – Cost**

As previously discussed, use of Lopez Flood Control Basin as a temporary storage area would require preexcavation and removal of the expected amount of sediment to be delivered to the basin. The estimated cost to excavate sediment from a facility like Lopez Flood Control Basin is approximately $3 per cubic yard. Excavating 4.6 MCY of sediment from the basin would cost approximately $14 million. Additionally, it is possible royalties would have to be paid to the Army Corps of Engineers for the sediment excavated and removed from Lopez Flood Control Basin.

#### 8.3.3.2 Canyon Sites

**Canyon Sites – Background**

There are two unnamed canyons totaling approximately 100 acres that are located along Pacoima Canyon Road, approximately 1 mile downstream of Pacoima Dam, as shown in Figure 8-34. As of 2012, environmental documents were being prepared by another agency for a surface mining project proposed by the owner of a couple parcels within the canyons. Alternatively, the canyons present an opportunity for the management of sediment from Pacoima Reservoir. The canyons could serve as a staging area to transfer sediment transported via conveyors from Pacoima Reservoir to trucks or for temporary storage of sediment so that it could be gradually taken to a placement site.

**Figure 8-34 Canyons downstream of Pacoima Dam**


**Canyon Sites – Environmental Impacts**

Prior to being burned during the Sayre Fire in 2008, both canyons contained sage and chaparral habitat. Studies would be needed to identify the habitat within the canyons.

For use as a staging area, only a portion (approximately five acres) of one canyon would be impacted by sediment operations. Nearby mitigation sites could be used to offset the impacts to the canyons. Additionally, once work is complete, habitat could be reestablished on disturbed areas.

Air quality would be affected by emissions of equipment used at the site, but this alternative would have minimal impact to water quality and ground water recharge.

**Canyon Sites – Social Impacts**

Use of the canyons as a staging or temporary sediment storage area would create visual impacts and increase noise, particularly for the neighborhood located across from the canyons, on the other side of Pacoima Wash. Restrictions on working hours and equipment noise would limit impacts.

There are no permitted recreational activities in the canyons. As a result, no impacts on recreation are expected. Nonetheless, stakeholders have expressed a concern over potential disruption of people's recreational use of the canyons. Some stakeholders have also expressed concern that temporary storage of sediment in the canyons could change wind conditions and possibly affect hang gliding activities near the canyons.

**Canyon Sites – Implementability**

Acquisition of the parcels and environmental permitting complexity are concerns that would need to be addressed in order for this alternative to be implemented.

**Canyon Sites – Performance**

The canyons have adequate space to accommodate staging operations or the temporary storage of sediment. Therefore, performance of the canyons as potential staging or temporary sediment storage areas is not a concern.

**Canyon Sites – Cost**

The cost to acquire and mitigate for the use of a canyon staging or temporary sediment storage area was estimated to be approximately $5 million.

## 8.3.4 REMOVAL ALTERNATIVES

The following section discusses the impacts and costs of sediment removal at Pacoima Reservoir by means of excavation, dredging, and sluicing. Discussion of the transportation and placement alternatives is presented in Sections 8.3.5 and 8.3.6, respectively. Combined alternatives that address all phases of the sediment management process are presented and discussed in Section 8.3.7.

### 8.3.4.1 EXCAVATION

Excavation has not previously been used at Pacoima Reservoir to remove accumulated material. Under regular operating conditions, Pacoima Reservoir is never completely dry, even outside of the storm season. Since there is no access to the back of Pacoima Reservoir (as of 2012), an access road would need to be constructed if excavation is to be employed (refer to Figure 8-31).

**Excavation – Environmental Impacts**

During a previous biological survey, a two-striped garter snake was observed along Pacoima Creek. Fish resembling the arroyo chub, the only known native species to Pacoima Creek, have also been observed along Pacoima Creek. Reestablishment of the access road to the back of Pacoima Reservoir and complete drainage of the reservoir should consider potential impacts to these and other species.

Emissions during construction of the back access road to Pacoima Reservoir and during excavation of the reservoir could potentially impact air quality.

**Excavation – Social Impacts**

Using excavation to remove the sediment accumulated in Pacoima Reservoir is not expected to impact traffic other than during the mobilization and the demobilization of the operations.

Due to the remote location of Pacoima Reservoir, reestablishment of the back access road and excavation operations are not expected to impact the viewshed of any residences. However, such operations could impact the view of visitors to the ridges above the reservoir.

As previously stated, there are no permitted recreational uses within Pacoima Reservoir; therefore, the road construction and excavation operations would not conflict with such use. Draining the reservoir in anticipation of excavation activities is not expected to impact recreation along Pacoima Wash as the wash does not have permitted recreational uses either. Moreover, as long as flows from Pacoima Reservoir into Lopez Flood Control Basin are able to be restricted to nonrecreational areas within the flood control basin, impact to recreational resources at Lopez Flood Control Basin would not be expected as a result of draining Pacoima Reservoir.

**Excavation – Implementability**

Pacoima Reservoir and the potential location of the access road to the back of the reservoir are located within Flood Control District right of way.

Reestablishment of the access road and excavation of the reservoir would require environmental regulatory permits.

Given the Flood Control District's experience with excavating sediment from other reservoirs and constructing roads in remote areas, implementing such operations for the purpose of managing sediment at Pacoima Reservoir is technically certain.

Maintenance of the access road into the back of Pacoima Reservoir would depend on the type of road constructed and the degree to which future storm flows would affect the road.

**Excavation – Performance (for Excavation)**

The reservoir must be completely drained of water prior to excavation, a process that depends on the initial reservoir level, valve operations, and downstream channel conditions. Approximately two months would be required to drain the reservoir and begin excavating sediment. For additional performance concerns, refer to Section 6.

**Excavation – Cost**

The cost to excavate sediment from a reservoir is approximately $3 per cubic yard. Excavating Pacoima Reservoir's entire 7.6-MCY planning quantity would cost approximately $23 million. Alternatively, excavation of only the 3.0 MCY of larger-sized material that would not be able to be dredged or sluiced would cost approximately $9 million.

#### 8.3.4.2 DREDGING

As discussed previously, approximately 60 percent of Pacoima Reservoir's 7.6-MCY planning quantity, or 4.6 MCY, could potentially be dredged. Therefore, if dredging is employed at Pacoima Reservoir, excavation would have to be employed to remove the remaining 3.0 MCY. For the impacts associated with excavating material from Pacoima Reservoir, refer to Section 8.3.4.1.

**Dredging – Environmental Impacts**

Largemouth bass, a species that is not native to the west coast of the country, has been observed within Pacoima Reservoir. There may be other species present within Pacoima Reservoir. In order to ascertain the potential impacts dredging would have on the habitat within Pacoima Reservoir, the specifics of the habitat would need to be determined. Furthermore, existing habitat in the area(s) considered for discharge and drying of dredged material would also need to be determined.

Dredging could impact water quality within the reservoir by increasing turbidity. However, as discussed in Section 6, water quality concerns could be partially addressed with a silt curtain around the dredge. As discussed in Section 6, dredging sediment (and transporting it via a slurry pipeline) could affect water conservation.

**Dredging – Social Impacts**

Dredging of Pacoima Reservoir is not expected to have a long-lasting impact on traffic. Due to the reservoir's remote location, impacts on noise levels and visual resources would not be expected either. In addition, recreation would not be impacted because it is not permitted at Pacoima Reservoir.

**Dredging – Implementability**

No additional right of way is anticipated to be required for implementation of a dredging operation within Pacoima Reservoir. Concerns associated with stockpiling of dredged material outside of the reservoir parcels are discussed in Section 8.1.3.

As for any other operation within Pacoima Reservoir, dredging would require environmental regulatory permits.

As discussed in Section 6, while dredging is a technique that has been used in other areas of the country for decades, dredging has not previously been employed by the Flood Control District. Analysis would be needed to determine if dredging is implementable at Pacoima Reservoir. It is expected that a dredging operation at Pacoima Reservoir would be more difficult to implement compared to other reservoirs under the jurisdiction of the Flood Control District, particularly due to the lack of roadway access to the body of the reservoir.

**Dredging – Performance**

Considering the capabilities of the dredging equipment and slurry pipeline discussed in Section 6, it would take approximately twelve (12) 6-month dredging operations to dredge the entire 4.6 MCY of material that could potentially be able to be dredged from Pacoima Reservoir during the 20-year planning period. Each 6-month dredging operation would remove approximately 400,000 CY of sediment from the reservoir.

As discussed in Section 6, because the dredge would draw water in addition to sediment, approximately 4 MCY or 2,500 acre-feet of water-sediment slurry would need to be dewatered as a result of each dredging operation. Given the assumed capabilities of the dredging equipment, the water-sediment mixture would flow into the dewatering area at a rate of approximately 15 cfs. Dewatering requirements and the availability of a dewatering area would need to be evaluated as part of a reservoir-specific planning effort.

**Dredging – Cost**

Based on the estimated unit cost, dredging the entire 4.6 MCY of sediment that could potentially be dredged from Pacoima Reservoir during the 20-year planning period would cost approximately $48 million.

#### 8.3.4.3 SLUICING (AS A REMOVAL METHOD)

Similar to dredging, approximately 60 percent of Pacoima Reservoir's 7.6-MCY planning quantity, or 4.6 MCY, could be small enough to sluice. Therefore, if sluicing is employed at Pacoima Reservoir, excavation would have to be employed to remove the remaining 3.0 MCY. For the impacts associated with excavating material from Pacoima Reservoir, refer to Section 8.3.4.1. This section focuses on sluicing as a sediment removal method and discusses the impacts of sluicing within Pacoima Reservoir only.

**Sluicing (Removal) – Environmental Impacts**

Within Pacoima Reservoir itself, sluicing would be expected to impact habitat in a similar manner as excavating sediment from the reservoir would since in both cases the reservoir would need to be drained. See the discussion under Excavation (Section 8.3.4.1) for more information.

As discussed in Section 6, employing sluicing to remove sediment would not impact water quality within the reservoir but could impact groundwater recharge.

Given the Flood Control District's previous sluicing projects, only a few pieces of equipment would be necessary within the reservoir in order to remove sediment by sluicing. Therefore, air quality impacts would not be significant.

**Sluicing (Removal) – Social Impacts**

Removal of sediment from Pacoima Reservoir through sluicing could impact the view from ridges above the reservoir as the reservoir needs to be drained and there would be equipment within the reservoir. There are no permitted recreational activities in the reservoir, so no impacts on recreation are expected.

**Sluicing (Removal) – Implementability**

Access to Pacoima Reservoir and activities within the reservoir do not pose any right of way concerns.

Similar to other methods of sediment removal already discussed, sluicing Pacoima Reservoir would require environmental regulatory permits.

Given that seven sluicing projects were conducted at Pacoima Reservoir in the past, it is technically certain that sluicing is able to be used to remove sediment from Pacoima Reservoir.

**Sluicing (Removal) – Performance**

Based on previous experiences, historical inflows into the reservoir, and Lopez Flood Control Basin's capacity, it was estimated that approximately 500,000 CY of sediment could be removed from Pacoima Reservoir in a year by sluicing. At this rate, sluicing would have to be performed approximately 9 of the 20 years in the planning period in order to sluice 4.6 MCY of sediment from the reservoir. However, it is important to note that the ability to sluice and quantity of sluiced material is dependent on inflow into the reservoir, which is entirely dependent on the weather.

In addition to inflow, another factor that limits sluicing is the availability of temporary storage areas and the rate at which they can receive the sluiced water-sediment mixture. As discussed in Section 6, it was assumed that the water-sediment slurry sluiced from a reservoir could have a nine-to-one water-to-sediment ratio. Therefore, sluicing 500,000 CY of sediment would result in the need to dewater 5 MCY or 3,000 AF of water-sediment slurry.

**Sluicing (Removal) – Cost**

Based on the estimated unit cost, sluicing 4.6 MCY of sediment from Pacoima Reservoir during the 20-year planning period would cost approximately $12 million.

### 8.3.5 TRANSPORTATION ALTERNATIVES

The following section discusses the impacts and costs of transporting sediment removed from Pacoima Reservoir by means of sluicing, trucking, conveyor belt, and slurry pipeline. Discussion of the removal alternatives was presented in Section 8.3.4. The placement alternatives are presented in Section 8.3.6. Combined alternatives that address all phases of the sediment management process are presented and discussed in Section 8.3.7.

#### 8.3.5.1 SLUICING (AS A TRANSPORT METHOD)

This section focuses on the impacts of utilizing sluicing as a transport method to move sediment downstream of Pacoima Dam along Pacoima Wash to Lopez Flood Control Basin. For the impacts of sluicing operations within Pacoima Reservoir, refer to the discussion of sluicing as a removal method in Section 8.3.4.3. Impacts at Lopez Flood Control Basin were discussed in Section 8.3.3.1.

**Sluicing (Transport) – Environmental Impacts**

Past vegetation and wildlife surveys conducted along Pacoima Wash between Pacoima Dam and Lopez Flood Control Basin have indicated the presence of riparian habitat, special status plant species such as Plummer's mariposa lily and Davidson's bush mallow, and least Bell's vireo, a California-listed endangered species. Sluicing activities could be temporarily disruptive to the existing habitat.

Transporting sediment via sluicing would impact water quality along Pacoima Wash. As discussed in Section 6, transporting sediment via sluicing could affect water conservation.

**Sluicing (Transport) – Social Impacts**

Sluicing sediment along Pacoima Wash is not expected to have impacts on traffic or noise levels. Visual impacts would consist of flows in Pacoima Wash with higher levels of sediment than normal. No impacts are expected to Los Angeles Mission College's Athletic Field immediately west of Pacoima Wash. Stakeholders have expressed concern over potential impacts to areas used by hang gliding activities downstream Pacoima Reservoir and adjacent to Pacoima Wash.

**Sluicing (Transport) – Implementability**

While sluicing sediment along Pacoima Wash would not require right of way agreements, accessing the wash with equipment to manage the deposition of sediment along the wash would need them. Additionally, the Flood Control District would need to obtain environmental regulatory permits in order to sluice sediment along Pacoima Wash.

Given that as of 2012, seven sluicing operations have been conducted to transport sediment downstream of Pacoima Dam, sluicing is a technically certain method of transporting sediment downstream of the dam.

**Sluicing (Transport) – Performance**

As noted in the previous section that discussed sluicing as a removal method, approximately 500,000 CY of sediment could be sluiced from Pacoima Reservoir in a year. Given a nine-to-one water-to-sediment ratio, this would mean during a sluicing year approximately 5 MCY or 3,000 AF of water-sediment slurry would be transported along Pacoima Wash in a year. The ability of Pacoima Wash to handle said volumes will need to be considered. In addition, sediment deposition locations and the possibility of flushing the stream course to remove the deposits will need to be analyzed if sluicing is to be employed.

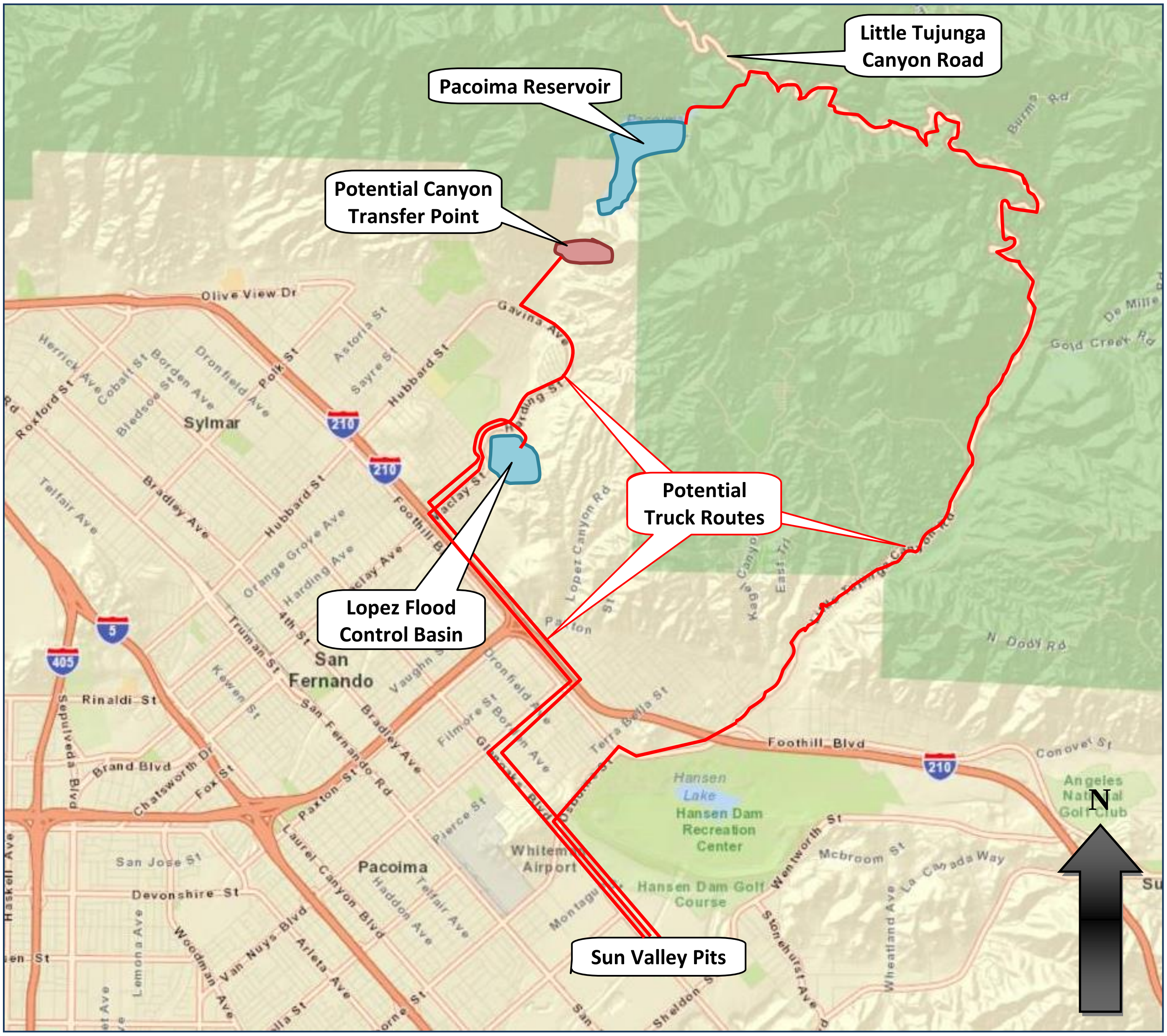
**Sluicing (Transport) – Cost**

The cost of transporting sediment via sluicing is minimal.

#### 8.3.5.2 TRUCKING

Trucking could be employed to transport sediment from Pacoima Reservoir, a staging area, and/or a temporary sediment storage area to a placement location. As of 2012, there was no access to the back of the reservoir. In order to truck sediment directly from the reservoir to a placement location, the access road from Little Tujunga Canyon Road to the back of the reservoir would need to be reestablished. Refer to the impacts associated with the reestablishment of the access road into Pacoima Reservoir were discussed under Excavation, in Section 8.3.4.1. This section focuses on the impacts associated with trucking sediment along the general routes shown in Figure 8-35.

**Figure 8-35 General potential trucking routes for transportation of sediment from Pacoima Reservoir**




**Trucking – Environmental Impacts**

Since existing roads would be used to truck sediment along the general routes previously shown, no particular impacts would be expected on habitat, water quality, or groundwater recharge. The use of low emission trucks would reduce air quality impacts.

**Trucking – Social Impacts**

Employing trucks could significantly impact traffic, especially if trucking sediment from behind Pacoima Reservoir as Little Tujunga Canyon Road is a two-lane, sinuous road. For the most part, trucks would travel along nonresidential roads; however, neighborhoods cannot be avoided entirely, as shown on Figure 8-36 through Figure 8-39. Restrictions on trucking start and end times would help reduce noise and visual impacts in residential areas. Access to recreational resources along Little Tujunga Canyon Road could potentially be impacted with the increase in traffic.

**Figure 8-36 Potential truck route from Pacoima Reservoir**


**Figure 8-37 Potential truck route from Lopez Flood Control Basin**

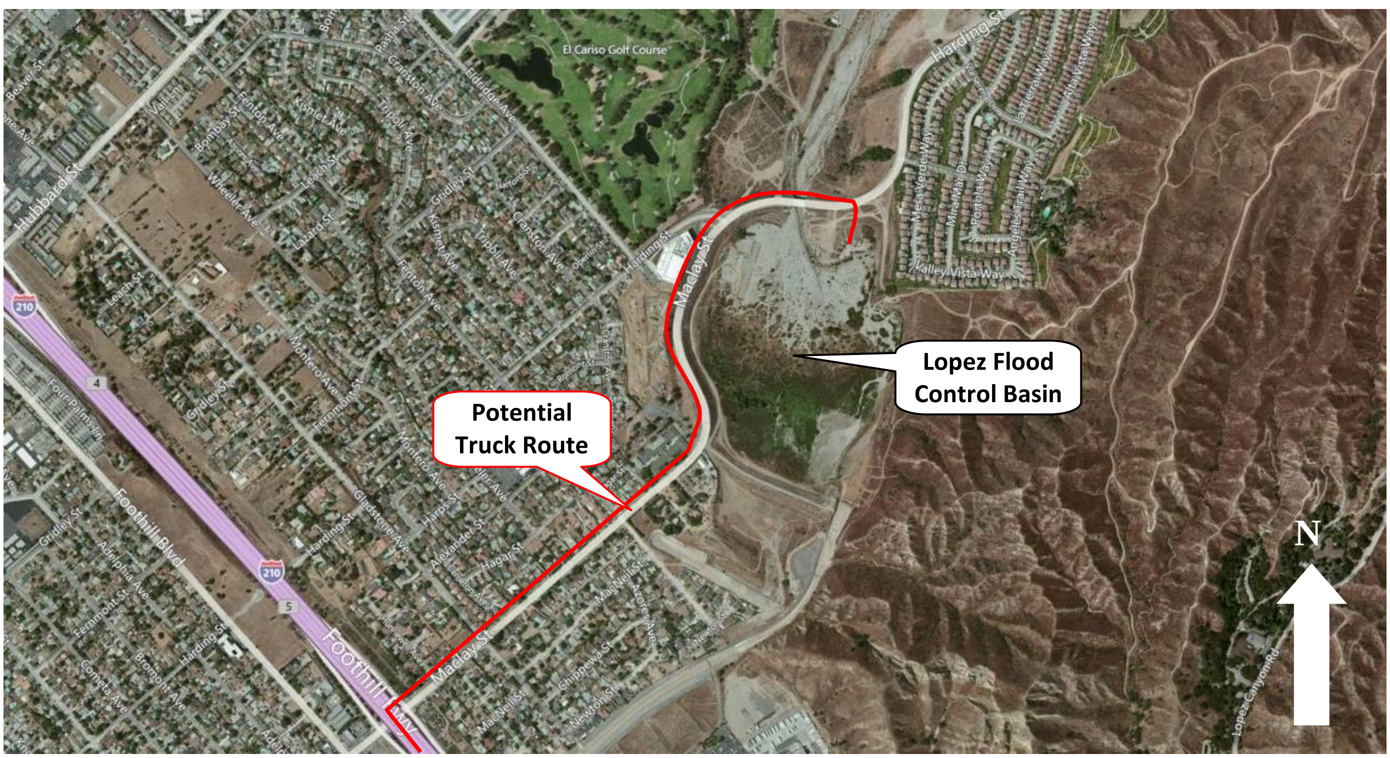


**Figure 8-38 Potential truck route from potential canyon transfer point**

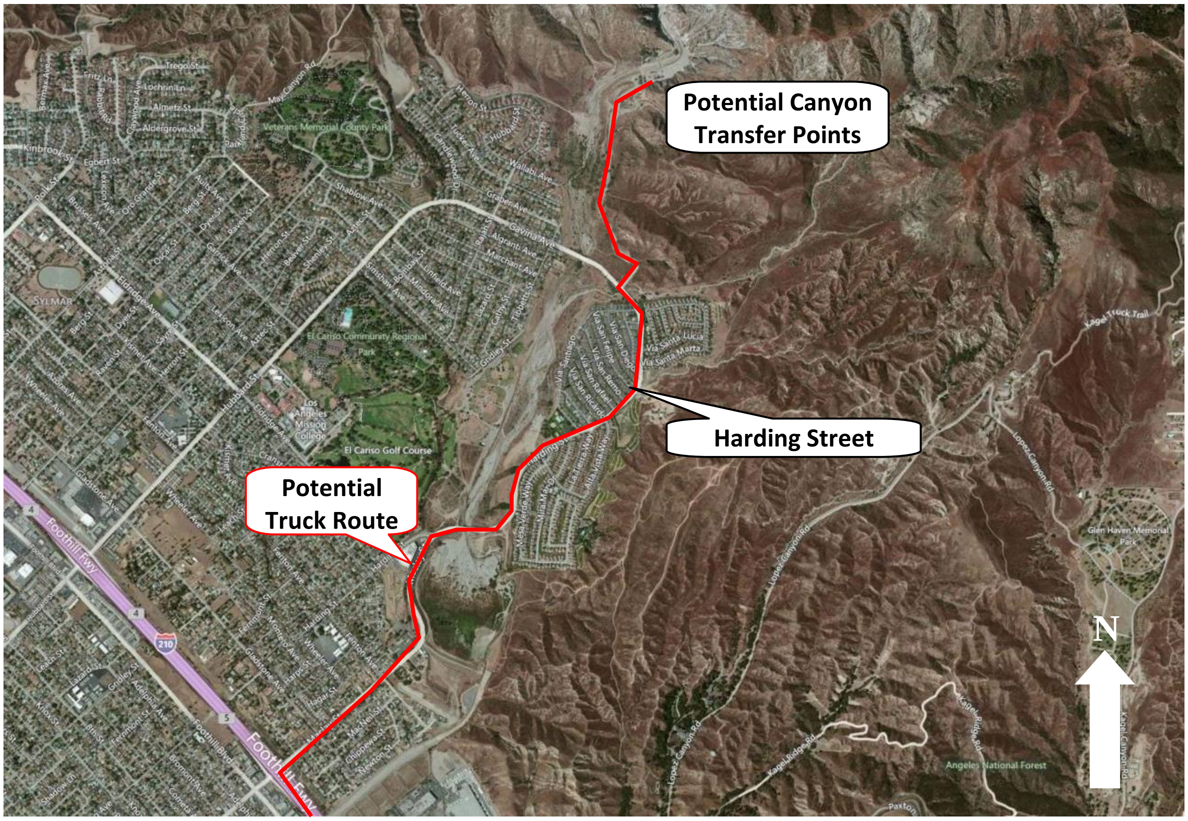



**Figure 8-39 Potential truck route to pits in Sun Valley**

**Trucking – Implementability**

Since trucking would occur on existing public roads, there are no right of way or permitting concerns.

**Trucking – Performance**

The following assumptions were made while considering trucking as an alternative for transporting all or part of Pacoima Reservoir's 7.6-MCY planning quantity.

- Single dump trucks with a capacity of approximately 8 CY per truck would be required when trucking directly from the reservoir due to the narrow and winding conditions of Little Tujunga Canyon Road.
- Double dump trucks with a capacity of approximately 16 CY per truck would be used when traveling from the canyon sites or Lopez Flood Control Basin.
- Between Pacoima Reservoir and the pits in Sun Valley, trucks would travel at an average speed of 20 miles per hour. For trips between the canyons sites and the pits in Sun Valley and Lopez Flood Control Basin and the pits, trucks would travel at an average speed of 30 miles per hour.

Using these assumptions, estimates on the number of trucking operations were determined, as shown in Table 8-14 under the subsequent cost section.

**Trucking – Cost**

Trucking unit costs on single dump and double dump trucks were estimated to be \$0.65 and \$0.30 per CY per mile, respectively, based on a loading time of 1 minute per truck. The cost of trucking will vary depending on the quantity to be trucked, the origin and destination, and the type of truck that can be used. The estimated trucking costs for the various scenarios range from \$21 million to \$158 million, as shown in Table 8-14.

**Table 8-14 Estimated trucking costs for Pacoima Reservoir**

| Destination | Origin | Type of Truck | Roundtrip Distance (miles) | Quantity of Sediment (MCY) | Number of Trucking Operations | Total (millions) |
|---|---|---|---|---|---|---|
| Pits in Sun Valley | Back of Pacoima Reservoir | Single dump | 32 | 7.6 | 19 | $158 |
| | | | | 3.0[a] | 8 | $62 |
| | Canyon Transfer Points | Double dump | 19 | 7.6 | 10 | $43 |
| | Lopez Flood Control Basin | Double dump | 15 | 7.6 | 10 | $34 |
| | | | | 4.6[b] | 6 | $21 |

Notes:

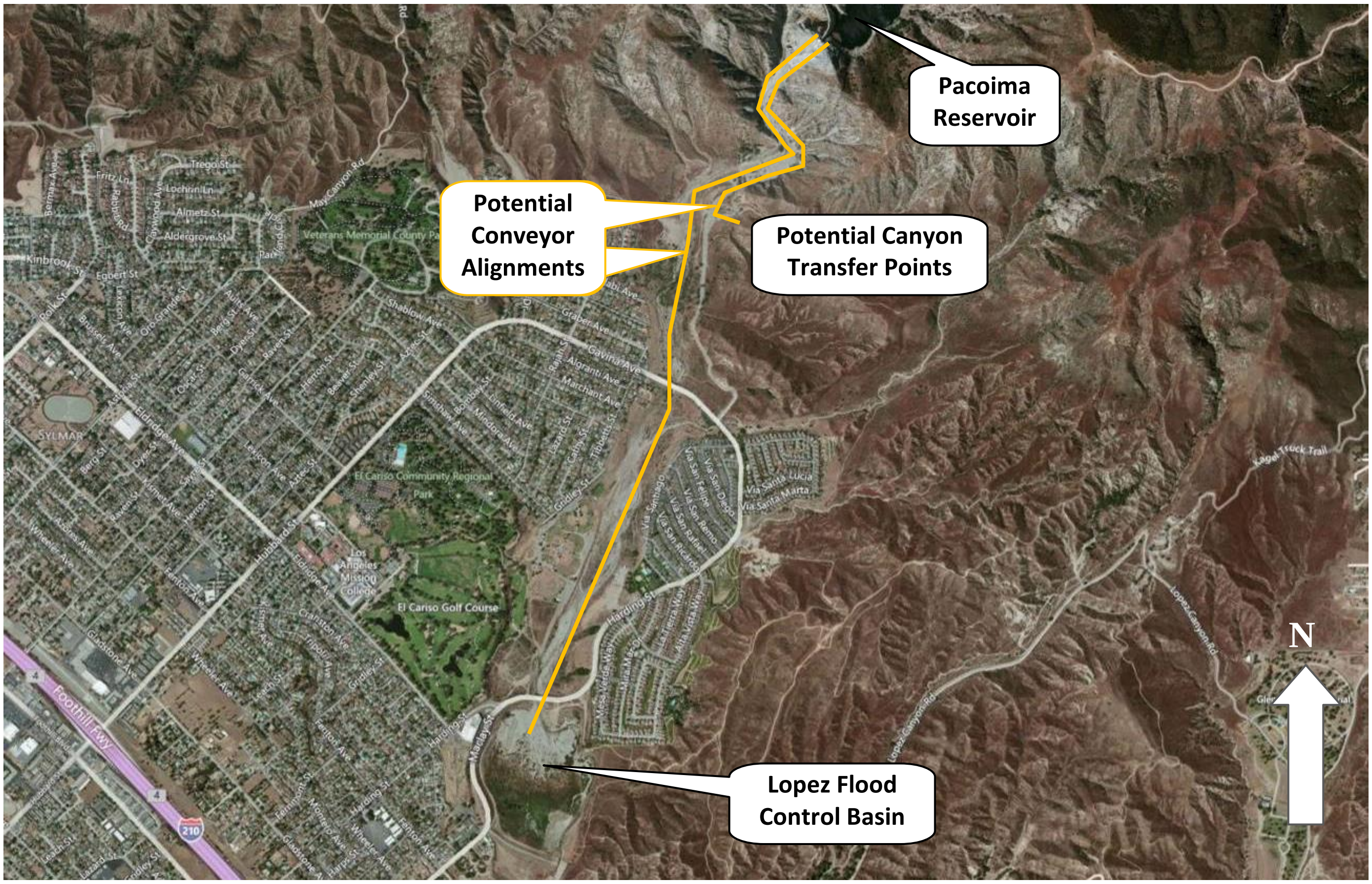
a. Approximate amount of Pacoima Reservoir's 7.6-MCY planning quantity that is too large to dredge or sluice from the reservoir.

b. Approximate amount of sediment that would need to be transported out of Lopez Flood Control Basin if the basin was to be used as the outlet of a slurry pipeline or the endpoint of a sluicing operation from Pacoima Reservoir.

#### 8.3.5.3 CONVEYOR BELTS

Conveyor belts could be used in conjunction with removal activities by excavation. This section discusses the impacts of utilizing a conveyor belt to transport sediment from Pacoima Reservoir through Pacoima Dam and on to a canyon transfer point or Lopez Flood Control Basin. The potential conveyor alignments are shown in Figure 8-40.

**Figure 8-40 Potential conveyor belt alignments**




**Conveyor Belts – Environmental Impacts**

In order to identify and minimize the potential impacts of placing and operating a conveyor belt from Pacoima Reservoir to one of the temporary sediment storage areas downstream, the habitat along the potential conveyor alignments would have to be studied. Placement of a conveyor belt along Pacoima Canyon Road would be expected to have less impact on the environment than placement of a conveyor belt along Pacoima Wash. Water quality, groundwater recharge, and air quality would not be expected to be impacted.

**Conveyor Belts – Social Impacts**

Installation and operation of a conveyor belt would cause some visual disturbances. No recreational resources would be impacted as there are no permitted recreational areas along the potential conveyor alignments.

**Conveyor Belts – Implementability**

Placement of a conveyor belt along Pacoima Canyon Road would not be expected to present any right of way issues since the road is located within a Flood Control District easement. No permitting issues would be expected either. On the other hand, placement of a conveyor belt along Pacoima Wash would present both right of way and permitting issues.

If a conveyor belt was to be placed through the sluice gate in Pacoima Dam, the conveyor belt would have to be less than five feet wide. The elevation gain and loss from one side of the dam to the other would also need to be considered in the design of the conveyor belt. The topographical conditions between Pacoima Dam and the potential temporary sediment storage areas would not be expected to lead to technical issues as the grade and curves along the potential alignments appear to be within the operational constraints of conveyor belts.

**Conveyor Belts – Performance**

Since conveyor belts would be used in conjunction with excavation operations and excavation at Pacoima Reservoir could be conducted approximately six months out of the year, it was assumed conveyors from Pacoima Reservoir to either a canyon site or Lopez Flood Control Basin would last approximately six months during a given year. Based on this assumption and other assumptions discussed in Section 6 for conveyor operations, it would take approximately ten (10) 6-month conveyors operations during the 20-year planning period to transport 7.6 MCY of sediment from Pacoima Reservoir.

**Conveyor Belts – Cost**

A conveyor belt from Pacoima Reservoir to one of the canyon sites downstream of the dam would have a generally challenging alignment. As discussed in Section 6, the estimated cost of a more difficult conveyor is approximately $1,200 per linear foot. Based on this unit cost and a conveyor length of approximately 1 mile, the cost of the conveyor belt would be approximately $6 million.

The cost of a conveyor belt from Pacoima Reservoir to Lopez Flood Control Basin would be approximately $12 million, based on the assumption that approximately 1 mile of the conveyor would have a difficult alignment and the remaining 1.5 mile would have a generally linear alignment. As discussed in Section 6, the cost for a generally linear conveyor belt would be approximately $800 per linear foot.

#### 8.3.5.4 SLURRY PIPELINE

As discussed in Section 6, slurry pipelines would be used in conjunction with dredging. A slurry pipeline could be constructed to transport dredged material from Pacoima Reservoir to Lopez Flood Control Basin.

The slurry pipeline would begin at the end of the dredge line on the downstream face of Pacoima Dam. From there, the slurry pipeline could possibly be constructed along one of two alignments, as shown in Figure 8-41.

If a dredging and slurry pipeline alternative was to be employed at Pacoima Reservoir, the feasibility of the alignments would have to be analyzed in detail. One potential alignment could be along Pacoima Wash all the way from Pacoima Dam to Lopez Flood Control Basin. The other could potentially be along Pacoima Canyon Road from Pacoima Dam to Gavina Avenue then along Pacoima Wash from Gavina Avenue to the basin. The later could require placing the slurry pipeline underground as it crossed Gavina Avenue or potentially placing it underground along Pacoima Canyon Road.

**Figure 8-41 Potential Slurry Pipeline Alignments for Pacoima Reservoir**


**Slurry Pipeline – Environmental Impacts**

In order to identify and minimize the potential environmental impacts of placing and operating a slurry pipeline from Pacoima Dam to Lopez Flood Control Basin, the habitat along the potential alignments would have to be studied. No impacts are expected on water quality, groundwater recharge, and air quality.

**Slurry Pipeline – Social Impacts**

If placed above ground, construction of the slurry pipeline would cause some visual disturbances. No recreational resources would be impacted as there are no permitted recreational areas along the potential slurry pipeline alignments.

**Slurry Pipeline – Implementability**

Placement of a slurry pipeline along Pacoima Wash and across Gavina Avenue would present both right of way and permitting issues. No right of way or permitting issues are to be expected for placement of a slurry pipeline along Pacoima Canyon Road since the road is located within a Flood Control District easement.

**Slurry Pipeline – Performance**

A slurry pipeline would be permanently installed and used at the frequency at which material would be dredged. Based on the assumptions that a dredge could remove approximately 200 CY of sediment per hour and a water-to-sediment ratio of 9 to 1 for dredging operation, the slurry pipeline would need to be able to transport approximately 2,0000 CY of the water-sediment slurry per hour (or approximately 15 cubic feet of the slurry per second). The slurry pipelines discussed in Section 6 are able to handle flow of this magnitude.

The approximately 2.5-mile slurry pipeline from Pacoima Dam to Lopez Flood Control Basin would require 3 booster pumps.

**Slurry Pipeline – Cost**

Based on the estimated construction cost of $37.50 per linear foot for above ground slurry pipelines, the estimated cost of constructing a slurry pipeline of approximately 2.5 miles from Pacoima Dam to Lopez Flood Control Basin is approximately $500,000. Given an installation and operation cost of $1 per CY of sediment per booster pump, the cost of installing and operating 3 booster pumps to transport 2.9 MCY of sediment was estimated to be $13 million.

## 8.3.6 PLACEMENT ALTERNATIVES

This section discusses the impacts and costs of potential placement alternatives for sediment removed from Pacoima Reservoir. Specifically, this section discusses the placement of sediment at pits and potential new sediment placement site(s). Discussion of the removal and transportation was presented in Sections 8.3.4 and 8.3.5, respectively. Combined alternatives that address all phases of the sediment management process are presented and discussed in Section 8.3.7.

### 8.3.6.1 PITS

As discussed in Section 6, there are multiple pits in Sun Valley. Refer back to Figure 8-35 on page 8-59 for the location of the pits in relation to Pacoima Reservoir and Lopez Flood Control Basin. The one-way trucking distance from the back of Pacoima Reservoir, the canyon sites downstream of the reservoir, and Lopez Flood Control Basin to the pits ranges from 8.5 miles to 16 miles. The general impacts of employing pits for sediment placement were discussed in Section 6.

It was assumed that 40 percent of Pacoima Reservoir's 7.6-MCY planning quantity, or 3.0 MCY, would be marketable. Given that assumption and other assumptions discussed in Section 6, it was assumed that pits operated by the gravel industry would accept a total of 6.0 MCY of sediment from Pacoima Reservoir free of charge. Depending on the type of truck used to deliver sediment to the third-party owned pits, tipping fees of $10 to $15 per cubic yard would have to be paid for the remaining 1.6 MCY of sediment. If the 1.6 MCY of sediment were to be trucked from the Pacoima Reservoir, single dump trucks would have to be used; therefore, the tipping fees would total approximately $24 million. If the 1.6 MCY of sediment were to be trucked from the canyon sites or Lopez Flood Control Basin, double dump trucks would be able to be used; therefore, the tipping fees would be approximately $16 million.

However, as discussed in Section 6, the acquisition of pits for the placement of sediment from facilities under the jurisdiction of the Flood Control District should be pursued. For planning purposes, it was assumed that the only material that would be placed at a Flood Control District-owned pit would be material that would not be accepted at the third-party owned pits for free. It would cost a total of $3 per cubic yard to acquire and place 1.6 MCY of sediment at the Flood Control District-owned pit. The cost to place 1.6 MCY in a Flood Control District-owned pit, including the cost to acquire the pit, would be approximately $4.8 million.

### 8.3.6.2 POTENTIAL NEW CANYON SEDIMENT PLACEMENT SITE(S)

This section discusses the impacts associated with developing a sediment placement site in one or both of the canyons discussed in Section 8.3.3.2. This placement alternative could potentially be used in combination the transportation alternative involving a conveyor from Pacoima Dam to the canyons.

**Canyon SPSs – Environmental Impacts**

If the canyons were to be used for placement, both canyons could be highly impacted over the life of the project. Nearby mitigation sites could be used to offset the impacts to the canyons. Additionally, once work is complete, habitat could be reestablished on disturbed areas. Air quality would be affected by emissions of equipment used at the site for placement, but this alternative would have minimal impact to water quality and quantity.

**Canyon SPSs – Social Impacts**

Development and use of the canyons as a sediment placement site would have some visual impacts. However, grading the SPSs in a manner that resembles the natural terrain nearby could reduce those visual impacts. There would be some noise impacts, particularly for the neighborhood located across Pacoima Wash from the canyons. Limits on working hours and equipment noise would limit impacts.

There are no permitted recreational activities in the canyons. As a result, no impacts on recreation are expected. Nonetheless, stakeholders have expressed a concern over potential disruption of people's recreational use of the canyons. Some stakeholders have also expressed concern that temporary storage of sediment in the canyons could change wind conditions and possibly affect hang gliding activities near the canyons.

**Canyon SPSs - Implementability**

Acquisition of the parcels and environmental permitting complexity are concerns that could likely be addressed. The Flood Control District may possibly need to obtain environmental regulatory permits in order to develop a sediment placement site in one or both of the canyon sites.

**Canyon SPSs - Performance**

With an approximate placement capacity of 19 MCY, the canyons would easily be able to serve Pacoima Reservoir's 20-year sediment management need of 4.8 MCY.

**Canyon SPSs - Cost**

The cost to acquire, develop a sediment placement site, and mitigate the impacts of such use was estimated to be approximately $6 million.

### 8.3.7 COMBINED SEDIMENT MANAGEMENT ALTERNATIVES

There are six combined sediment management alternatives for Pacoima Reservoir. A description of each of these and the combined impacts and costs are subsequently provided. For specific details regarding environmental impacts, social impacts, feasibility, implementability, and cost for the individual removal, transportation, temporary sediment storage, and placement components refer to Sections 8.1.3 through 8.1.6. Please note that combined alternatives that include dredging and sluicing assume 60 percent of Pacoima Reservoir's planning quantity could be dredged or sluiced and that the remainder would have to be excavated and trucked from the back of the reservoir.

All the combined sediment management alternatives, except for Combined Alternative 5, show a range in cost. The lower cost is based on the assumption that 40 percent of the 20-year planning quantity is marketable, that the gravel industry will accept the 40 percent plus an additional 40 percent of the material free of charge, and that the remaining 20 percent is placed at a quarry the Flood Control District has acquired. The higher cost assumes the

Flood Control District was not able to acquire a quarry and so that all sediment has to be delivered to the gravel industry. The assumption is that the Flood Control District would have to pay tipping fees ($10/CY) for 20 percent of the 20-year planning quantity.

### 8.3.7.1 COMBINED ALTERNATIVE 1: EXCAVATE → TRUCKS → SUN VALLEY PITS

This alternative involves draining the reservoir, excavating the sediment under dry conditions, and then trucking the sediment through a back access road. The sediment would be trucked to the pits in Sun Valley. Figure 8-42 and Figure 8-43 schematically illustrate this alternative. Due to the need to fully drain the reservoir, this alternative would be implementable approximately six months during a given year.

**Figure 8-42 Pacoima Reservoir's Alternative 1, Map 1 of 2**

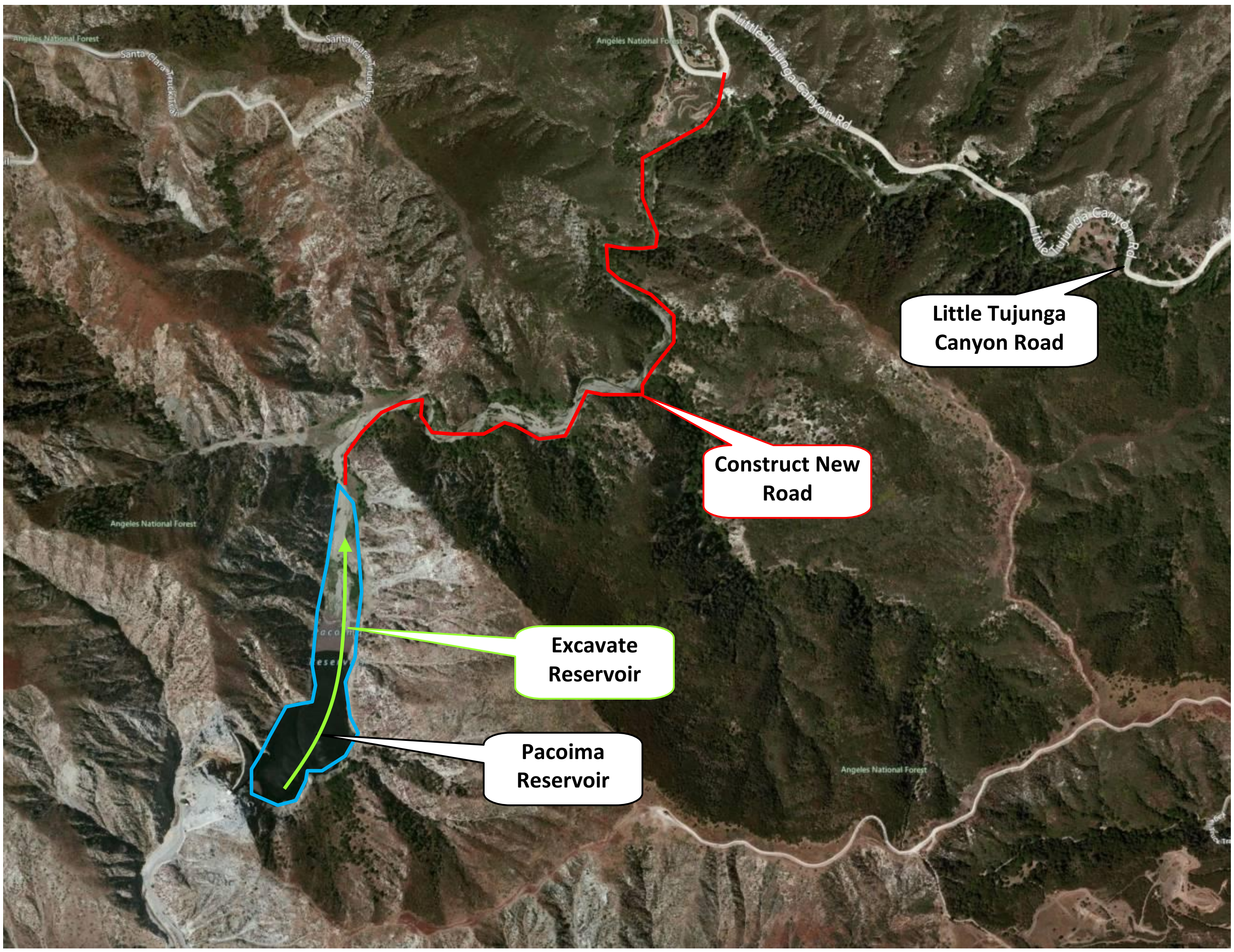


**Figure 8-43 Pacoima Reservoir's Alternative 1, Map 2 of 2**


Construction of an access road to the back of Pacoima Reservoir is required for this alternative, which would result in impact to habitat. Further analysis is needed to determine if there are various potential road alignments, and if so, which one would have the least environmental impact. In any case, mitigation of environmental impacts would be required as they would not be able to be avoided. Air quality would be impacted by the use of excavation equipment and trucks. Use of low emission trucks would reduce air quality impacts.

In order to remove the entire 7.6 MCY planning quantity during the 20-year planning period, sediment removal operations involving excavation in conjunction with trucking would need to occur during approximately 19 of the 20 years. This assumes an operation duration of approximately six months per cleanout.

For the most part, trucks directly transporting sediment from Pacoima Reservoir to a site in Sun Valley would travel along nonresidential roads. However, the route would pass along some residential areas, as previously shown on Figures 8-37 to 8-40.

Implementation of this alternative could cost an estimated $190 million to $200 million. The breakdown of the estimated costs is provided in Table 8-15.

**Table 8-15 Estimated costs for Pacoima Reservoir's Alternative 1**

| Activity | Estimated Cost (in millions) |
|---|---|
| Construct and mitigate for road from Little Tujunga Canyon Road to back of Pacoima Reservoir | $ 2 |
| Excavate sediment from Pacoima | $ 23 |
| Truck sediment to pits in Sun Valley | $ 158 |
| Place sediment at pits in Sun Valley | $ 5-15 |
| Total | $ 190-200 |

### 8.3.7.2 COMBINED ALTERNATIVE 2A: EXCAVATE → CONVEYOR → CANYON TRANSFER POINT → TRUCKS → SUN VALLEY PITS

This alternative consists of draining Pacoima Reservoir, excavating the sediment, transporting it to a canyon temporary sediment storage area via a conveyor belt through the dam, and then trucking it from the temporary sediment storage area to a placement site. Figure 8-44 and Figure 8-45 schematically illustrate this alternative.

**Figure 8-44 Pacoima Reservoir's Alternative 2A – Map 1 of 2**

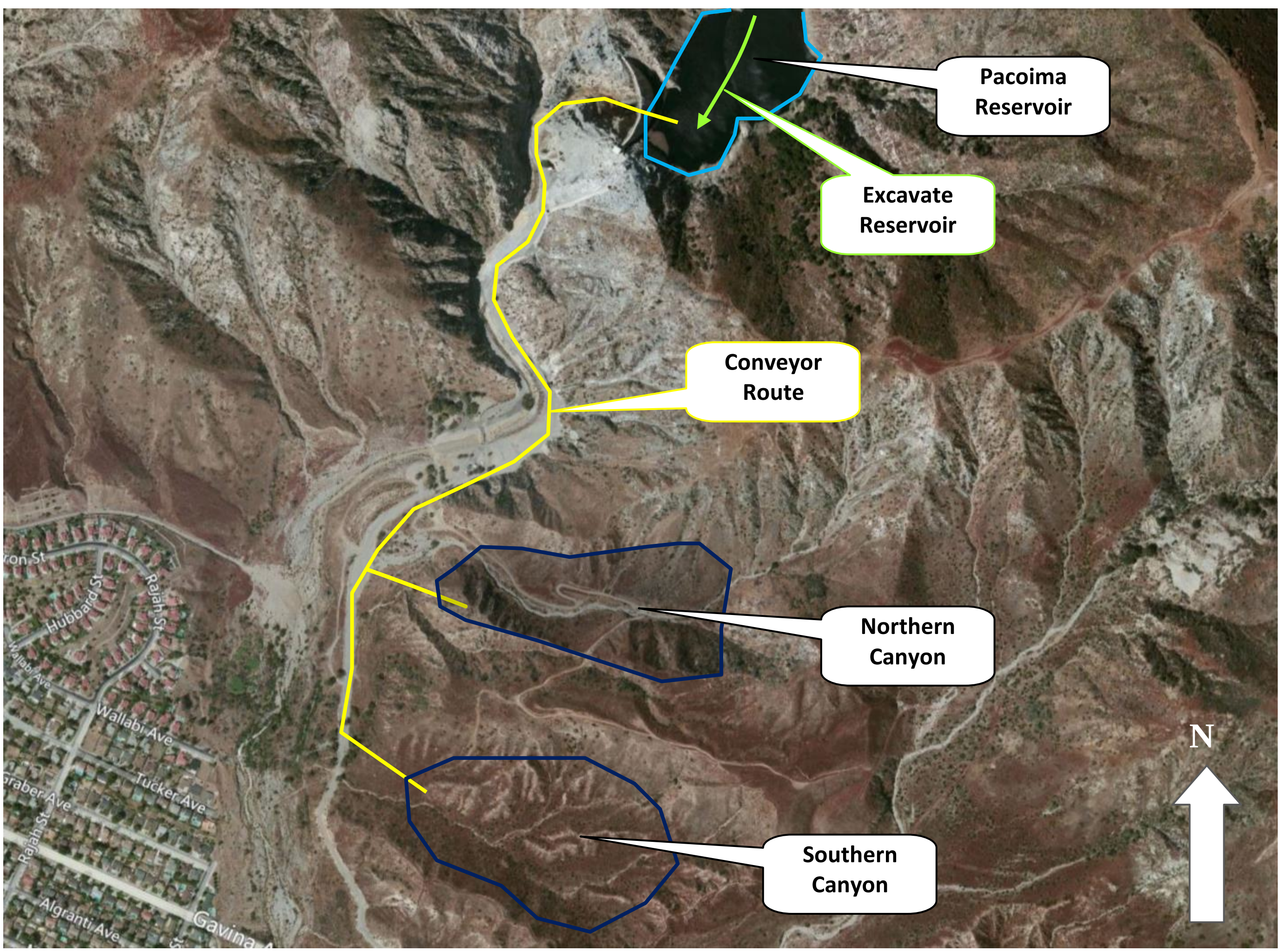


**Figure 8-45 Pacoima Reservoir's Alternative 2A – Map 2 of 2**


One of the limitations of this alternative is the Flood Control District's ability to acquire or obtain permission to use one of the canyons downstream of Pacoima Reservoir for the transfer of sediment from conveyor belt to trucks.

The conveyor belt could be placed along Pacoima Canyon Road, which would limit interference with habitat along the conveyor's alignment.

Employing this combined alternative to remove the entire 7.6 MCY planning quantity during the 20-year planning period would require 10 separate operations. This is based on the assumptions that 800 CY (or approximately 1,200 tons) of sediment could be transported on the conveyor belt every hour, 8 hours per day, 4 months a year.

Implementation of this alternative could cost an estimated $85 million to $95 million. The breakdown of the estimated costs is provided in Table 8-16.

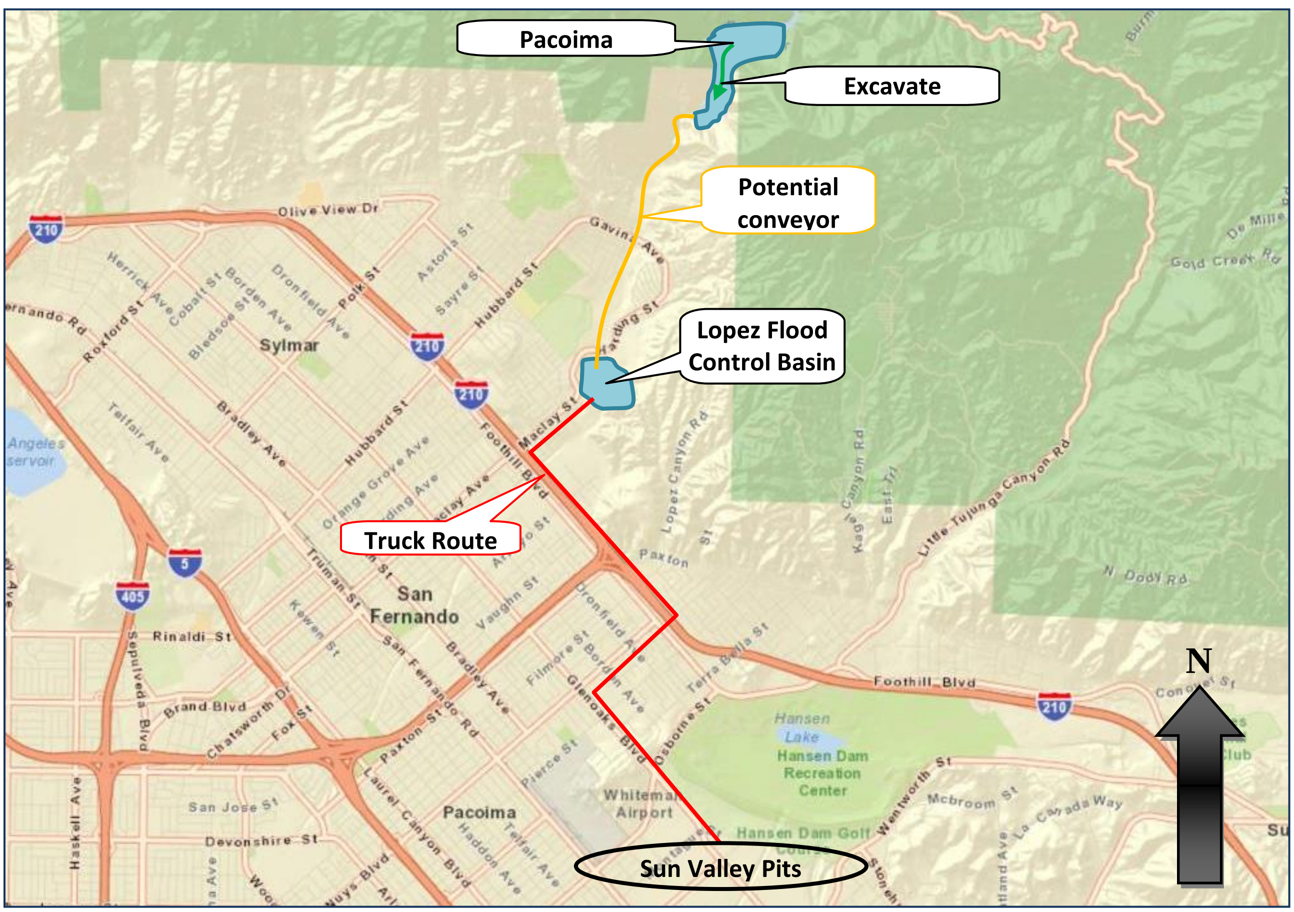
**Table 8-16 Estimated costs for Pacoima Reservoir's Alternative 2A**

| Activity | Estimated Cost |
|---|---|
| Construct and mitigate for temporary access roads to Pacoima Reservoir | $2 M |
| Excavate material | $23 M |
| Acquire canyon temporary sediment storage area | $2 M |
| Mitigate for use of the canyon temporary sediment storage area | $3 M |
| Convey sediment from Pacoima Reservoir to canyon temporary sediment storage area | $6 M |
| Truck to pits in Sun Valley | $43 M |
| Place sediment at pits in Sun Valley | $5-15 M |
| **Total** | **$85-95 M** |

### 8.3.7.3 Combined Alternative 2B: Excavate → Conveyor → Lopez Flood Control Basin Transfer Point → Trucks → Sun Valley Pits

Combined Alternative 2B is essentially the same as Combined Alternative 2A, except for the endpoint of the conveyor belt and potential temporary sediment storage area. In Combined Alternative 2B, the conveyor would extend from Pacoima Reservoir to Lopez Flood Control Basin. Figure 8-46 illustrates this alternative.

**Figure 8-46 Pacoima Reservoir's Alternative 2B**



This alternative would require the Army Corps of Engineers' permission for the Flood Control District to use Lopez Flood Control Basin for staging and stockpiling operations. In addition, permission from the Army Corps of Engineers would need to be acquired in order to place the conveyor belt along Pacoima Wash.

Implementation of this alternative would require 10 separate cleanout operations, which could cost an estimated $75 million to $85 million. The breakdown of the estimated costs is provided in Table 8-17.

**Table 8-17 Estimated costs for Pacoima Reservoir's Alternative 2B**

| **Activity** | **Estimated Cost** |
|---|---|
| Construct and mitigate for temporary access roads to Pacoima Reservoir | $2 M |
| Excavate material | $23 M |
| Convey sediment from Pacoima Reservoir to Lopez Flood Control Basin | $12 M |
| Truck to the pits in Sun Valley | $34 M |
| Place sediment at the pits in Sun Valley | $5-15 M |
| **Total** | **$75-85 M** |

#### 8.3.7.4 COMBINED ALTERNATIVE 3: DREDGE (4.6 MCY) → SLURRY PIPELINE → LOPEZ FLOOD CONTROL BASIN → EXCAVATE → TRUCKS → SUN VALLEY PITS + EXCAVATE (3.0 MCY) → TRUCKS → PITS IN SUN VALLEY

This alternative would involve sediment removal operations at the Army Corps of Engineers' Lopez Flood Control Basin in addition to sediment removal operations at Pacoima Reservoir. First, in order to create capacity for the material to be delivered to Lopez Flood Control Basin, sediment would be excavated from the basin and trucked to the pits in Sun Valley. Subsequently, sediment would be dredged from Pacoima Reservoir and the sediment-water mixture transported to the basin through a slurry pipeline. Additionally, because the large material in Pacoima Reservoir would not be able to be dredged, the larger material would have to be excavated. It was assumed the large material would then be trucked to a pit in Sun Valley. Figure 8-47 and Figure 8-48 illustrate this alternative.

**Figure 8-47 Pacoima Reservoir's Alternative 3 – Map 1 of 2**

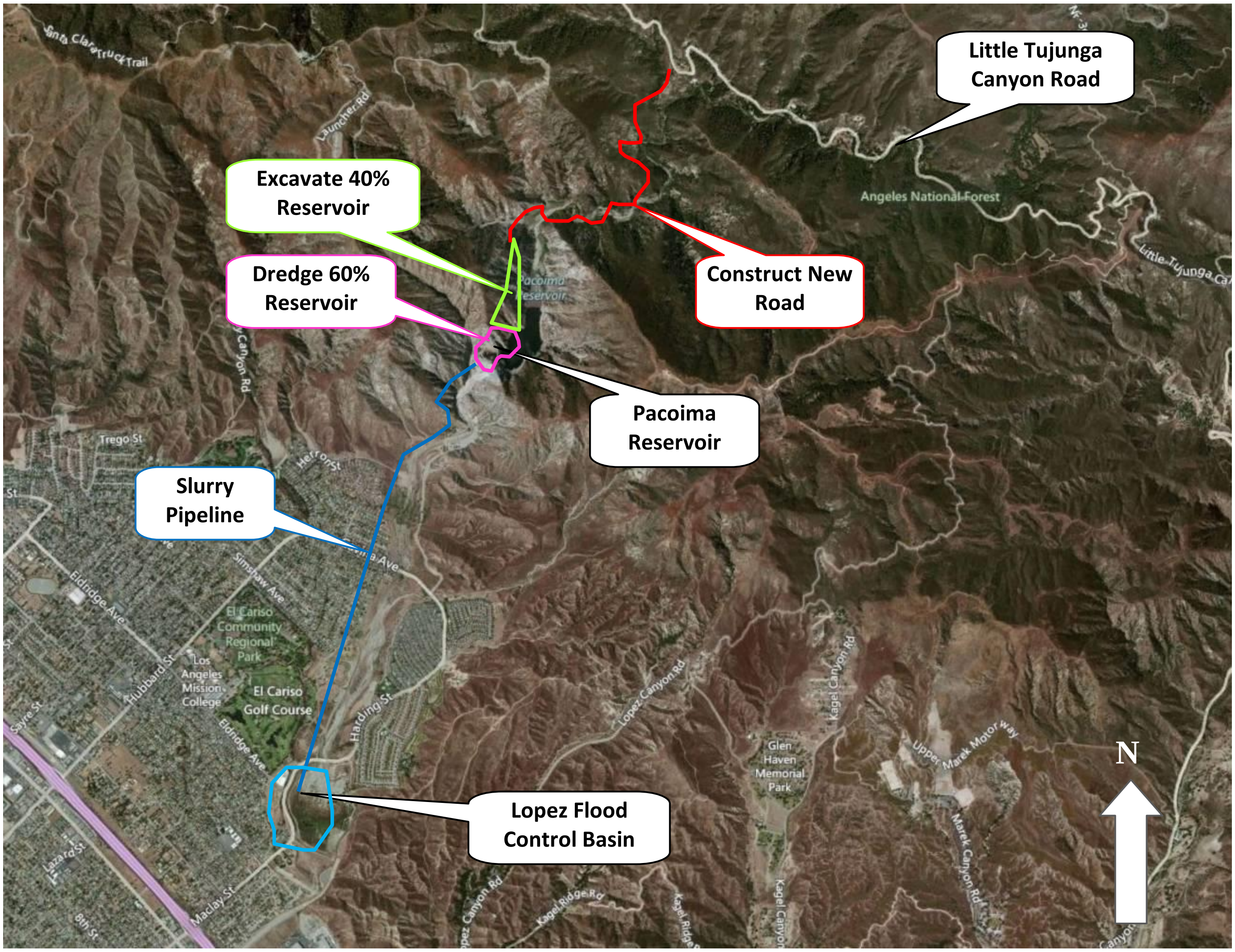


**Figure 8-48 Pacoima Reservoir's Alternative 3 – Map 2 of 2**


Implementation of this alternative is highly dependent on the ability to obtain permission from the Army Corps of Engineers to use Lopez Flood Control Basin as a dewatering and temporary sediment storage area for the dredged material and the ability to create enough capacity for the operations.

Given the assumptions made regarding dredging operations and assuming capacity at Lopez Flood Control Basin would not limit the dredging operations, it could take 12 dredging operations during the 20-year planning period to remove the 4.6 MCY of sediment that could potentially be dredged from Pacoima Reservoir. If the operations could be conducted on a regular basis, the interval between the dredging operations would range from one to two years. The remaining 3.0 MCY of larger material that could not be dredged would need to be excavated and removed in possibly 8 separate operations. Dredging and excavation operations may be able to be conducted in the same year, just during different parts of the year.

Trucks used to transport sediment would pass through several residential areas as previously shown on Figure 8-36 through Figure 8-39.

Implementation of this alternative could cost from an estimated $185 million to $195 million. The breakdown of the estimated costs is provided in Figure 8-17.

**Table 8-18 Estimated costs for Pacoima Reservoir's Alternative 3**

| Activity | Estimated Cost |
|---|---|
| Excavate material at Lopez Flood Control Basin to create capacity | $14 M |
| Truck material from Lopez Flood Control Basin on double-dump trucks | $21 M |
| Place sediment at pits in Sun Valley | $5-15 M |
| Dredge sediment from Pacoima Reservoir | $48 M |
| Construct and operate slurry pipeline | $22 M |
| Construct and mitigate for temporary access roads to Pacoima Reservoir | $2 M |
| Excavate the larger material that cannot be dredged | $9 M |
| Truck the larger material from the reservoir to the pits in Sun Valley on single-dump trucks | $62 M |
| **Total** | **$185-195 M** |

#### 8.3.7.5 COMBINED ALTERNATIVE 4: SLUICE (4.6 MCY) → LOPEZ FLOOD CONTROL BASIN → EXCAVATE → TRUCKS → SUN VALLEY PITS + EXCAVATE (3.0 MCY) → TRUCKS → PITS IN SUN VALLEY

Combined Alternative 4 would involve sediment removal operations at the Army Corps of Engineers' Lopez Flood Control in addition to sediment removal operations at Pacoima Reservoir. It was assumed that sediment within the Lopez Flood Control Basin would be excavated and trucked to a placement site. Once capacity had been made available at the basin, Pacoima Reservoir would be drained to expose the accumulated sediment. Water flowing through the reservoir would then carry the sediment from Pacoima Reservoir to Lopez Flood Control Basin, returning the basin's capacity to where it had been prior to the presluicing excavation at the basin and the sluicing operation at Pacoima. Figure 8-49 and Figure 8-50 illustrate this alternative.

Figure 8-49 Pacoima Reservoir's Alternative 4 – Map 1 of 2

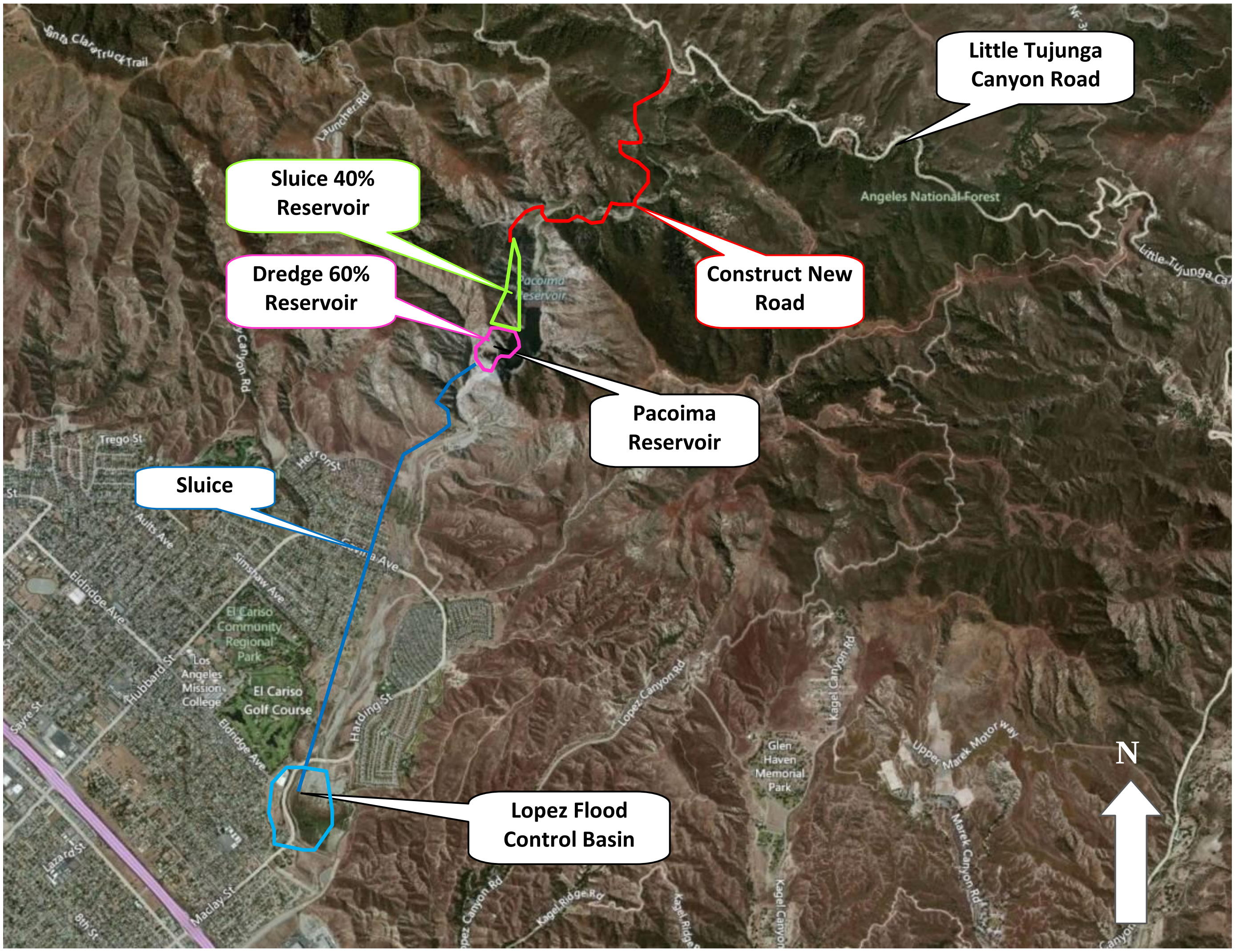
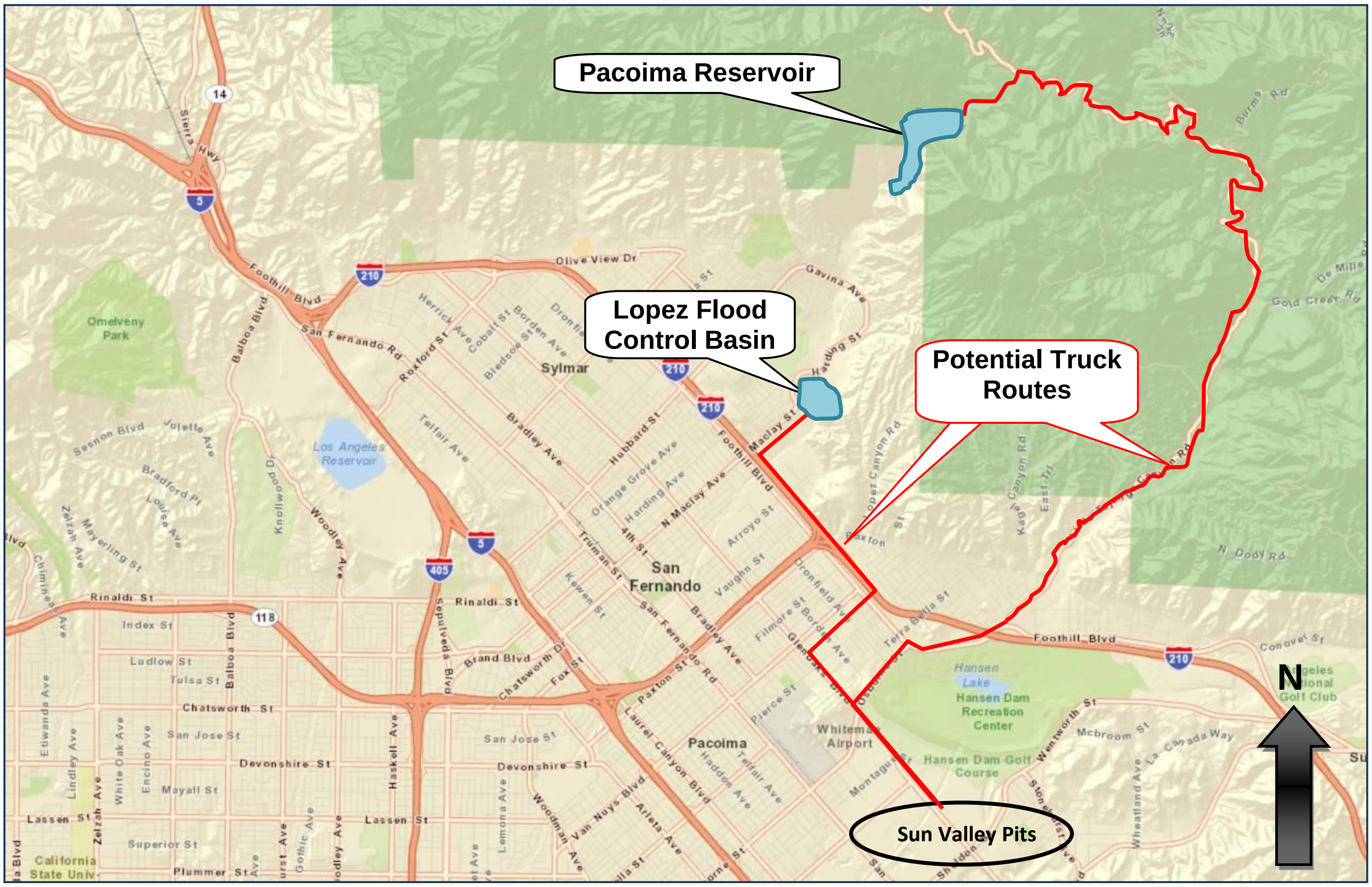


**Figure 8-50 Pacoima Reservoir's Alternative 4 – Map 2 of 2**




Implementation of this alternative is highly dependent on the ability to obtain permission from the Army Corps of Engineers to use Lopez Flood Control Basin as a dewatering and temporary sediment storage area for the sluiced material and the ability to create enough capacity for the operations.

Given the assumptions made regarding sluicing operations, it could take 9 sluicing operations during the 20-year planning period to remove the 4.6 MCY of smaller material in the planning quantity from Pacoima Reservoir. Similar to Combined Alternative 3, the remaining 3.0 MCY of larger material would need to be excavated and removed in possibly 8 separate operations. Sluicing and excavation operations may be able to be conducted in the same year.

Implementation of this alternative could cost an estimated \$125 million to \$135 million. The breakdown of the estimated costs is provided in Table 8-19.

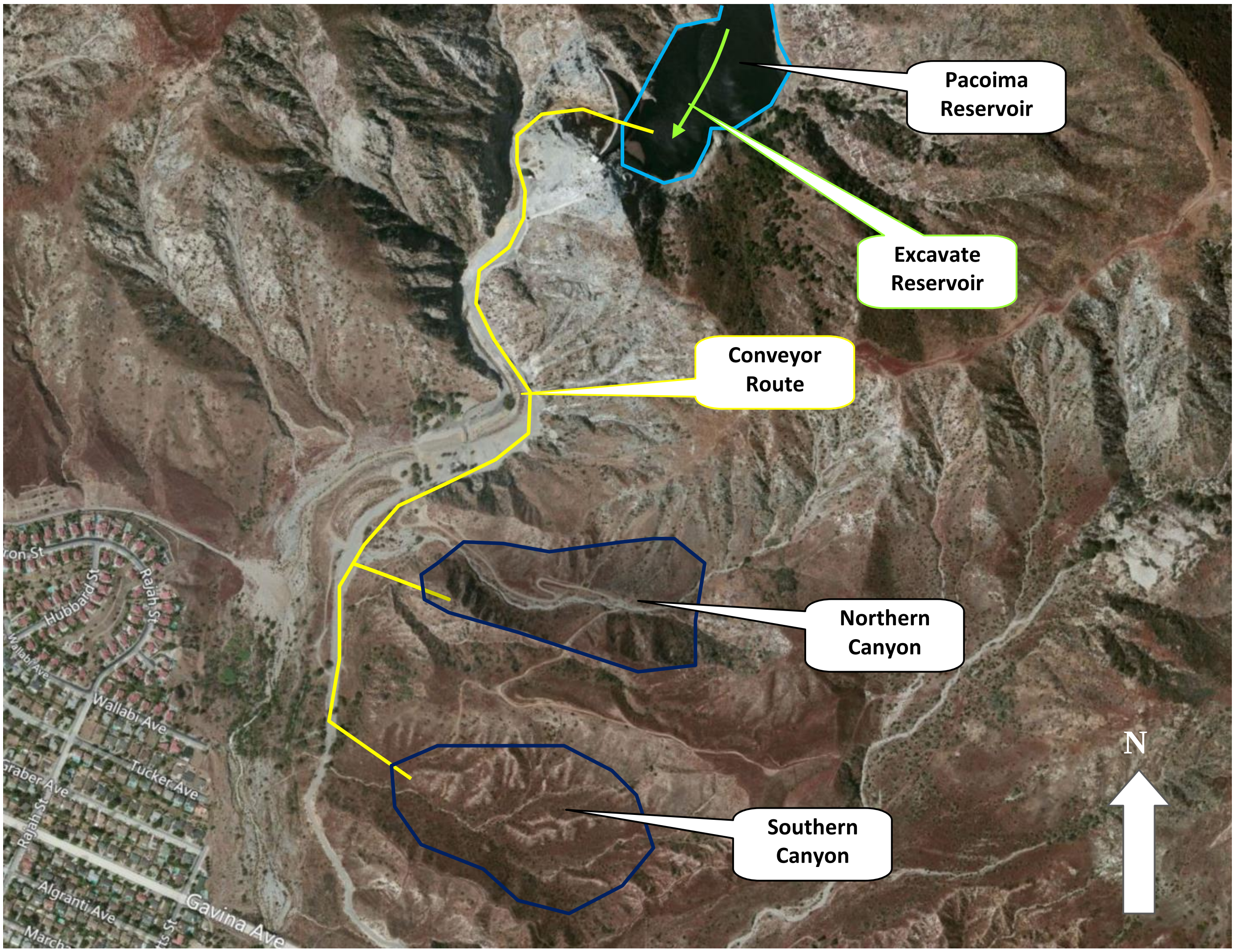
**Table 8-19 Estimated costs for Pacoima Reservoir's Alternative 4**

| Activity | Estimated Cost |
|---|---|
| Excavate material at Lopez Flood Control Basin to create capacity | $14 M |
| Truck material from Lopez Flood Control Basin on double-dump trucks | $21 M |
| Place sediment at pits in Sun Valley | $5-15 M |
| Sluice sediment to Lopez Flood Control Basin | $12 M |
| Construct and mitigate for temporary access roads to Pacoima Reservoir | $2 M |
| Excavate material that cannot be sluiced | $9 M |
| Truck sediment that can be dredged from reservoir to pits in Sun Valley on single-dump trucks | $62 M |
| **Total** | **$125-135 M** |

#### 8.3.7.6 COMBINED ALTERNATIVE 5: EXCAVATE → CONVEYOR → PERMANENT PLACEMENT AT NEW CANYON SPS

Combined Alternative 5 involves excavating the sediment from Pacoima Reservoir under dry conditions and transporting it via a conveyor belt through Pacoima Dam to one or both of the canyons downstream of Pacoima Dam, just like Combined Alternative 2A. The difference is that a sediment placement site would be developed at the canyon(s) and sediment would permanently be placed there. Figure 8-51 shows a representation of this alternative.

**Figure 8-51 Pacoima Reservoir's Combined Alternative 5**




Similar to Combined Alternative 2A, one of the limitations of this alternative is the Flood Control District's ability to acquire one of the canyons downstream of Pacoima Dam. Another concern is the ability to secure environmental regulatory permits required for the development and use of a canyon sediment placement site.

Placing the conveyor belt along Pacoima Canyon Road would limit interference with habitat along the conveyor's alignment. However, development and use of the sediment placement site would highly impact habitat in the canyons over the life of the placement site. Nearby mitigation sites could be used to offset the impacts to the canyons. Additionally, once work is complete, habitat could be reestablished on disturbed areas.

Using a conveyor to transport 7.6 MCY of sediment from Pacoima Reservoir to a Canyon Sediment Placement Site would require 14 separate operations. This is based on the assumptions that 800 CY (or approximately 1,200 tons) of sediment could be transported on the conveyor belt every hour, 8 hours per day, 4 months a year.

Implementation of this alternative could cost an estimated $35 million. The breakdown of the estimated costs is provided in Table 8-20.

**Table 8-20 Estimated costs for Pacoima Reservoir's Alternative 5**

| Activity | Estimated Cost |
|---|---|
| Construct and mitigate for temporary access roads to Pacoima Reservoir | $2 M |
| Excavate material | $23 M |
| Acquire canyon temporary sediment storage area | $2 M |
| Mitigate for use of the canyon temporary sediment storage area | $3 M |
| Develop SPS | $1 M |
| Convey sediment from Pacoima Reservoir to canyon temporary sediment storage area | $6 M |
| **Total** | **$35 M** |

## 8.3.8 SUMMARY AND RECOMMENDATIONS

### 8.3.8.1 SUMMARY

Over the next 20 years, up to 7.6 MCY of sediment are planned to be removed from Pacoima Reservoir including the 5.2 MCY currently accumulated in the reservoir. The different management alternatives are briefly explained below and the impacts are shown in **Error! Reference source not found.**.

**Sediment Management Alternatives**

1 Excavate → Trucks → Sun Valley Pits
This alternative involves draining the reservoir, excavating the sediment under dry conditions, and then trucking the sediment through a back access road to the pits in Sun Valley.

2A Excavate → Conveyor → Canyon Transfer Point → Trucks → Sun Valley Pits
This alternative consists of draining the reservoir, excavating the sediment, transporting it to a temporary sediment storage area via a conveyor belt through the dam, and then trucking it to a placement site. One of the limitations of this alternative is the ability to acquire or obtain permission to use one of the canyons downstream of Pacoima Dam for temporary storage.

2B Excavate → Conveyor → Lopez Flood Control Basin Transfer Point → Trucks → Sun Valley Pits
This alternative is essentially the same as Alternative 2A, except for the conveyor endpoint and potential temporary sediment storage area would be at Lopez Flood Control Basin (FCB). Use of Hansen FCB and placement of the conveyor along Pacoima Wash would require permission from the Army Corps of Engineers.

3 Dredge (4.6 MCY) → Slurry Pipeline → Lopez Flood Control Basin → Excavate → Trucks → Sun Valley Pits
+ Excavate (3.0 MCY) → Trucks → Pits in Sun Valley
Smaller-sized material would be dredged and transported via slurry pipeline to Lopez FCB. The larger-sized material would be excavated and trucked to the pits in Sun Valley. This alternative is highly dependent on the ability to obtain permission from the Army Corps of Engineers to use Lopez FCB and the ability to create enough capacity for the operations.

4 Sluice (4.6 MCY) → Lopez Flood Control Basin → Excavate →Trucks → Sun Valley Pits + Excavate (3.0 MCY) → Trucks → Pits in Sun Valley

This alternative is very similar to Alternative 3 except sediment would be sluiced rather than dredged. Employing this alternative would result in habitat impacts along Big Tujunga Wash.

5 Excavate → Conveyor → Permanent Placement at New Canyon SPS

Alternative 5 involves excavating the sediment from Pacoima Reservoir under dry conditions and transporting it via a conveyor belt through Pacoima Dam to one or both of the canyons downstream of Pacoima Dam, just like Alternative 2A. The difference is that a sediment placement site (SPS) would be developed at the canyon(s) and sediment would permanently be placed there.

**Table 8-21 Summary of Sediment Management Alternatives for Pacoima Reservoir**

| Alternative | | Quantity Removed (MCY) | Environmental | | | | Social | | | Implementability | Performance | | Cost |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Habitat | Water Quality | Groundwater Recharge | Air Quality[a] | Traffic | Visual | Noise | Special Permit/Agreement Required[b] | Previous Experience | Number of years out of 20 years that would require cleanout operations | $ Millions |
| 1 | Excavation | 7.6 | ◑ | | ○ | ◑ | | ○ | ○ | | Yes | 19 | 190-200 |
| | Trucks | | ● | | | ● | ● | ◑ | ◑ | | | | |
| | Pits in Sun Valley | | | | | | | | | Yes | | | |
| 2A | Excavation | 7.6 | ◑ | | ○ | ◑ | | ○ | ○ | | Yes | 10 | 85-95 |
| | Conveyor | | ○ | | | | | ○ | ○ | | | | |
| | Canyon Transfer Point | | ◑ | | | | | ◑ | ○ | Yes | | | |
| | Trucks | | | | | ● | ● | ◑ | ◑ | | | | |
| | Pits in Sun Valley | | | | | | | | | Yes | | | |
| 2B | Excavation | 7.6 | ◑ | | ○ | ◑ | | ○ | ○ | | Yes | 10 | 75-85 |
| | Conveyor | | ○ | | | | | ○ | ○ | | | | |
| | Lopez FCB Transfer Point | | ○ | | | | | ◑ | ○ | Yes | | | |
| | Trucks | | | | | ● | ● | ◑ | ◑ | | | | |
| | Pits in Sun Valley | | | | | | | | | Yes | | | |
| 3 | Dredge | 4.6 | ◑ | ◑ | ○ | | | ○ | ○ | | No | 12[c] | 185-195 |
| | Slurry Pipeline to Lopez FCB | | ○ | | | | | ○ | | Yes | | | |
| | Lopez FCB | | ◑ | ● | | ◑ | | ◑ | ◑ | | | | |
| | Trucks | | | | | ● | ● | ◑ | ◑ | | | | |
| | Pits in Sun Valley | | | | | | | | | Yes | | | |
| | Excavation | 3.0 | ◑ | | ○ | ◑ | | ○ | ○ | | Yes | 8[c] | |
| | Trucks | | | | | ● | ● | ◑ | ◑ | | | | |
| | Pits in Sun Valley | | | | | | | | | Yes | | | |
| 4 | Sluice to Lopez FCB | 4.6 | ● | ● | ◑ | | | ◑ | | Yes | Yes | 9[d] | 125-135 |
| | Lopez FCB | | ◑ | ● | | ◑ | | ◑ | ◑ | | | | |
| | Trucks | | | | | ● | ● | ◑ | ◑ | | | | |
| | Pits in Sun Valley | | | | | | | | | Yes | | | |
| | Excavation | 3.0 | ◑ | | ○ | ◑ | | ○ | ○ | | | 8[d] | |
| | Trucks | | ● | | | | ● | ◑ | ◑ | | | | |
| | Pits in Sun Valley | | | | | | | | | Yes | | | |

(Table continued on next page)

| Alternative | | Quantity Removed (MCY) | Environmental | | | | Social | | | Implementability | Performance | | Cost |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Habitat | Water Quality | Groundwater Recharge | Air Quality[a] | Traffic | Visual | Noise | Special Permit/Agreement Required[b] | Previous Experience | Number of years out of 20 years that would require cleanout operations | $ Millions |
| **5** | Excavation | 7.6 | ◑ | | ○ | ◑ | | ○ | ○ | | Yes | 10 | 35 |
| | Conveyor | | ○ | | | | | ◑ | ○ | | | | |
| | Canyon SPS | | ● | | | | | ◑ | ○ | Yes | | | |

Legend:

| | |
|---|---|
| ● | significant impact |
| ◑ | some impact |
| ○ | possible impact |
| | no impact |

Notes:

(a) Use of low-emission trucks would reduce air quality impacts from significant impact (●) to some impact (◑).
(b) All options require environmental regulatory permits.

## Recommendations

It is recommended that Combined Alternatives 2A, 2B, 4, and 5 be considered for future sediment removal projects at Pacoima Reservoir. Additionally, further combining the aforementioned alternatives should be taken into consideration. For example, it may be possible for the excavation and conveyor alternatives (2A or 2B) to follow a sluicing project (Alternative 4) in order to take advantage of the already drained reservoir. This could help to reduce environmental impacts, increase performance, and reduce costs.

Combined Alternatives 1 and 3 should be considered only after all previous recommendations are deemed infeasible. Alternative 1 requires high number of cleanout operations and has a high estimated cost. Similarly, Alternative 3 has a high cost compared to other alternatives.

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## 8.4 PUDDINGSTONE RESERVOIR

### 8.4.1 BACKGROUND

Puddingstone Dam, shown in Figure 8-52, was constructed in 1928 by the Flood Control District. The dam is comprised of three concrete-faced earth embankments. With a drainage area of 33.1 square miles and a reservoir capacity of 28 MCY, the dam functions as a flood risk management, water conservation, and recreational facility. Water impounded during the storm season behind the dam is gradually released and diverted into the downstream spreading facilities to recharge groundwater within the operating limits for recreational activities.

**Figure 8-52 Puddingstone Dam**

#### 8.4.1.1 LOCATION

Puddingstone Reservoir is situated in Bonelli Regional Park, approximately 1.5 miles south of the City of San Dimas, as shown in Figure 8-53. Located well downstream of the other reservoirs, Puddingstone Reservoir is a collection point for San Dimas Reservoir, Puddingstone Diversion Reservoir, and Live Oak Reservoir outflows. The reservoir is currently used as a recreational lake and is very broad, approximately 0.7 mile across, with relatively flat side slopes. Figure 8-54 shows the topography of Puddingstone Reservoir.

**Figure 8-53 Puddingstone Reservoir Vicinity Map**

**Figure 8-54 Puddingstone Reservoir Topography**

#### 8.4.1.2 ACCESS

Access to both the dam and reservoir is available from Raging Waters Drive, Via Verde, Fisherman Park Road, and Puddingstone Drive, as shown in Figure 8-55.

**Figure 8-55 Puddingstone Reservoir Access**


### 8.4.1.3 DAM OUTLETS

The only dam outlets that Puddingstone Dam is equipped with are two slide gates that are 5 feet by 6 feet and 4 feet by 5 feet.

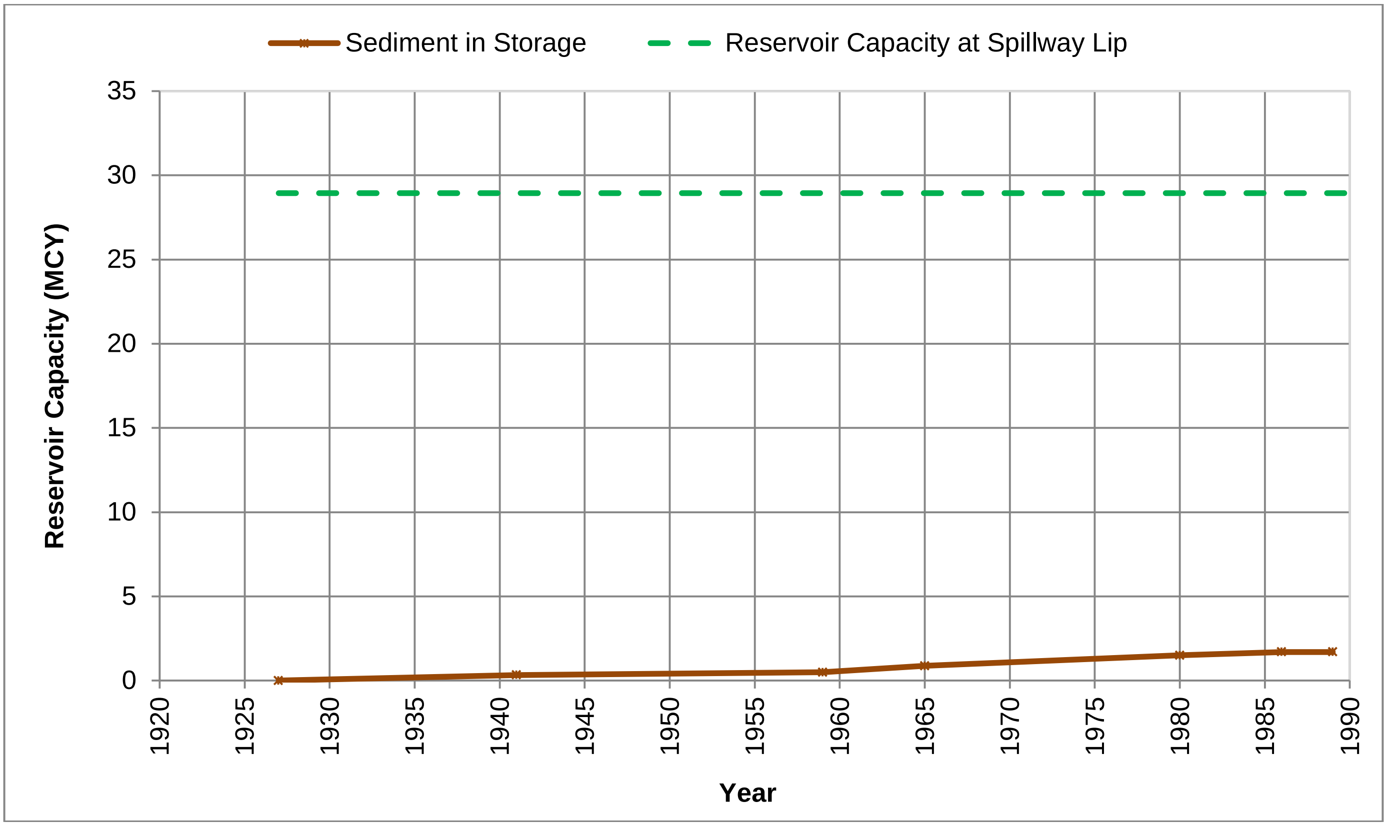
### 8.4.1.4 DOWNSTREAM FLOOD CONTROL AND WATER CONSERVATION SYSTEM COMPONENTS

Live Oak Wash, Puddingstone Diversion Channel, Marshall Canyon Channel, and Emerald Wash are the major channels that discharge into Puddingstone Reservoir, in additional to many underground storm drains. Puddingstone Reservoir is not subject to significant sediment compared to other dams because San Dimas Dam, Live Oak Dam, Puddingstone Diversion Dam, and numerous debris basins capture the sediment before the flows enter Puddingstone Dam. Puddingstone Dam discharges into Walnut Creek, which feeds the Walnut Creek Spreading Grounds and eventually discharges into the San Gabriel River.

### 8.4.1.5 SEDIMENT DEPOSITION AND REMOVAL HISTORY

Figure 8-56 shows the approximate sediment storage in Puddingstone Reservoir. As shown by the figure, the sediment that has accumulated in the reservoir over past 80 years has taken up approximately 6 percent of the reservoir's capacity. Therefore, sediment accumulation at Puddingstone Reservoir is not a great concern.

**Figure 8-56 Graph of Historical Sediment Storage at Puddingstone Reservoir**




Sediment has been removed once in the 84-year life of the reservoir, as shown in Table 8-22.

**Table 8-22 Summary of Sediment Removed**

| Survey Date | | Reservoir Capacity (MCY) | Quantity Sluiced (MCY) | Quantity Excavated (MCY) | Sediment Accumulated Between Surveys (MCY) | Sediment in Storage (MCY) |
|---|---|---|---|---|---|---|
| October | 1927 | 28.1 | - | - | - | - |
| January | 1941 | 27.7 | - | - | 0.3 | 0.3 |
| September | 1959 | 27.6 | - | - | 0.2 | 0.5 |
| November | 1965 | 27.2 | - | - | 0.4 | 0.9 |
| November | 1980 | 26.7 | - | - | 0.6 | 1.5 |
| January | 1986 | 26.4 | - | - | 0.2 | 1.7 |
| September | 1989 | 26.4 | - | 0.006 | 0 | 1.7 |

## 8.4.2 PLANNING QUANTITIES

As described in Section 5, the 20-year planning quantity for sediment inflow into Puddingstone Reservoir is 0.8 MCY.

## 8.4.3 SUMMARY AND RECOMMENDATIONS

### 8.4.3.1 SUMMARY

Over the next 20 years, 0.8 MCY of sediment is estimated to be deposited in the Puddingstone Reservoir.

Excavation has been used in the past in Puddingstone Reservoir, however, only 6,453 CY of sediment was removed, which is not a significant amount compared to the 1.7 MCY currently stored in the reservoir. However, the 1.7 MCY of sediment that has accumulated in the past 80 years for a 33.1 square mile watershed is not significant compared to other similarly sized reservoirs. For comparison, Pacoima Dam has a similar watershed of 28.2 square miles but has seen 7.3 MCY of accumulated sediment during the past 80 years.

In addition, a complete draw down of the reservoir would have a major impact to wildlife and habitat. Drawing down the reservoir may not be a viable option due to the year round recreational use of the reservoir for boating and fishing. Raging Waters, a recreational water park, also uses the reservoir to serve its needs. Due to the environmental constraints with wildlife and the social constraints with the recreational use of Bonelli Park, any alternative that requires dewatering, such as excavation or sluicing, of the reservoir would have high environmental and social impacts and is not be considered a viable option at this time.

### 8.4.3.2 RECOMMENDATION

Due the minimal amount of sediment stored and expected, the primary function of recreation for Puddingstone Reservoir, and the environmental and social impacts that would be caused by removing sediment from the reservoir, it is recommended that Puddingstone Reservoir not be cleaned out unless sediment accumulation impacts operation of the reservoir.

## 8.5 SAN DIMAS RESERVOIR

### 8.5.1 BACKGROUND

San Dimas Dam, shown in Figure 8-57, is a concrete gravity arch dam that was constructed in 1922 by the Flood Control District and functions as a flood risk management and water conservation facility. With a drainage area of 16.2 square miles, San Dimas Dam had an original storage capacity of 2.4 MCY. Water impounded during the storm season behind the dam is gradually released and diverted into the downstream spreading facilities to recharge groundwater.

**Figure 8-57 San Dimas Dam**

#### 8.5.1.1 LOCATION

San Dimas Reservoir is located at the southern end of San Dimas Canyon in the San Gabriel Mountains, approximately 3 miles northeast of the City of San Dimas. Figure 8-58 shows a vicinity map of San Dimas Reservoir.

**Figure 8-58 San Dimas Reservoir Vicinity Map**


San Dimas Canyon is a steep-walled, deeply incised canyon that opens out into the upper alluvial fan of the Foothill Basin, located in the San Gabriel Valley, as shown in Figure 8-59. Due to the shape of the canyon, San Dimas Reservoir is long, narrow, and sinuous with a length of approximately 0.8 mile and an average width of 300 feet. The canyon side slopes are rocky and as steep as 1:1 horizontal to vertical.

**Figure 8-59 San Dimas Reservoir Topography**

#### 8.5.1.2 Access

Access to the downstream and upstream sides of the dam is available off San Dimas Canyon Road, which is a sinuous paved road running along the east side of the reservoir and terminating at the north end of the reservoir, as shown in Figure 8-60. San Dimas Canyon Road south of the dam is wide enough for two-way traffic. The road narrows north of the dam to about 20 feet wide, becoming more difficult to accommodate two-way traffic. The access road to the downstream side of the dam is paved and over 30 feet wide. There is also a recently constructed paved, non-public access road leading from San Dimas Canyon Road (approximately 200 feet north of the dam) into the body of the reservoir, allowing vehicular access to the upstream side of the dam for sediment removal. This road is approximately 25 feet wide and adequate for two-way traffic.

**Figure 8-60 San Dimas Access**


### 8.5.1.3 Dam Outlets

San Dimas Dam is equipped with multiple valves and two slide gates that are 4 feet by 6 feet that are near the bottom of the reservoir. Modifications to the risers will be needed, if sluicing or a slurry pipeline alternative is used.

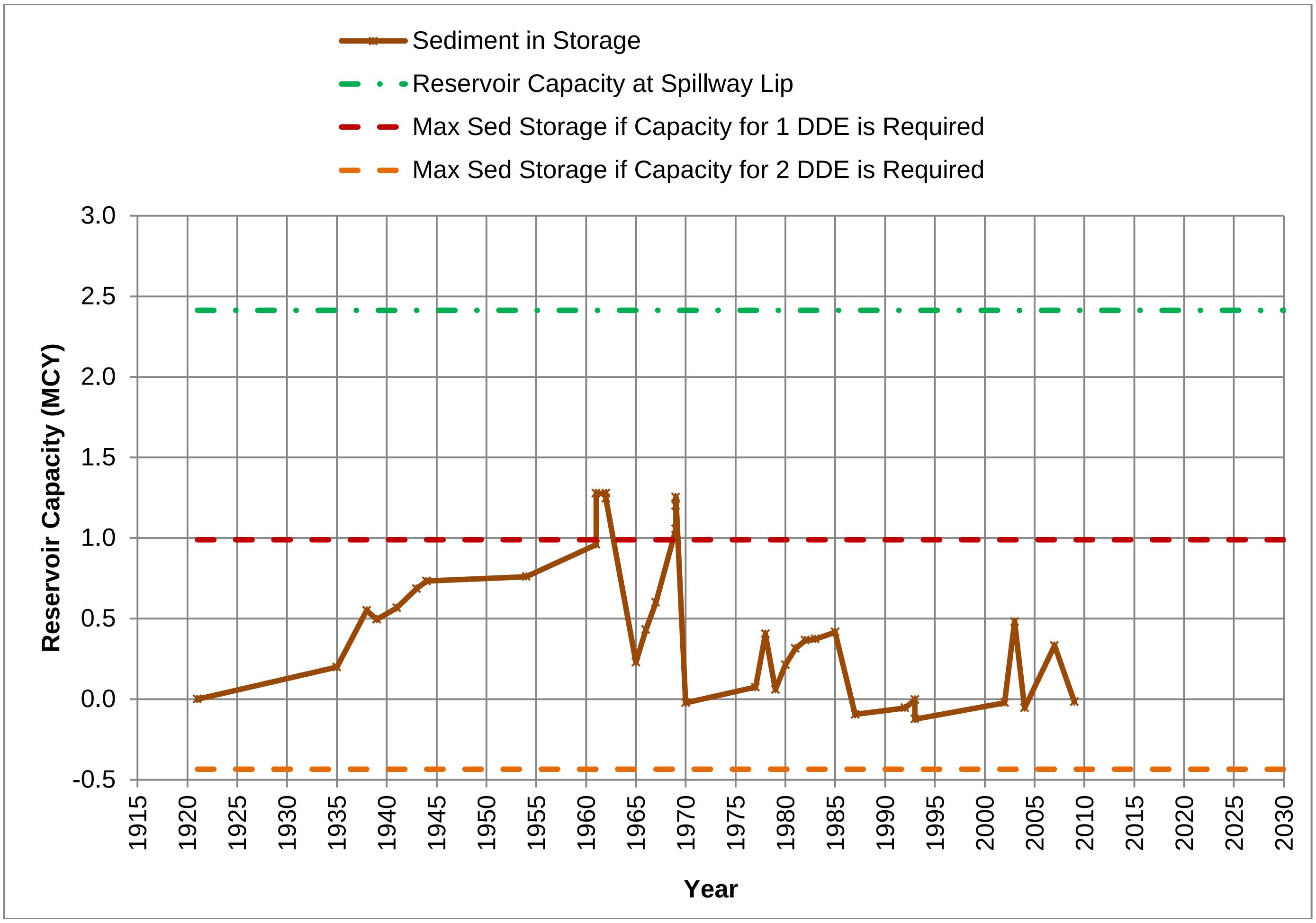
### 8.5.1.4 Downstream Flood Control and Water Conservation System Components

Water that passes through San Dimas Dam travels 1.5 miles downstream along San Dimas Creek to the Puddingstone Diversion Reservoir. Puddingstone Diversion Dam can either divert flows to Puddingstone Reservoir or San Dimas Wash. The San Dimas Spreading Grounds is immediately downstream of Puddingstone Diversion Dam. All flows from the San Dimas Dam watershed are tributary to the San Gabriel River.

### 8.5.1.5 Sediment Deposition and Removal History

Figure 8-61 shows the approximate sediment storage in San Dimas Reservoir. It is the Flood Control District's practice to retain enough storage capacity within a reservoir for two DDEs, which are calculated and determined for each specific reservoir. For reference purposes, Table 8-23 shows the original reservoir capacity at spillway lip and the maximum sediment storage that allows for the storage of one and two DDEs. The graph shows that the Flood Control District has reduced the quantity of sediment in storage at San Dimas Reservoir on numerous occasions.

**Figure 8-61 Graph of Historical Sediment Storage at San Dimas Reservoir**




Sediment has been removed 9 times in the 89-year life of the reservoir. Table 8-23 shows that both excavation and sluicing have been used to remove sediment from San Dimas Reservoir in the past. The majority of the sediment (95 percent) has been removed through excavation.

**Table 8-23 Summary of Historic Sediment Inflows and Cleanouts – San Dimas Reservoir**

| Survey Date | | Reservoir Capacity (MCY) | Quantity Sluiced (MCY) | Quantity Excavated (MCY) | Sediment Accumulated Between Surveys (MCY) | Sediment in Storage (MCY) |
|---|---|---|---|---|---|---|
| October | 1921 | 2.41 | - | - | - | 0.20 |
| December | 1935 | 2.21 | - | - | 0.20 | 0.55 |
| May | 1938 | 1.86 | - | - | 0.35 | 0.55 |
| November | 1939 | 1.92 | 0.05 | - | - | 0.62 |
| December | 1941 | 1.85 | - | - | 0.07 | 0.74 |
| October | 1943 | 1.73 | - | - | 0.12 | 0.79 |
| November | 1944 | 1.68 | - | - | 0.05 | 0.81 |
| October | 1954 | 1.65 | - | - | 0.03 | 1.01 |
| August | 1961 | 1.45 | - | - | 0.20 | 1.33 |
| November | 1961 | 1.14 | - | - | 0.32 | 1.33 |
| January | 1962 | 1.14 | - | - | - | 1.43 |
| April | 1962 | 1.18 | 0.012 | - | 0.09 | 1.71 |
| November | 1965 | 2.20 | 0.06 | 1.24 | 0.28 | 1.92 |
| August | 1966 | 2.00 | - | - | 0.20 | 2.08 |
| April | 1967 | 1.82 | - | - | 0.17 | 2.54 |
| February | 1969 | 1.37 | - | - | 0.45 | 2.68 |
| March | 1969 | 1.22 | - | - | 0.15 | 2.74 |
| November | 1969 | 1.17 | - | - | 0.05 | 2.77 |
| November | 1970 | 2.44 | - | 1.31 | 0.03 | 2.87 |
| July | 1977 | 2.35 | - | - | 0.10 | 3.20 |
| March | 1978 | 2.02 | - | - | 0.33 | 3.20 |
| November | 1979 | 2.36 | - | 0.35 | - | 3.35 |
| March | 1980 | 2.21 | - | - | 0.15 | 3.45 |
| November | 1981 | 2.11 | - | - | 0.10 | 3.50 |
| October | 1982 | 2.06 | - | - | 0.05 | 3.51 |
| April | 1983 | 2.05 | - | - | 0.01 | 3.56 |
| May | 1985 | 2.00 | - | - | 0.04 | 3.56 |
| May | 1987 | 2.52 | - | 0.51 | - | 3.60 |
| December | 1992 | 2.48 | - | - | 0.04 | 3.65 |
| March | 1993 | 2.42 | - | - | 0.05 | 3.65 |
| June | 1993 | 2.55 | - | 0.12 | - | 3.75 |
| November | 2002 | 2.44 | - | - | 0.10 | 4.25 |
| September | 2003 | 1.94 | - | - | 0.50 | 4.25 |
| October | 2004 | 2.48 | - | 0.53 | - | 4.64 |
| January | 2007 | 2.09 | - | - | 0.39 | 4.64 |
| July | 2009 | 2.47 | - | 0.35 | 0 | 0.20 |

Historically, excavated material has been placed at San Dimas SPS.

### 8.5.2 PLANNING QUANTITY AND ASSUMED SEDIMENT CHARACTERISTICS

As described in Section 5, the 20-year planning quantity for sediment inflow into San Dimas Reservoir is 1.9 MCY.

Approximately two thirds of the sediment in San Dimas Reservoir's planning quantity could potentially consist of particle sizes small enough to be dredged or sluiced. Given this assumption, if dredging or sluicing was to be employed, approximately 1.3 MCY of sediment could potentially be dredged or sluiced while the remaining 0.6 MCY would need to be excavated.

### 8.5.3 POTENTIAL STAGING AND TEMPORARY SEDIMENT STORAGE AREAS

#### 8.5.3.1 SAN DIMAS SPS

The San Dimas SPS, as shown in Figure 8-62, is currently owned by the Flood Control District and was originally developed for the receipt of sediment form San Dimas and Puddingstone Diversion Reservoirs and other local debris retaining facilities.

**Figure 8-62 San Dimas SPS Looking Southwest**

**San Dimas SPS - Environmental Impacts**

If the open spaces that have been clear of vegetation are used as a staging or temporary sediment storage area then there will be minimal habitat impact. Air quality will be minimally impacted due to equipment used when spreading and compacting the sediment.

**San Dimas SPS - Social Impacts**

Visual and noise impacts may affect local residents directly on the east side of the SPS and a golf course directly to the west.

**San Dimas SPS – Implementabilty**

San Dimas SPS has been used to place sediment from past San Dimas Reservoir cleanouts. Environmental permits may be required for any modifications to the SPS.

**San Dimas SPS – Performance**

The San Dimas SPS is an active facility with an area of approximately 25 acres and a total remaining capacity of approximately 201,000 CY (about 50 percent of its total capacity). The material at the SPS can be excavated, gradually transported out, and placed at an alternative placement site to increase capacity at the SPS. This will maintain capacity at the SPS for future cleanouts.

**San Dimas SPS – Cost**

There is no additional cost to use San Dimas SPS as it is already owned by the Flood Control District. However, if the SPS is used to transition between different transportation methods, it will incur additional costs to manage and spread the sediment at the SPS ($2/CY) and place the material in trucks ($7.50/CY).

### 8.5.3.2 PUDDINGSTONE DIVERSION RESERVOIR

Puddingstone Diversion Reservoir, as shown in Figure 8-63, is approximately 2 miles downstream of San Dimas Dam along San Dimas Creek and is owned and operated by the Flood Control, refer to Section 9.5 for more information regarding Puddingstone Diversion Reservoir.

**Figure 8-63 Puddingstone Diversion Reservoir**

**Puddingstone Diversion Reservoir - Environmental Impacts**

Environmental permitting may be required to use Puddingstone Diversion Reservoir as a collection point for San Dimas outflows. Impacts to water quality and conservation are not expected.

**Puddingstone Diversion Reservoir –Social Impacts**

The reservoir is adjacent to residential properties to the South and the San Dimas Canyon Golf Course to the North. Any operations would increase traffic and noise near the reservoir. The hours of operation could be limited to minimize disturbance to the residents.

**Puddingstone Diversion Reservoir – Implementabilty**

Puddingstone Diversion Reservoir naturally collects sediment from San Dimas Reservoir outflows. There are no implementability issues expected.

**Puddingstone Diversion Reservoir – Performance**

As of October 2007, the reservoir had a capacity of 361,000 CY. This volume would be sufficient to stage or temporarily store sediment at this location. However, sediment would need to be immediately removed in order to restore the flood risk management functionality of the reservoir.

**Puddingstone Diversion Reservoir – Cost**

There is no additional cost to use Puddingstone Diversion Reservoir as it is already owned by the Flood Control District. However, if the Reservoir is used to transition between different transportation methods, it will incur additional costs to excavate the material ($3/CY).

## 8.5.4 REMOVAL ALTERNATIVES

The following section discusses impacts and costs of sediment removal at San Dimas Reservoir by means of excavation, dredging, and sluicing. Discussion of the transportation and placement alternatives is presented in Sections 8.5.5 and 8.5.6, respectively. Combined alternatives that address all phases of the sediment management process are presented and discussed in Section 8.5.7.

### 8.5.4.1 EXCAVATION

Excavation has been used in the past at San Dimas Reservoir and could be used in conjunction with either the conveyor or trucking transportation modes. Much of the reservoir bed is exposed during the dry season due to the limited inflow from the small watershed.

**Excavation - Environmental Impacts**

Emission from heavy equipment used during excavation will impact air quality within the proximity of the excavation site.

Excavating the reservoir is not expected to have impacts on water quality. As discussed in Section 6, dewatering a reservoir in order to excavate it could impact water conservation if the water is released faster than spreading facilities downstream of the reservoir can handle.

**Excavation - Social Impacts**

Excavation will have minimal social impacts due to the remote location of San Dimas Dam. Recreational users that hike in the vicinity of the reservoir may be subject to air quality and noise impacts.

**Excavation – Implementability**

Environmental permits may be required prior to the excavation operation. However, there are no implementability concerns with using excavation as a removal method.

**Excavation – Performance**

This method has performed well in the past and its ability to be used for sediment removal is not a concern for future cleanouts. For additional performance discussion, refer to Section 6.

**Excavation – Cost**

The cost to excavate sediment from a reservoir is approximately $3 per cubic yard. Excavating 1.9 MCY of sediment would cost approximately $5.7 million over a 20-year period.

#### 8.5.4.2 DREDGING

Approximately two-thirds of San Dimas Reservoir's planning quantity meets the characteristics of dredgeable material. Therefore, if dredging is to be employed at San Dimas Reservoir, another removal method would have to be employed to remove the non-dredgeable material. Excavation with either trucking or conveyors is likely the only feasible methods to remove the larger, non-dredgeable material from the reservoir.

**Dredging - Environmental Impacts**

Dredging could impact water quality within San Dimas Reservoir by increasing the turbidity. However, as discussed in Section 6, water quality concerns could be partially addressed with a silt curtain around the dredge. As discussed in Section 6, dredging sediment (and transporting it via a slurry pipeline) could affect water conservation.

There are also some minor impacts to air quality due the dredging equipment.

**Dredging - Social Impacts**

Dredging will have minimal social impact due to the remote location of San Dimas Dam. Recreational users that hike along North San Dimas Canyon Road may be subject to air quality and noise impacts.

**Dredging – Implementability**

The reservoir would need to be drained to a certain depth for the hydraulic dredge to be operable.

No additional right of way is anticipated to be required for implementation of a dredging operation within the reservoir. Dredging would require environmental regulatory permits.

Dredging has not previously been employed by the Flood Control District and is not considered to be a proven method to remove sediment from the reservoir under the Flood Control District's jurisdiction.

Drawing down the reservoir significantly may still be needed in order to meet the 50-foot water depth capabilities of the hydraulic dredge. Another limitation of dredging may the availability of an area to dewater material downstream.

**Dredging – Performance**

Assuming a dredge can operate at 200 CY per hour and operate all year round, a dredging operation can be performed for 6 months every 3 years and remove 1.3 MCY.

**Dredging – Cost**

Based on the estimated unit cost of $10.50/CY for dredging and $2/CY for two booster pumps required to pump the material to Puddingstone Diversion Reservoir, dredging 1.3 MCY of sediment would cost approximately $15.9 million.

#### 8.5.4.3 SLUICING (AS A REMOVAL METHOD)

Historically, sluicing has accounted for only about 5 percent of the sediment that has been removed from San Dimas Reservoir. Sluicing events in 1939, 1962, and 1965 removed a total of about 245,000 CY from the reservoir. In contrast to this amount, over 4.4 MCY of sediment has been removed by 7 different excavations between 1965 and 2009.

Sluicing would only be effective for finer materials and would still require excavation for larger materials. It is estimated that approximately two thirds of the material meets the characteristics of sluiceable material. The sediment would travel along San Dimas Creek and be captured by the Puddingstone Diversion Dam.

This section focuses on sluicing as a sediment removal method and discusses the impacts of sluicing within San Dimas Reservoir only. For the impacts of sluicing downstream of the dam refer to Section 8.5.5.1.

**Sluicing (Removal) – Environmental Impacts**

Within San Dimas Reservoir itself, sluicing would be expected to impact vegetation and animal species in a similar manner as excavating sediment from the reservoir would, since in both cases the reservoir would need to be drained. See the discussion under Excavation for more information.

During a sluicing operation, water quality within the reservoir would be impacted due to the higher-than-normal sediment concentration. As discussed in Section 6, removing sediment from a reservoir by sluicing could affect water conservation.

Sluicing operations within San Dimas Reservoir would result in equipment emissions. However, given the Flood Control District's previous sluicing projects, only a few pieces of equipment would be necessary within the reservoir.

**Sluicing (Removal) – Social Impacts**

Due to the remote location of the reservoir, minimal noise and visual impacts would be associated with sluicing.

**Sluicing (Removal) – Implementability**

Base flows from San Dimas Creek have shown to be sufficient to use sluicing as a means of removing sediment from San Dimas Reservoir. In the past, the flows have supported sluicing events with an average sediment removal of 75,000 CY per event. Environmental permitting will be required to use sluicing to remove sediment from San Dimas Reservoir.

**Sluicing (Removal) – Performance**

Based on previous cleanout data of 75,000 CY per event, a cleanout will be required almost every year to remove the 1.3 MCY of sluiceable material.

**Sluicing (Removal) – Cost**

The cost to sluice sediment from a reservoir is approximately $2.5 per cubic yard. Sluicing 1.3 MCY of sediment would cost approximately $3.2 million over a 20-year period.

## 8.5.5 TRANSPORTATION ALTERNATIVES

The following section discusses the impacts and costs of transporting sediment removed from San Dimas Reservoir. The alternatives discussed include sluicing, trucking, conveyor belts, and slurry pipelines. Discussion of the removal alternatives was presented in Section 8.5.4. The placement alternatives are presented in 8.5.6. Combined alternatives that address all phases of the sediment management process are presented and discussed in Section 8.5.7.

### 8.5.5.1 SLUICING (AS A TRANSPORT METHOD)

This section focuses on the impacts of utilizing sluicing as a transport method to move sediment downstream of San Dimas Dam along San Dimas Creek to the Puddingstone Diversion Reservoir. For the impacts of sluicing operations within San Dimas Reservoir, refer to the discussion of sluicing as a removal method in the previous section. Impacts at Puddingstone Diversion Reservoir were discussed in Section 8.5.3.2.

**Sluicing (Transport) – Environmental Impacts**

Several sensitive species exist within San Dimas Creek. Sluicing along the creek could result in some scouring of the streambed, temporary loss of native habitat and wildlife, and probable sediment deposition and accumulation in the channel.

Sluicing would impact water quality by increasing the turbidity within San Dimas Creek and Puddingstone Diversion Reservoir. As discussed in Section 6, transporting sediment via sluicing could affect water conservation.

**Sluicing (Transport) – Social Impacts**

Minimal noise and visual impacts would be associated with sluicing. Visual impacts will consist of flows in San Dimas Creek with higher levels of sediment than normal. Recreation along the creek could be impacted by sluicing operations.

**Sluicing (Transport) – Implementability**

Base flows from San Dimas Creek have shown to be sufficient to use sluicing as a means of transporting sediment along San Dimas Creek. Environmental permitting will be required to use sluicing to transport sediment.

Modifications to the risers attached to the slide gates may be required in order to pass the sluiced material downstream.

**Sluicing (Transport) – Performance**

Based on previous cleanout data of 75,000 CY per event, a cleanout will be required almost every year to remove the 1.3 MCY of sluiceable material.

**Sluicing (Transport) – Cost**

The cost to sluice sediment from a reservoir is approximately $2.5 per cubic yard. Sluicing 1.3 MCY of sediment would cost approximately $3.2 million over a 20-year period.

### 8.5.5.2 TRUCKING

Trucks could operate as a stand-alone transportation mode from the body of San Dimas Reservoir to the final placement location or in conjunction with sluicing and conveyors where the sediment is transported to the San Dimas SPS or Puddingstone Diversion Reservoir and then trucked to its final placement location. Truck access to the dam and the body of the reservoir is available along North San Dimas Canyon Road.

**Trucking - Environmental Impacts**

Since existing roads would be used to truck sediment, no particular impacts would be expected on habitat, water quality, or water conservation. Air quality would be impacted due to the truck operations to the residents and recreational users within proximity of the haul route. Employing low emission trucks would reduce air quality impacts.

**Trucking - Social Impacts**

The haul route travels through a residential area and will impact the traffic and noise for the residents with properties near the proximity of the haul route. However, residential properties do not immediately face North San Dimas Canyon Road.

**Trucking – Implementability**

Trucking, combined with excavation, has been the primary method to remove sediment from the reservoir. Double dump trucks can be used for this operation since the haul route mainly uses major roadways and the reservoir is very accessible.

**Trucking – Performance**

Double dump trucks, which have the capacity for approximately 16 CY, can operate for 6 months and transport 800,000 CY of sediment. A cleanout operation can be performed every 6-7 years and remove the total 20-year quantity of 1.9 CY

**Trucking – Cost**

Assuming a trucking unit cost of approximately $0.30/CY-Mile for a double dump truck, the estimated trucking cost to transport 1.9 MCY of sediment from San Dimas Reservoir to a pit in the Irwindale area is approximately $14.9 million.

**Conveyor Belts**

A conveyor system can be combined with excavation in order to transport the material one mile downstream to the San Dimas SPS along the shoulder of North San Dimas Canyon Road.

**Conveyor Belts - Environmental Impacts**

The conveyor system would be installed along the existing road from the outlet of the slide gate tunnel and have minimal impact on habitat along the route. A conveyor system would have very minimal air quality impacts unless a generator is used as discussed in Section 6.

**Conveyor Belts - Social Impact**

Use of a conveyor belt system may result in visual intrusion issues to residents or recreational users along the conveyance route; however, the impact is expected to be minimal.

The conveyor system may not be able to accommodate two-way traffic along North San Dimas Canyon Road and may significantly impact traffic.

The conveyor system will cross Golden Hills Road and will impact traffic access for the residents who live in the proximity of the SPS. An overhead conveyor can be used at this intersection to alleviate traffic concerns.

**Conveyor Belts – Implementability**

Conveyor systems have the ability to handle relatively circuitous alignments as long as the turning radii are no less than approximately 300 feet. Because of the infrequent need for cleanouts, a conveyor would be installed on a temporary basis.

**Conveyor Belts – Performance**

Assuming a conveyor system can operate at 500 CY per hour and operate for 6 months, a conveyor operation would be required every 5 years to remove the total 20-year quantity of 1.9 MCY.

**Conveyor Belts – Cost**

Conveyor costs are approximately $800/LF for installation and operating costs. The cost for 1 mile of conveyor would be approximately $4.2 million.

#### 8.5.5.3 SLURRY PIPELINE

A slurry pipeline would only be feasible if dredging is used. The dredge will pump the sediment/water into a 12-inch high-density polyethylene (HDPE) slurry pipeline that would run along the shoulder of North San Dimas Canyon Road and eventually discharge into the Puddingstone Diversion Reservoir. The sediment can be dewatered at the reservoir and eventually excavated and trucked out to the final placement site. Impacts associated with using Puddingstone Diversion Reservoir were discussed previously.

**Slurry Pipeline - Environmental Impacts**

The slurry pipeline would be constructed along the roadway and not likely impact habitat. Water quality at the dewatering site would be impacted by high turbidity.

**Slurry Pipeline - Social Impacts**

The slurry pipeline would impact traffic as the pipe would be placed along the shoulder of North San Dimas Canyon Road. Portions of the slurry pipe that cross intersections (such as at Golden Hills Road) could be installed underground.

The slurry pipeline may not be able to accommodate two-way traffic along North San Dimas Canyon Road and may impact traffic.

**Slurry Pipeline – Implementability**

Sediment in San Dimas Reservoir could be removed with hydraulic dredging and transported through the dam to a slurry pipeline. The pipeline could be constructed down the shoulder of North San Dimas Canyon Road and the Puddingstone Diversion Reservoir where dredge spoil piles could be created awaiting removal for final placement. The pipeline to the reservoir would be approximately 2 miles long. Booster pumps will likely be needed to pump the slurry material to the reservoir due to the lack of grade along North San Dimas Canyon Road. The slurry pipeline will need to be installed underground at intersections to eliminate traffic impacts.

Modifications to the risers attached to the slide gates may be required in order to pass the sluiced material downstream.

**Slurry Pipeline – Performance**

Assuming a dredge operation can remove 200 CY per hour, the 12-inch HDPE slurry pipeline will have approximately 15 cubic feet per second (cfs) flowing in it.

**Slurry Pipeline – Cost**

The slurry pipeline cost is approximately $37.50/LF for an above ground 12-inch HDPE slurry pipeline. For a 2-mile long slurry pipe, the total cost is approximately $400,000.

## 8.5.6 PLACEMENT ALTERNATIVES

This section discusses the impacts and costs at potential placement alternatives for sediment removed from San Dimas Reservoir. Specifically, this section discusses the placement of sediment at pits and the existing San Dimas Sediment Placement Site. Discussion of the removal and transportation was presented in Sections 8.5.4 and 8.5.5, respectively. Combined alternatives that address all phases of the sediment management process are presented and discussed in Section 8.5.7.

Combined alternatives that address all phases of the sediment management process are presented and discussed in Section 8.5.7.

### 8.5.6.1 LANDFILLS

Scholl Canyon Landfill is the closest landfill to San Dimas Reservoir at a distance of 27 miles. More information regarding the landfill can be found in Section 6.

### 8.5.6.2 QUARRY WITH EXISTING OPERATIONS

There are existing operational pits in the Irwindale area (13 miles away) and the Claremont area (8 miles away) that could accept material from San Dimas Reservoir as discussed in Section 6.

It is assumed that one third of the material will be high quality material that will be of value to the existing operational pits. In exchange for this high quality material, it is assumed that the Flood Control District will be allowed to place the same amount of lower quality material in the operational quarry pits. The remaining one third of the material that will be placed at the pit will be subject to a tipping fee.

#### 8.5.6.3 ACQUIRED QUARRY

As discussed previously, the acquisition of a quarry for placement of sediment from facilities under the jurisdiction of the Flood Control District is being pursued for sediment management. Acquisition of a quarry in the Irwindale area would be most desirable for sediment management operations related to Puddingstone Diversion Reservoir.

It will be assumed that acquiring a quarry could potentially cost the Flood Control District approximately $1 per CY and that placement of sediment would cost $2 per CY.

In order to conserve space in an acquired quarry, the high quality material can still be taken an existing quarry operation where the Flood Control District can place an equivalent volume of lower quality material. The remaining material can be placed at the acquired quarry.

#### 8.5.6.4 SEDIMENT PLACEMENT SITES

As mentioned earlier, San Dimas SPS is an existing SPS that is one mile downstream of San Dimas Dam. While the remaining available capacity at San Dimas SPS was approximately 200,000 as of the writing of the Strategic Plan, it was assumed that the capacity would be reserved for emergencies. Thus, this Strategic Plan does not include placing sediment from San Dimas Reservoir at San Dimas Sediment Placement Site.

### 8.5.7 COMBINED SEDIMENT MANAGEMENT ALTERNATIVES

#### 8.5.7.1 COMBINED ALTERNATIVE 1: EXCAVATION > TRUCKING > IRWINDALE PITS

The sediment can be excavated and placed directly into a double dump truck and transported to the final placement site at a pit in the Irwindale area, as shown in Figure 8-64 and Figure 8-65. It would take 3 cleanout events, or a cleanout every 6-7 years, to remove the expected 20-year quantity. The total cost is estimated to be approximately $20-25 million, as shown in Table 8-24. It is assumed that only one third of the material will be subject to a tipping or acquisition fee as discussed in Section 8.5.6.

**Figure 8-64 San Dimas Management Alternative 1 – Map 1 of 2**

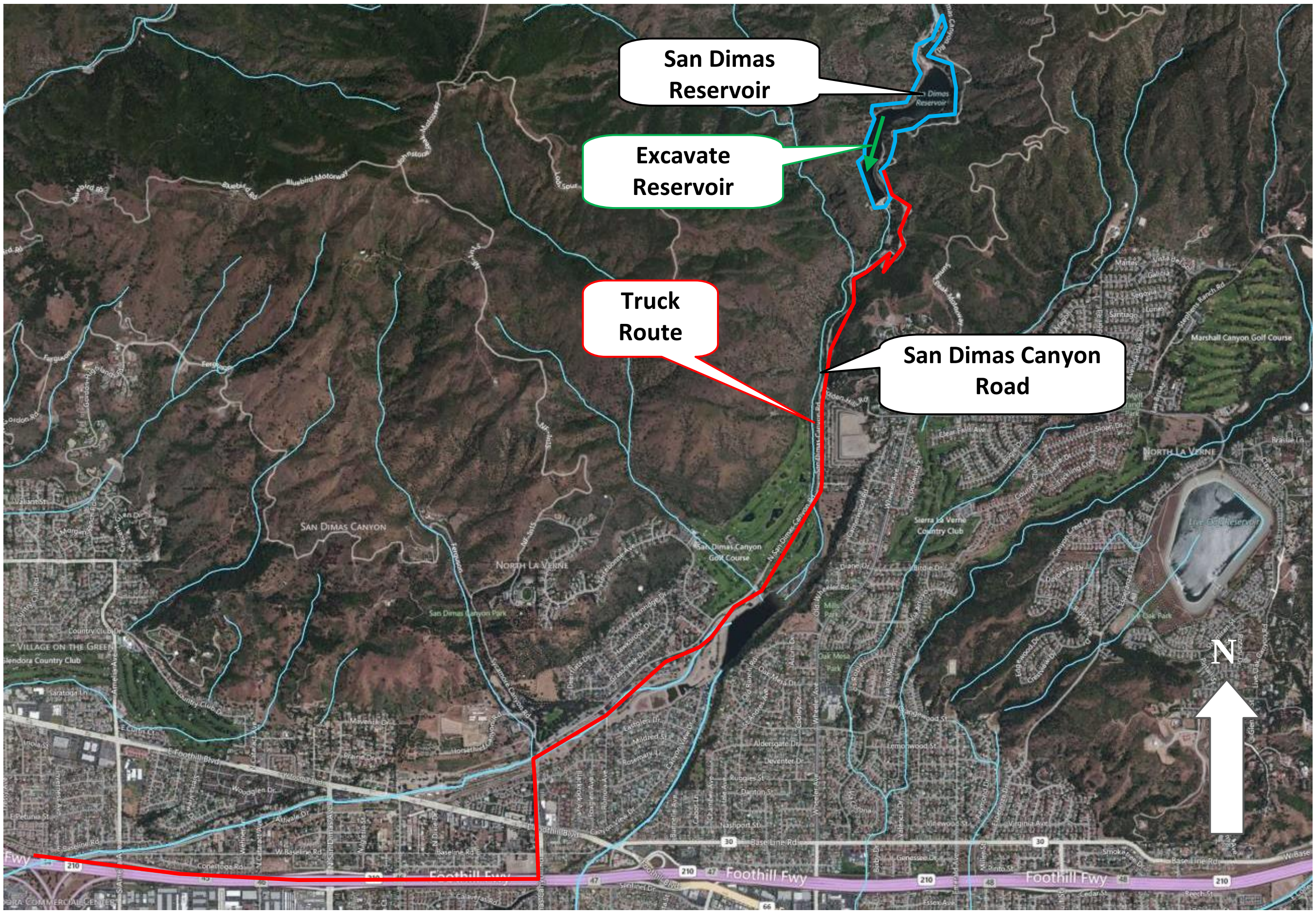



**Figure 8-65 San Dimas Management Alternative 1 – Map 2 of 2**

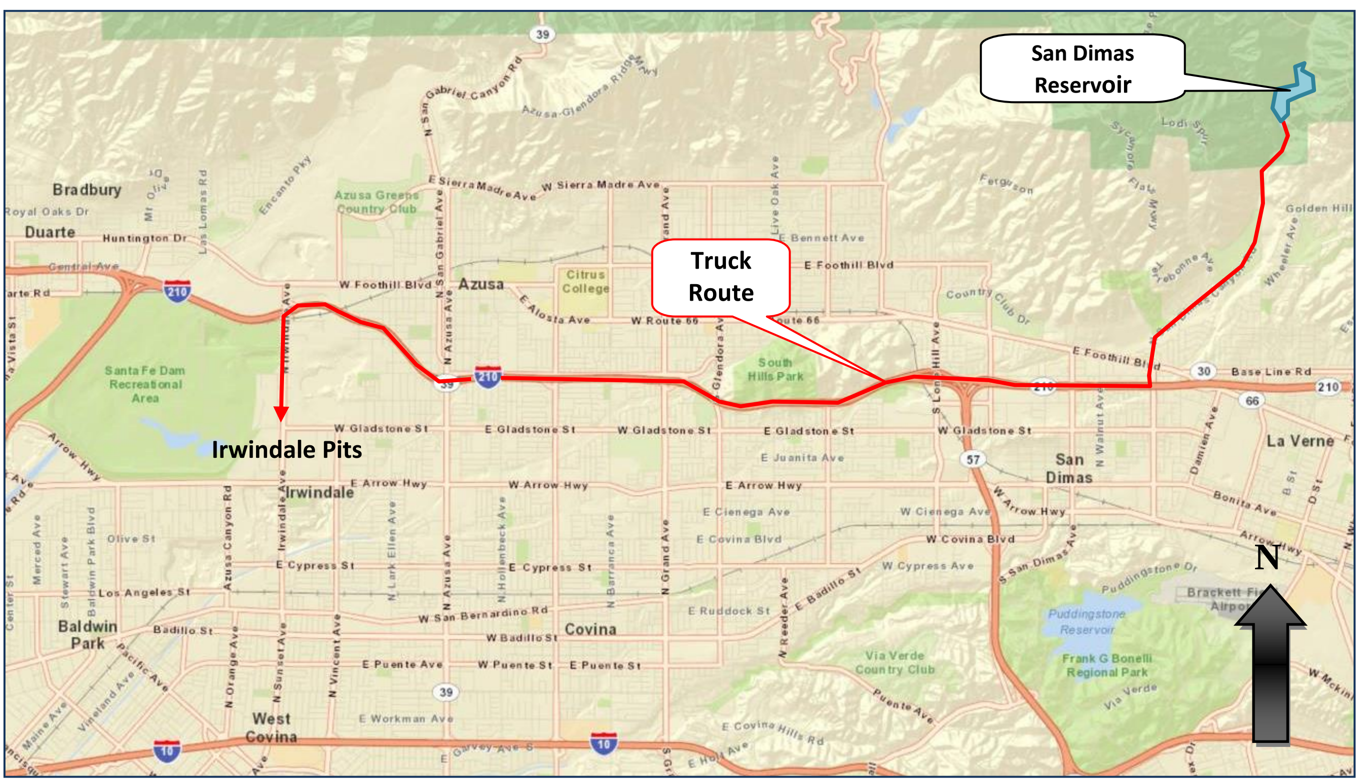


**Table 8-24 San Dimas Management Alternative 1 Cost Estimate**

| Activity | Amount (MCY) | Distance (MI) | Unit Cost | Unit | Total Cost ($ Millions) |
|---|---|---|---|---|---|
| Excavation at San Dimas Reservoir | | | $ 3.00 | CY | $ 5.7 |
| Double Dump Truck from Reservoir to Pit | 1.9 | 26 | $ 0.30 | MI-CY | $ 14.9 |
| Pit Placement Fee | | | $ 3.00 - 7.00 | CY | $ 1.9 - 4.5 |
| | | | | **Total** | **$ 20 – 25** |

#### 8.5.7.2 COMBINED ALTERNATIVE 2: EXCAVATION > CONVEYOR > SAN DIMAS SPS > EXCAVATION > TRUCK > IRWINDALE PITS & LANDFILLS

This combined alternative would consist of excavating sediment from San Dimas Reservoir and transporting the sediment via a conveyor system to San Dimas SPS, where it would be stored temporarily. Then, from San Dimas SPS, the sediment would be transported out gradually via double dump trucks at a rate that would reduce social impacts. From San Dimas SPS, the sediment would be taken to either a pit or a landfill. This combined alternative is illustrated by Figure 8-66 and Figure 8-67. It would take 4 cleanout events, or a cleanout every 5 years, to remove the expected 20-year quantity. The total cost is estimated to be approximately $35-40 million, as shown in Table 8-25. It is assumed that only one third of the material will be subject to a tipping or acquisition fee as discussed in Section 8.5.6.

**Figure 8-66 San Dimas Management Alternative 2 – Map 1 of 2**

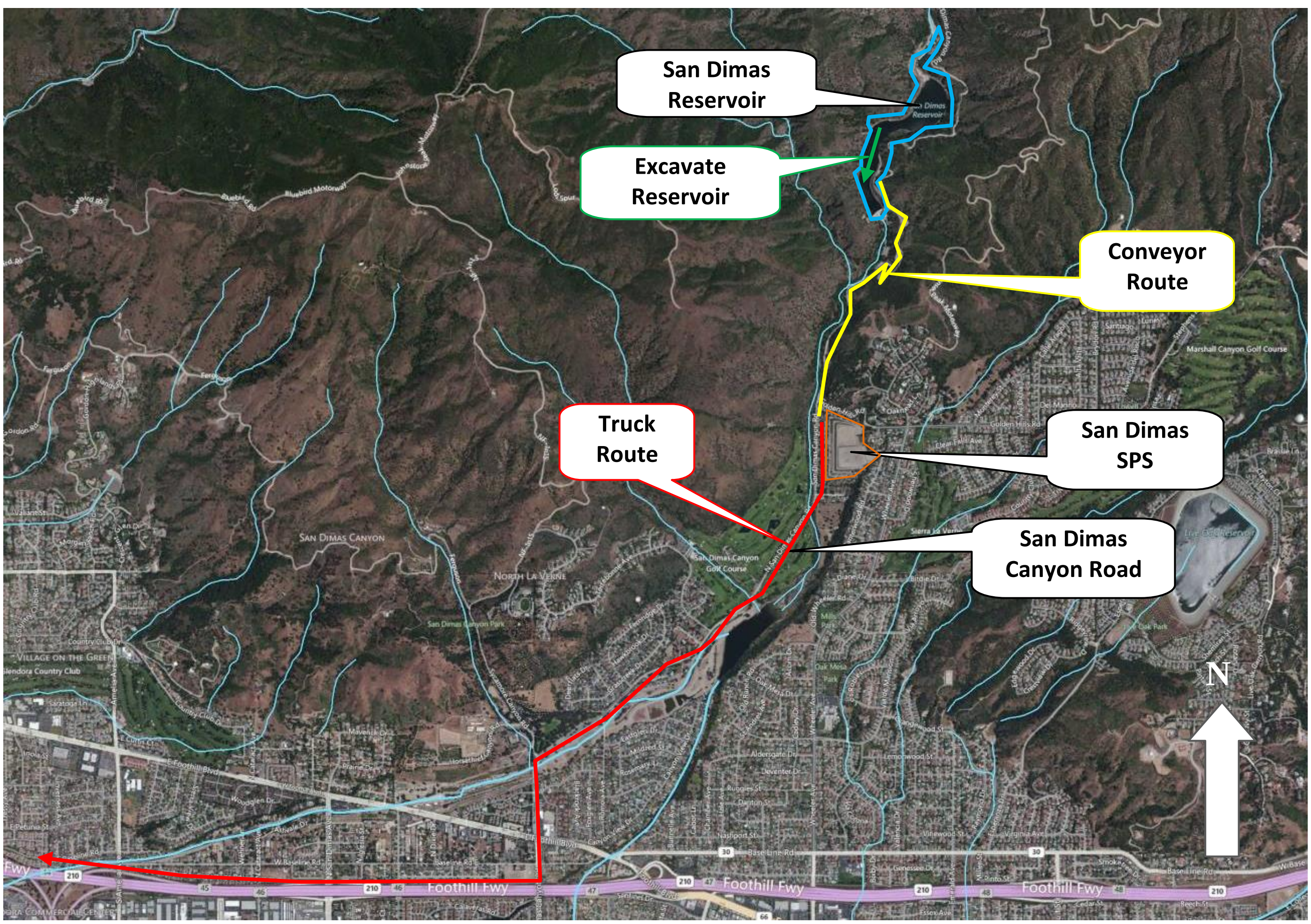


**Figure 8-67 San Dimas Management Alternative 2 – Map 2 of 2**

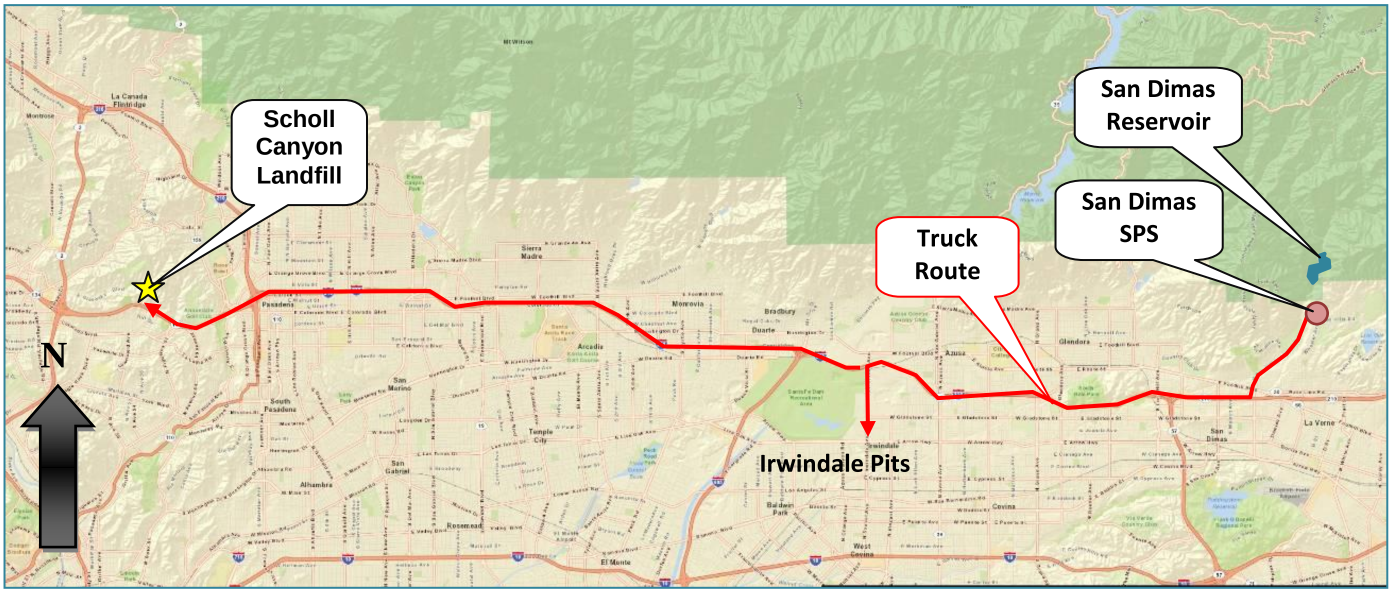



**Table 8-25 San Dimas – Alternative 2 Cost Estimate**

| Activity | Amount (MCY) | Distance (MI) | Unit Cost | Unit | Total Cost ($ Millions) |
|---|---|---|---|---|---|
| Excavation at San Dimas Reservoir | 1.9 | | $ 3.00 | CY | $ 5.7 |
| Conveyor from Reservoir to SPS | | 1 | $ 800.00 | LF | $ 4.2 |
| Spreading at San Dimas SPS | | | $ 2.00 | CY | $ 3.8 |
| Excavation from SPS | | | $ 3.00 | CY | $ 5.7 |
| Double Dump Truck from SPS | | 24 -52 | $ 0.30 | MI-CY | $ 13.8 - 19.0 |
| Pit or Landfill Placement Fee | | | $ 3.00-7.00 | CY | $ 1.9 – 4.5 |
| | | | | **Total** | **$ 35 – 40** |

### 8.5.7.3 COMBINED ALTERNATIVE 3: SLUICING > PUDDINGSTONE DIVERSION RESERVOIR > EXCAVATION > TRUCKING > IRWINDALE PITS + EXCAVATION > TRUCKING > IRWINDALE PITS

Two thirds of the sediment can be sluiced from the reservoir and into the San Dimas Creek and eventually to the Puddingstone Diversion Reservoir as shown in Figure 8-68. The material will be dewatered at the reservoir, excavated, and transported out via trucks to a pit in the Irwindale area, as shown in Figure 8-69.

Refer to Section 9.5, for more information regarding removal alternatives for the Puddingstone Diversion Reservoir. The remaining one third of the larger material would not be suitable for sluicing and will have to be excavated similar to option 1. It would take 20 sluicing events, or a cleanout every year, to remove the 20-year planning quantity. The total cost is estimated to be approximately $25 million, as shown on Table 8-26 below. It is assumed that only one third of the material will be subject to a tipping or acquisition fee as discussed in Section 8.5.6.

Figure 8-68 San Dimas Management Alternative 3 – Map 1 of 2

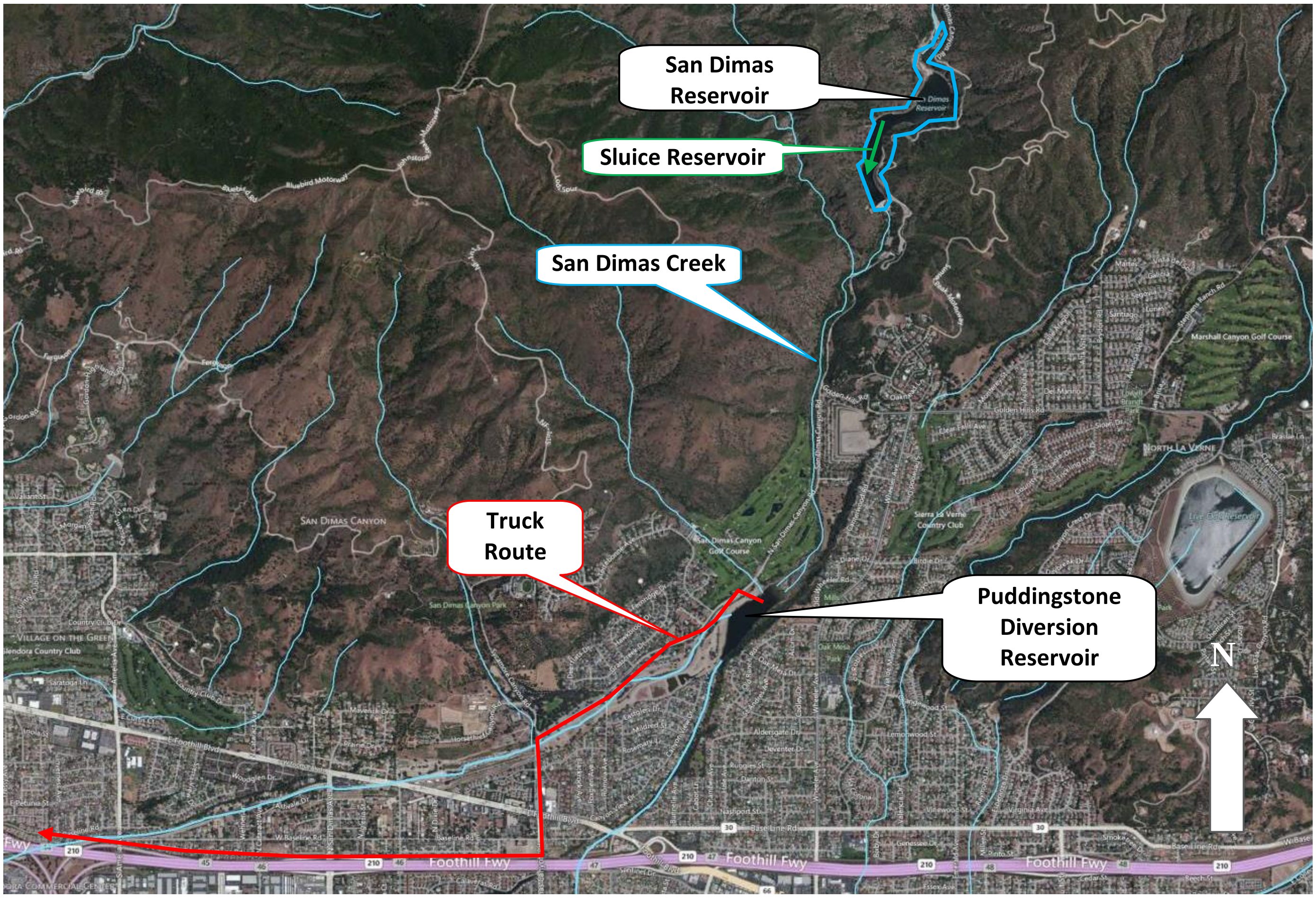



Figure 8-69 San Dimas Management Alternative 3 – Map 2 of 2

**Table 8-26 San Dimas – Alternative 3 Cost Estimate**

| Activity | Amount (MCY) | Distance (MI) | Unit Cost | Unit | Total Cost ($ Millions) |
|---|---|---|---|---|---|
| Sluicing at San Dimas Reservoir | 1.3 | | $ 2.50 | CY | $ 3.2 |
| Excavation at Puddingstone Diversion Reservoir | | | $ 3.00 | CY | $ 3.8 |
| Double Dump Truck from Puddingstone Diversion Reservoir to Pits | | 22 | $ 0.30 | MI-CY | $ 8.4 |
| Excavation at San Dimas Reservoir | 0.6 | | $ 3.00 | CY | $ 1.9 |
| Double Dump Truck from San Dimas Reservoir to Pit | 0.6 | 26 | $ 0.30 | MI-CY | $ 5.0 |
| Pit Placement Fee | 1.9 | | $ 3.00-7.00 | CY | $ 1.9 – 4.5 |
| | | | | **Total** | **$ 25** |

#### 8.5.7.4 COMBINED ALTERNATIVE 4: DREDGING > PUDDINGSTONE DIVERSION RESERVOIR > EXCAVATION > TRUCKING IRWINDALE PITS + EXCAVATION > TRUCKING > IRWINDALE PITS

Two thirds of the sediment can be dredged from the reservoir and transported via slurry pipeline into the Puddingstone Diversion Reservoir, as shown in Figure 8-70. The material will be dewatered at the Puddingstone Diversion Reservoir, excavated, and transported out via trucks to a pit in the Irwindale area, as shown in Figure 8-71. Refer to Section 9.5 for more information regarding removal alternatives for the Puddingstone Diversion Reservoir. The remaining one third of the larger material would not be suitable for dredging and will have to be excavated similar to Alternative 1. It would take 7 cleanouts, or a cleanout every 3 years, to remove the 20-year planning quantity. The total cost is estimated to be approximately $35-40 million, as shown on Table 8-27 below. It is assumed that only one third of the material will be subject to a tipping or acquisition fee as discussed in Section 8.5.6.

Figure 8-70 San Dimas Management Alternative 4 – Map 1 of 2

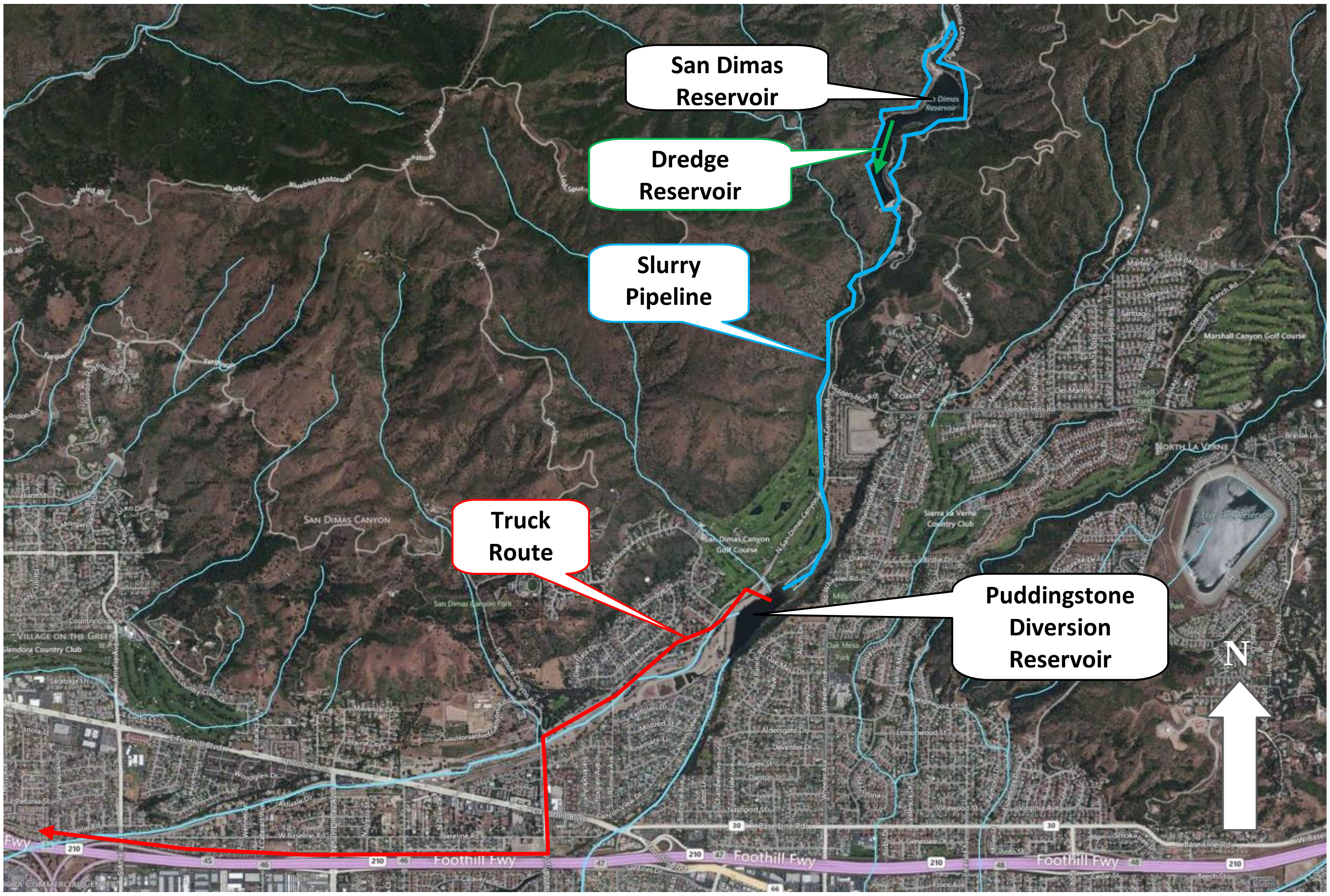



Figure 8-71 San Dimas Management Alternative 4 – Map 2 of 2

**Table 8-27 San Dimas – Alternative 4 Cost Estimate**

| Activity | Amount (MCY) | Distance (MI) | Unit Cost | Unit | Total Cost ($ Millions) |
|---|---|---|---|---|---|
| Dredging (2/3) at San Dimas Reservoir | 1.3 | | $ 12.50 | CY | $ 15.9 |
| Excavation at Puddingstone Diversion Reservoir | | | $ 3.00 | CY | $ 3.8 |
| Double Dump Truck from Puddingstone Diversion Reservoir to Pits | | 22 | $ 0.30 | MI-CY | $ 8.4 |
| Excavation (1/3) at San Dimas Reservoir | 0.6 | | $ 3.00 | CY | $ 1.9 |
| Double Dump Truck from San Dimas Reservoir to Pit | | 26 | $ 0.30 | MI-CY | $ 5.0 |
| Placement at Pits | 1.9 | | $ 3.00-7.00 | CY | $ 1.9 - 4.5 |
| | | | | **Total** | **$ 35 - 40** |

## 8.5.8 SUMMARY AND RECOMMENDATIONS

### 8.5.8.1 SUMMARY

Over the next 20 years, 1.9 MCY of sediment is planned to be removed from San Dimas Reservoir. The different management alternatives are briefly explained below and the impacts are shown in Table 8-28.

**Sediment Management Alternatives**

1 Excavate → Trucks → Irwindale Pits
Excavating the sediment and truck it to a pit in the Irwindale area.

2 Excavate → Conveyor → San Dimas SPS → Excavation → Trucks → Irwindale Pits & Landfills
Excavate the sediment and place it on a conveyor system where it will be transported to the San Dimas SPS. From the SPS, the sediment can be gradually transported out via trucks to a pit in the Irwindale area or a landfill.

3 Sluice (1.3 MCY) → Puddingstone Diversion Reservoir → Excavate → Trucks → Irwindale Pits + Excavate (0.6 MCY) → Trucks → Irwindale Pits
It is assumed that two thirds of the 1.9 MCY will be small enough to sluice. Sluice 1.6 MCY from San Dimas Dam along San Dimas Creek to the Puddingstone Diversion Reservoir, where the sediment will be excavated and trucked to a pit in the Irwindale area. The larger material (0.6 MCY) will be excavated similar to alternative one.

4 Dredge (1.3 MCY) → Slurry Pipeline → Puddingstone Diversion Reservoir → Excavate → Trucks → Irwindale Pits + Excavate (0.6 MCY) → Trucks → Irwindale Pits
It is assumed that two thirds of the 1.9 MCY will be small enough to dredge. Dredge 1.6 MCY from San Dimas Dam into a slurry pipeline along San Dimas Canyon Road and discharge the sediment to the Puddingstone Reservoir. The sediment will be excavated from the Puddingstone Reservoir and trucked to a pit in the Irwindale area. The larger material (0.6 MCY) will be excavated similar to alternative one.

**Table 8-28 San Dimas Reservoir Summary Table**

| | Alternative | Quantity Removed (MCY) | Environmental | | | | Social | | | Implementability | Performance | | Cost |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Habitat | Water Quality | Groundwater Recharge | Air Quality[1] | Traffic | Visual | Noise | Special Permit/Agreement Required[2] | Previous Experience | # of Operations Required in Next 20 years | $ Millions |
| 1 | Excavation | 1.9 | ◑ | | ○ | ◑ | | ○ | ○ | | Yes | 3 | 25 |
| | Trucks | | | | | ● | ● | ◑ | ◑ | | | | |
| | Irwindale Pits | | | | | | | | | Yes | | | |
| 2 | Excavation | 1.9 | ◑ | | ○ | ◑ | | ○ | ○ | | Yes | 4 | 35-40 |
| | Conveyor | | ○ | | | | ○ | ◑ | ○ | | | | |
| | San Dimas SPS | | ○ | | | ○ | | ◑ | ◑ | | | | |
| | Trucks | | | | | ● | ● | ◑ | ◑ | | | | |
| | Irwindale Pits/Landfills | | | | | | | | | Yes | | | |
| 3 | Sluice | 1.3 | ● | ● | ◑ | | | ◑ | | | Yes | 20 | 25 |
| | Puddingstone Div. Reservoir | | ◑ | ● | ○ | | | ◑ | ◑ | | | | |
| | Excavation | 1.9 | ◑ | | ○ | ◑ | | ○ | ○ | | | | |
| | Trucks | | | | | ● | ● | ◑ | ◑ | | | | |
| | Irwindale Pits | | | | | | | | | Yes | | | |
| 4 | Dredge | 1.3 | ○ | ◑ | ○ | | | ○ | ○ | | No | 7 | 35-40 |
| | Slurry Pipeline | | ◑ | | | | ○ | ◑ | | | | | |
| | Puddingstone Diversion Res. | | ◑ | ● | ○ | | | ◑ | ◑ | | | | |
| | Excavation | 1.9 | ○ | | ○ | ◑ | | ○ | ○ | | | | |
| | Trucks | | | | | ● | ● | ◑ | ◑ | | | | |
| | Irwindale Pits | | | | | | | | | Yes | | | |

Legend

| | |
|---|---|
| ● | significant impact |
| ○ | possible impact |
| ◑ | some impact |
| | no impact |

Notes:
(a) Use of low-emission trucks would reduce air quality impacts from significant impact (●) to some impact (◑).
(b) All options require environmental regulatory permit.

### 8.5.8.2 Recommendation

It is recommended that all the alternatives be considered for future sediment removal projects at San Dimas Reservoir.

## 8.6 SANTA ANITA RESERVOIR

### 8.6.1 BACKGROUND

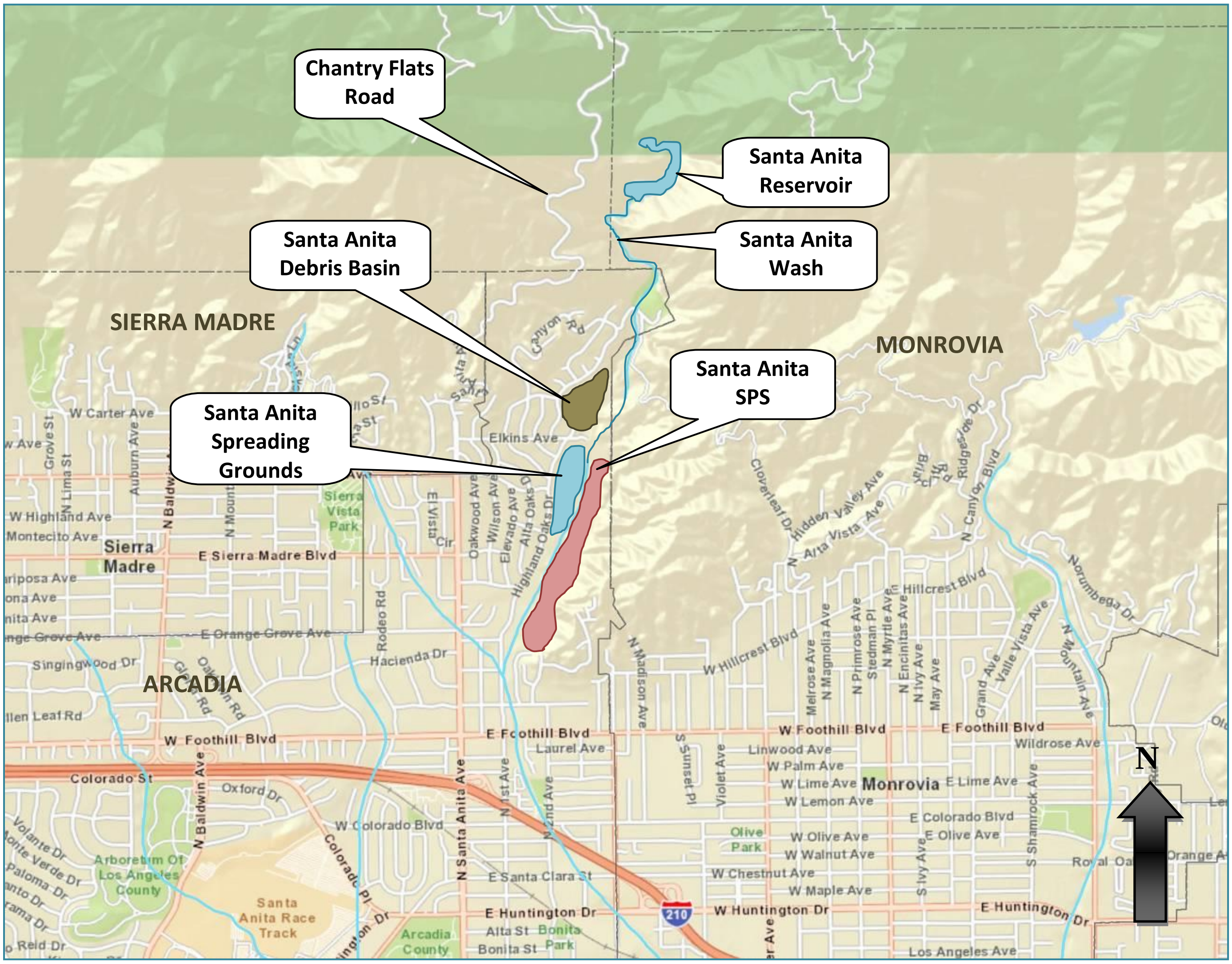
Santa Anita Dam, shown in Figure 8-72, is a concrete, constant angle arch dam that was built in 1927 by the Flood Control District and functions as a flood risk management and water conservation facility. With a drainage area of 10.8 square miles, Santa Anita Dam had an original storage capacity of 2.2 MCY. Water impounded during the storm season behind the dam is released gradually and diverted into the downstream spreading facilities to recharge groundwater. However, the first 20 cubic feet per second (cfs) discharged from the dam is diverted to a water intake for the City of Sierra Madre. Santa Anita Reservoir is not accessible to the public and is not used for recreation.

**Figure 8-72 Santa Anita Dam**

#### 8.6.1.1 LOCATION

Santa Anita Reservoir is located in the San Gabriel Mountains, on Santa Anita Wash, approximately 2.5 miles north of the City of Arcadia, as shown in Figure 8-73.

**Figure 8-73 Santa Anita Reservoir Vicinity Map**




Santa Anita Canyon is a steep-walled, deeply incised canyon that opens out into the upper alluvial fan of the Los Angeles Basin. Due to the shape of the canyon, Santa Anita reservoir is long and narrow, with a length of approximately 1,500 feet and an average width of 200 feet. The canyon side slopes are rocky and can exceed 2:1 horizontal to vertical.

The average gradient of Santa Anita Wash below the dam is 310 feet per mile. The natural watercourse below the reservoir terminates 1.3 miles downstream in Santa Anita Debris Basin, which is operated by the Flood Control District. Figure 8-74 shows the topography of Santa Anita Canyon at the dam and reservoir.

**Figure 8-74 Santa Anita Reservoir Topography**

#### 8.6.1.2 ACCESS

Access to the top of the dam is available off Chantry Flats Road via the Flood Control District's access road. Both Chantry Flats Road and the access road are very narrow and winding. Chantry Flats Road can accommodate two-way traffic for most of its length, but the access road can only accommodate one-way traffic. At the top of the dam, an unpaved road runs along the west side of the reservoir allowing vehicular access to the upstream end of the reservoir.

Located on the downstream side of the dam, Santa Anita Debris Basin, Spreading Grounds, and SPS can be accessed via Elkins Avenue, a residential road, as shown in Figure 8-75.

**Figure 8-75 Santa Anita Dam Access**


### 8.6.1.3 DAM OUTLETS

In addition to being equipped with a variety of valves, Santa Anita Dam is also equipped with a sluiceway controlled by a 5-foot by 5-foot sluice gate. An access tunnel, with dimension of at least 5 feet by 5 feet is not used to discharge water but connects the south edge of the reservoir with an access road on the east side of Santa Anita Wash downstream of the dam.

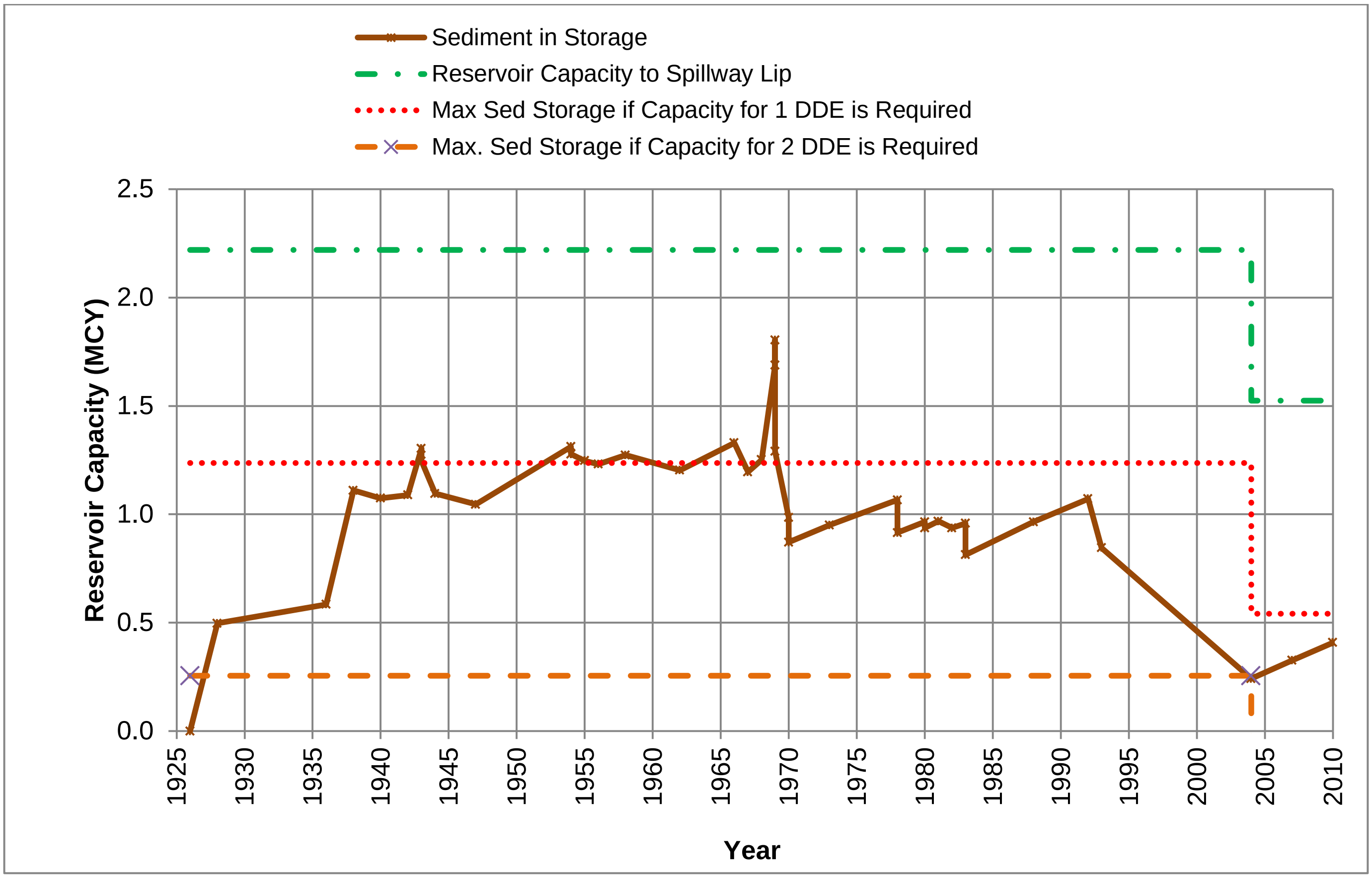
### 8.6.1.4 DOWNSTREAM FLOOD CONTROL AND WATER CONSERVATION SYSTEM COMPONENTS

Water that passes through Santa Anita Dam travels 1.3 miles along Santa Anita Wash then to the Santa Anita Debris Basin, which is adjacent to the Santa Anita Spreading Grounds and Santa Anita SPS. Santa Anita Wash continues downstream where it joins the Rio Hondo, which eventually flows into the Los Angeles River.

### 8.6.1.5 SEDIMENT DEPOSITION AND REMOVAL HISTORY

Figure 8-76 shows the approximate sediment storage in Santa Anita Reservoir. It is the Flood Control District's practice to retain enough storage capacity within a reservoir for two DDEs, which are calculated and determined for each specific reservoir. For reference purposes, Table 8-29 shows the original reservoir capacity at spillway lip and the maximum sediment storage that allows for the storage of one and two DDEs. The graph shows that the Flood Control District has reduced the quantity of sediment in storage at Santa Anita Reservoir on numerous occasions.

**Figure 8-76 Graph of Historical Sediment Storage at Santa Anita Reservoir**




Note: For July 2004, sediment in storage volume based on new maximum capacity figure of 1.5 MCY.

Sediment has been removed 21 times in the 87-year life of the reservoir. Table 8-29 shows that both excavation and sluicing have been used to remove sediment from Santa Anita Reservoir in the past. The majority of the sediment (69 percent) has been removed through sluicing.

**Table 8-29 Summary of Historic Sediment inflows and Cleanouts – Santa Anita Reservoir**

| Survey Date | | Reservoir Capacity (MCY) | Quantity Sluiced (MCY) | Quantity Excavated (MCY) | Sediment Accumulated Between Surveys (MCY) | Sediment in Storage (MCY) |
|---|---|---|---|---|---|---|
| October | 1926 | 2.22 | - | - | - | - |
| March | 1928 | 1.72 | - | - | 0.50 | 0.50 |
| January | 1936 | 1.64 | - | - | 0.09 | 0.58 |
| July | 1938 | 1.11 | - | - | 0.53 | 1.11 |
| February | 1940 | 1.15 | 0.26 | - | 0.22 | 1.07 |
| February | 1942 | 1.13 | 0.04 | - | 0.05 | 1.09 |
| March | 1943 | 0.92 | - | - | 0.21 | 1.30 |
| September | 1943 | 0.97 | 0.10 | - | 0.05 | 1.25 |
| May | 1944 | 1.12 | 0.15 | - | - | 1.10 |
| January | 1947 | 1.17 | 0.07 | - | 0.02 | 1.05 |
| February | 1954 | 0.91 | 0.02 | - | 0.29 | 1.31 |
| July | 1954 | 0.94 | 0.25 | - | 0.21 | 1.28 |
| August | 1955 | 0.97 | 0.03 | - | - | 1.25 |
| February | 1956 | 0.99 | 0.08 | - | 0.06 | 1.23 |
| September | 1958 | 0.95 | - | - | 0.04 | 1.27 |
| April | 1962 | 1.02 | 0.13 | - | 0.06 | 1.20 |
| September | 1966 | 0.89 | 0.02 | - | 0.15 | 1.33 |
| June | 1967 | 1.02 | 0.13 | - | - | 1.20 |
| October | 1968 | 0.97 | 0.02 | - | 0.08 | 1.25 |
| February | 1969 | 0.53 | - | - | 0.44 | 1.69 |
| March | 1969 | 0.42 | - | - | 0.12 | 1.80 |
| November | 1969 | 0.93 | 0.12 | 0.39 | - | 1.29 |
| February | 1970 | 1.23 | - | 0.33 | 0.03 | 0.99 |
| November | 1970 | 1.35 | - | 0.11 | - | 0.87 |
| October | 1973 | 1.27 | - | - | 0.08 | 0.95 |
| April | 1978 | 1.15 | - | - | 0.12 | 1.07 |
| May | 1978 | 1.31 | 0.15 | - | - | 0.91 |
| March | 1980 | 1.26 | - | - | 0.05 | 0.96 |
| August | 1980 | 1.28 | 0.03 | - | - | 0.94 |
| December | 1981 | 1.25 | - | - | 0.03 | 0.97 |
| September | 1982 | 1.25 | - | - | - | 0.94 |
| March | 1983 | 1.23 | - | - | 0.02 | 0.96 |
| June | 1983 | 1.38 | 0.15 | - | - | 0.81 |
| February | 1988 | 1.36 | - | - | 0.03 | 0.96 |
| July | 1992 | 1.22 | - | - | 0.13 | 1.07 |
| April | 1993 | 1.34 | 0.12 | - | - | 0.85 |
| July | 2004 | 1.28 | - | - | 0.06 | 0.24 |
| July | 2007 | 1.20 | - | - | 0.14 | 0.33 |
| December | 2010 | 1.22 | - | - | 0.01 | 0.41 |

Note: For July 2004, sediment in storage volume based on new maximum capacity figure of 1.5 MCY.

Historically, excavated material has been placed at Santa Anita SPS. This SPS is approximately 1.1 miles downstream of the reservoir.

### 8.6.2 PLANNING QUANTITY AND ASSUMED SEDIMENT CHARACTERISTICS

As described in Section 5, the 20-year planning quantity for sediment inflow into Santa Anita Reservoir is 1.2 MCY.

Approximately two thirds of the sediment in Santa Anita Reservoir's planning quantity could potentially be small enough to be dredged or sluiced. Given this assumption, if dredging or sluicing was to be employed, approximately 0.8 MCY of sediment could potentially be dredged or sluiced while the remaining 0.4 MCY would need to be excavated.

### 8.6.3 POTENTIAL STAGING AND TEMPORARY SEDIMENT STORAGE AREAS

#### 8.6.3.1 SANTA ANITA SPS

Santa Anita SPS, as shown in Figure 8-77, is currently owned by the Flood Control District and was originally developed for the receipt of sediment from Santa Anita Reservoir and Debris Basin. As part of the 2011 cleanout project, the Upper Middle Santa Anita SPS was cleared of vegetation. As part of the mitigation efforts from the Upper Middle Santa Anita SPS clearing, the Lower Santa Anita SPS will be re-vegetated once the SPS reaches ultimate capacity. The Upper Santa Anita SPS is currently used as a temporary stockpiling area for debris basin cleanouts. There are no plans to develop the Lower Middle Santa Anita SPS as a SPS.

**Figure 8-77 Santa Anita SPS**


**Santa Anita SPS – Environmental Impacts**

Lower Middle Santa Anita SPS is currently vegetated by oak woodlands, which would be impacted if the entire site were used. However, currently there are no plans to develop the Lower Middle Santa Anita SPS as a future SPS. Upper Santa Anita SPS is currently used as a staging or temporary sediment storage area and using this area will have minimal environmental impacts. Lower Santa Anita SPS will be re-vegetated and will not be available to use as a temporary storage area.

**Santa Anita SPS – Social Impacts**

There is no permitted recreational use of the area, but visual and noise impacts may affect residents near the SPS.

**Santa Anita SPS – Implementability**

Santa Anita SPS has been used to place sediment from past Santa Anita Reservoir cleanouts; however, environmental permits may be required for modifications to the SPS.

**Santa Anita SPS – Performance**

The entire SPS has 3 MCY of remaining capacity; however, there are no plans to develop the entire SPS due to the environmental impacts associated with expansion as discussed above. The existing material at the SPS can be excavated, gradually transported out, and placed at an alternative placement site in order to restore capacity at the SPS and be used for future cleanout projects.

**Santa Anita SPS – Cost**

There is no additional cost to use Santa Anita SPS as it is already owned by the Flood Control District. However, if the SPS is used to transition between different transportation methods, it will incur additional costs to manage and spread the sediment at the SPS ($2/CY) and place the material in trucks ($7.50/CY).

### 8.6.3.2 SANTA ANITA DEBRIS BASIN

Santa Anita Debris Basin, as shown in Figure 8-78, is approximately 1.3 miles downstream of the reservoir and is owned and operated by the Flood Control District.

**Figure 8-78 Santa Anita Debris Basin**

**Santa Anita Debris Basin – Environmental Impacts**

Additional environmental permitting would be required to use the debris basin as a staging area during the dry months as it is heavily vegetated. Impacts to water quality and conservation are not expected.

**Santa Anita Debris Basin – Social Impacts**

The debris basin is adjacent to several residential properties on the west, and any operations in the debris basin would increase traffic and noise in the vicinity of the debris basin. The hours of operation could be limited to minimize disturbance to the residents.

**Santa Anita Debris Basin – Implementability**

Santa Anita Debris Basin can be used as a staging area, but the availability will be limited to the dry season due to the need to use the debris basin to capture sediment during the storm season. Environmental regulatory permits would also be required to use this site for staging or temporary sediment storage.

**Santa Anita Debris Basin – Performance**

The debris basin has a capacity of 395,000 CY, which would be sufficient space to stage sediment at this location. The debris basin has been used as a staging area in previous sluicing events.

**Santa Anita Debris Basin – Cost**

There is no additional cost to use Santa Anita Debris Basin as it is already owned by the Flood Control District. However, if the debris basin is used to transition between different transportation methods, it will incur additional costs to manage and spread the sediment ($2/CY) and place the material in trucks ($7.50/CY).

## 8.6.4 REMOVAL ALTERNATIVES

The following section discusses the impacts and costs of sediment removal at Santa Anita Reservoir by means of excavation, dredging, and sluicing. Discussion of the transportation and placement alternatives is presented in Sections 8.6.5 and 8.6.6, respectively. Combined alternatives that address all phases of the sediment management process are presented and discussed in Section 8.6.7.

### 8.6.4.1 EXCAVATION

Excavation has been used in the past in Santa Anita Reservoir and could be used in conjunction with the conveyor transportation mode.

**Excavation – Environmental Impacts**

Emissions from heavy equipment used during excavation will impact air quality within the proximity of the excavation site.

Excavating the reservoir is not expected to have impact on water quality. As discussed in Section 6, dewatering a reservoir in order to excavate it could impact water conservation if the water is released faster than spreading facilities downstream of the reservoir can handle.

**Excavation – Social Impacts**

Excavation will have minimal social impact due to the remote location of Santa Anita Dam. Recreational users that hike in the vicinity of the reservoir may be subject to air quality and noise impacts.

**Excavation – Implementability**

Environmental permits may be required prior to the excavation operation; however, there are no implementability concerns with using excavation as a removal method.

**Excavation – Performance**

This method has performed well in the past and its ability to be used for sediment removal is not a concern for future cleanouts. For additional performance discussion, refer to Section 6.

**Excavation – Cost**

The cost to excavate sediment from a reservoir is approximately $3 per cubic yard. Excavating 1.2 MCY of sediment would cost approximately $3.6 million over a 20-year period.

#### 8.6.4.2 DREDGING

Approximately two-thirds of Santa Anita Reservoir's planning quantity meets the characteristics of dredgeable material. Therefore, if dredging were to be employed at Santa Anita Reservoir, another removal method would have to be employed to remove the non-dredgeable material. Excavation with conveyors may be the only feasible method to remove the larger, non-dredgeable material from the reservoir.

**Dredging – Environmental Impacts**

Dredging could impact water quality within Santa Anita Reservoir by increasing the turbidity. However, as discussed in Section 6, water quality concerns could be partially addressed with a silt curtain around the dredge. As discussed in Section 6, dredging sediment (and transporting it via a slurry pipeline) could affect water conservation.

There are also some minor impacts to air quality due the dredging equipment.

**Dredging – Social Impacts**

Dredging will have minimal social impact due to the remote location of Santa Anita Dam. Recreational users that hike along Chantry Flats Road may be subject to air quality and noise impacts.

**Dredging – Implementability**

The reservoir would need to be drained to a certain depth for the hydraulic dredge to be operable.

No additional right of way is anticipated to be required for implementation of a dredging operation within the reservoir. Dredging would require environmental regulatory permits.

Dredging has not previously been employed by the Flood Control District and is not considered a proven method to remove sediment from the reservoirs managed by the Flood Control District.

Drawing down the reservoir significantly may still be needed in order to meet the 50-foot water depth capabilities of the hydraulic dredge. Another limitation of dredging is the availability of an area to dewater material downstream.

**Dredging – Performance**

Assuming a dredge can operate at 200 CY per hour and operate for 6 months, a dredging operation can be performed 5 or 6 times during the 20 year period to remove 0.8 MCY.

**Dredging – Cost**

Based on the estimated unit cost of $10.50/CY for dredging, dredging 0.8 MCY of sediment would cost approximately $8.5 million.

#### 8.6.4.3 SLUICING (AS A REMOVAL METHOD)

Sluicing would only be effective for finer materials and would still require excavation for larger materials. It is estimated that approximately two thirds of the material meets the characteristics of sluiceable material.

This section focuses on sluicing as a sediment removal method and discusses the impacts of sluicing within Santa Anita Reservoir only. For the impacts of sluicing downstream of the dam refer to Section 8.6.5.1.

**Sluicing (Removal) – Environmental Impacts**

Within Santa Anita Reservoir itself, sluicing would be expected to impact vegetation and animal species in a similar manner as excavating sediment from the reservoir would since in both cases the reservoir would need to be drained. See the discussion under Excavation for more information.

During a sluicing operation, water quality within the reservoir would be impacted due to the higher-than-normal sediment concentration. As discussed in Section 6, removing sediment from a reservoir by sluicing could affect water conservation.

Sluicing operations within Santa Anita Reservoir would result in equipment emissions. However, given the Flood Control District's previous sluicing projects, only a few pieces of equipment would be necessary within the reservoir.

**Sluicing (Removal) – Social Impacts**

Due to the remote location of the reservoir, minimal noise and visual impacts would be associated with sluicing.

**Sluicing (Removal) – Implementability**

Base flows from Santa Anita Wash have shown to be sufficient to use sluicing as a means of removing sediment from Santa Anita Reservoir. In the past, the flows have supported sluicing events with an average sediment removal of 100,000 CY per event. Environmental permitting will be required to use sluicing to remove sediment from Santa Anita Reservoir.

**Sluicing (Removal) – Performance**

Based on previous cleanout data, a sluicing event can remove up to 100,000 CY of sediment at this site. Assuming, two thirds of the material is sluiceable, a sluicing event would be required every 2-3 years to remove 0.8 MCY.

**Sluicing (Removal) – Cost**

The cost to sluice sediment from a reservoir is approximately $2.50 per cubic yard. Sluicing 0.8 MCY of sediment would cost approximately $2.0 million over a 20-year period.

## 8.6.5 TRANSPORTATION ALTERNATIVES

The following section discusses the impacts and costs of transporting sediment removed from Santa Anita Reservoir. The alternatives discussed include sluicing, trucking, conveyor belts, and slurry pipelines. Discussion of the removal alternatives was presented in Section 8.6.4. The placement alternatives are presented in Section 8.6.6. Combined alternatives that address all phases of the sediment management process are presented and discussed in Section 8.6.7.

### 8.6.5.1 SLUICING (AS A TRANSPORT METHOD)

This section focuses on the impacts of utilizing sluicing as a transport method to move sediment downstream of Santa Anita Dam along Santa Anita Wash to the Santa Anita Debris Basin. For the impacts of sluicing operations within Santa Anita Reservoir, refer to the discussion of sluicing as a removal method in the previous section. Impacts at Santa Anita Debris Basin were discussed in Section 8.6.3.2.

**Sluicing (Transport) – Environmental Impacts**

Major sluicing releases of sediment through the dam to the Santa Anita Wash would likely be disruptive to downstream riparian and aquatic habitats.

Sluicing would impact water quality by increasing the turbidity within Santa Anita Wash. As discussed in Section 6, transporting sediment via sluicing could affect water conservation.

Drinking water supplies could be impacted by high turbidity within Santa Anita Wash as the City of Sierra Madre operates a drinking water intake between the dam and the debris basin.

**Sluicing (Transport) – Social Impacts**

Minimal noise and visual impacts would be associated with sluicing. Visual impacts will consist of flows in Santa Anita Wash with higher levels of sediment than normal. Recreation along the wash could be impacted by sluicing operations.

**Sluicing (Transport) – Implementability**

Base flows from Santa Anita Wash have shown to be sufficient to use sluicing as a means of transporting sediment along Santa Anita Wash. Environmental permitting will be required to use sluicing to transport sediment.

**Sluicing (Transport) – Performance**

Based on previous cleanout data, a sluicing event can remove approximately 100,000 CY of sediment. Assuming, two thirds of the material is sluiceable, a sluicing event would be required every 2-3 years to remove 0.8 MCY.

**Sluicing (Transport) – Cost**

The cost to sluice sediment from a reservoir is approximately $2.50 per cubic yard. Sluicing 0.8 MCY of sediment would cost approximately $2.0 million over a 20-year period.

#### 8.6.5.2 TRUCKING

Due to the roadway configuration and load limitations along Chantry Flats Road, trucks cannot operate as a stand-alone transportation mode from the body of Santa Anita Reservoir. However, they are feasible for use in conjunction with sluicing and conveyors where the sediment is transported to the Santa Anita SPS and then trucked to its final placement location. Trucks can access the Santa Anita SPS via N. Santa Anita Avenue and Elkins Avenue.

**Trucking – Environmental Impacts**

Since existing roads would be used to truck sediment, no particular impacts would be expected on habitat, water quality, or water conservation. Air quality would be impacted due to the truck operations to the residents within proximity of the haul route. Employing low emission trucks would reduce air quality impacts.

**Trucking – Social Impacts**

Sediment hauling activities would impact traffic and noise for residents in proximity to the truck haul routes, particularly for residential areas to the west and south of the project site, the Arcadia Wilderness Park, the Highland Oaks Elementary School, and the Foothill Middle School.

**Trucking – Implementability**

All routes pass through the residential areas in the City of Arcadia, although the trucks could alternate use of multiple routes to reduce traffic on any given route. Double dump trucks can be used for this operation.

An alternative route is to utilize single dump trucks along the Eastern access road along Santa Anita Wash and exit the access road at Sycamore Avenue, which would reduce residential impacts. However, the access road along the wash would need to be improved and there might be major impacts to Foothill Middle School which is adjacent to the access road entrance.

Another option would be to utilize single dump trucks inside the 20'-wide and 12'-high Santa Anita Wash. An invert access ramp could be constructed at Foothill Blvd. or the existing access ramp at Colorado Blvd. could be used. A structural analysis of the channel must be completed in order to determine if the channel has the structural integrity to handle the trucks. In addition, utilities and bridge clearances must be checked since single dump trucks are 11 to 13' in height. A drawback of this option is that the channel would only allow one way traffic, therefore access of residential streets would still be required.

For this analysis, only the Elkins Ave. truck route was shown for the combined management alternatives (Section 8.6.7), however, a combination of all these alternatives could be used to reduce social impacts.

**Trucking – Performance**

Double dump trucks, which have the capacity for approximately 16 CY, can operate for 6 months and transport 800,000 CY of sediment. A cleanout operation can be performed every 10 years and remove the total 20-year quantity of 1.2 MCY.

This method has performed well in the past, and its ability to successfully perform sediment removal is not a concern for future cleanouts.

**Trucking – Cost**

Trucking costs are approximately $0.30/CY-Mile for a double dump truck, and assuming the sediment is taken to a pit in the Irwindale area which is 12 miles away (one way), the total cost for the 20-year period for 1.2 MCY of removal is approximately $8.8 million.

#### 8.6.5.3 <u>CONVEYOR BELTS</u>

A conveyor system can be combined with excavation in order to transport the material 1.3 miles downstream through the access tunnel to the Santa Anita SPS, as performed in 2011.

**Conveyor Belts – Environmental Impacts**

The conveyor system would be installed along the existing access road from the outlet of the access tunnel and have minimal impact on habitat along the route. A conveyor system would have very minimal air quality impacts.

**Conveyor Belts – Social Impact**

Use of a conveyor belt system may result in visual impacts for residents or recreational users along the conveyance route, however, the impact is expected to be minimal. Also, while the conveyor operations will create some noise, it has not been an issue for past operations.

**Conveyor Belts – Implementability**

Conveyor systems have the ability to handle relatively circuitous alignments as long as the turning radii are no less than approximately 300 feet. Because of the infrequent need for cleanouts, a conveyor would be installed on a temporary basis.

**Conveyor Belts – Performance**

Assuming a conveyor system can operate at 500 CY per hour and operate for 6 months, a conveyor operation would be required every 8 years to remove the total 20-year quantity of 1.22 MCY.

**Conveyor Belts – Cost**

Conveyor costs are approximately $800/LF for installation and operating costs. The cost for 1.3 miles of conveyor would be approximately $5.5 million.

#### 8.6.5.4 <u>SLURRY PIPELINE</u>

A slurry pipeline would only be feasible if dredging is used. The dredge would pump the sediment/water into a 12-inch HDPE slurry pipeline that could possibly be routed through the access tunnel, along the access road, and eventually discharge into the debris basin. This would require significant modification to the upstream tunnel entrance since it is normally sealed when the reservoir contains water. The sediment could be dewatered at the debris basin and eventually trucked out to the final placement site. Impacts associated with using Santa Anita Debris Basin were discussed previously.

**Slurry Pipeline – Environmental Impacts**

The slurry pipeline would be constructed along the existing access road and not likely impact habitat. Water quality at the dewatering site would be impacted by high turbidity. In addition, water supplies to the City of Sierra Madre would be impacted because their intake would be bypassed by the slurry pipeline.

**Slurry Pipeline – Social Impacts**

The slurry pipeline would have minimal social impact since it would be placed along the remote access road.

**Slurry Pipeline – Implementability**

While it is technically feasible, the biggest implementability concern with the slurry pipeline is the connection through the upstream end of the access tunnel. The remainder of the route does not present implementability concerns.

**Slurry Pipeline – Performance**

Assuming a dredge operation can remove 200 CY per hour, the 12-inch HDPE slurry pipeline would have approximately 15 cfs flowing in it. No booster stations would be required due to the elevation change from the reservoir to the debris basin.

**Slurry Pipeline – Cost**

The slurry pipeline cost is approximately $37.50/LF for an above ground 12-inch HDPE pipe. For a 1.5 mile long slurry pipe, the total cost is approximately $297,000.

## 8.6.6 PLACEMENT ALTERNATIVES

This section discusses the impacts and costs at potential placement alternatives for sediment removed from Santa Anita Reservoir. Specifically, this section discusses the placement of sediment at landfills and pits. Discussion of the removal and transportation was presented in Sections 8.6.4 and 8.6.5, respectively. Combined alternatives that address all phases of the sediment management process are presented and discussed in Section 8.6.7.

Combined alternatives that address all phases of the sediment management process are presented and discussed in Section 8.6.7.

### 8.6.6.1 LANDFILLS

Scholl Canyon Landfill is the closest landfill to Santa Anita Reservoir at a distance of 13 miles. More information regarding the landfill can be found in Section 6.

### 8.6.6.2 QUARRY WITH EXISTING OPERATIONS

There are existing operational pits in the Irwindale area at a distance of 12 miles that could accept material from Santa Anita Reservoir as discussed in Section 6.

It is assumed that one third of the material will be high quality material that will be of value to the existing operational pits. In exchange for this high quality material, it is assumed that the Flood Control District will be allowed to place the same amount of lower quality material in the operational quarry pits. The remaining one third of the material that will be placed at the pit will be subject to a tipping fee.

### 8.6.6.3 ACQUIRED QUARRY

As discussed previously, the acquisition of a quarry for placement of sediment from facilities under the jurisdiction of the Flood Control District is being pursued for sediment management. Acquisition of a quarry in the Irwindale area would be most desirable for sediment management operations related to Santa Anita Reservoir.

It will be assumed that acquiring a quarry could potentially cost the Flood Control District approximately $1 per CY and that placement of sediment would cost $2 per CY.

In order to conserve space in an acquired quarry, the high quality material can still be taken an existing quarry operation where the Flood Control District can place an equivalent volume of lower quality material. The remaining material can be placed at the acquired quarry.

#### 8.6.6.4 SEDIMENT PLACEMENT SITES

As mentioned earlier, Santa Anita SPS is an existing SPS, 1.5 miles downstream of Santa Anita Dam. The SPS can be filled until the remaining currently available capacity is filled. However, there are no plans to expand the SPS and increase capacity.

### 8.6.7 COMBINED SEDIMENT MANAGEMENT ALTERNATIVES

#### 8.6.7.1 COMBINED ALTERNATIVE 1: EXCAVATION > CONVEYOR > SANTA ANITA SPS > EXCAVATION > TRUCKING > IRWINDALE PITS & LANDFILLS

The sediment can be excavated and placed on a conveyor system to the Santa Anita SPS, as shown in Figure 8-79. Once remaining capacity at the SPS is exhausted, the material at the SPS can be gradually transported out via trucks at a rate that reduces social impacts and be taken to either a pit in the Irwindale area or a landfill, as shown in Figure 8-80. It would take 3 cleanout events, or every 8 years, to remove the expected 20-year quantity. The total cost is estimated to be approximately $30 million, as shown in Table 8-30. It is assumed that only one third of the material will be subject to a tipping or acquisition fee as discussed in Section 8.6.6.

Figure 8-79 Santa Anita Reservoir Management Alternative 1 – Map 1 of 2

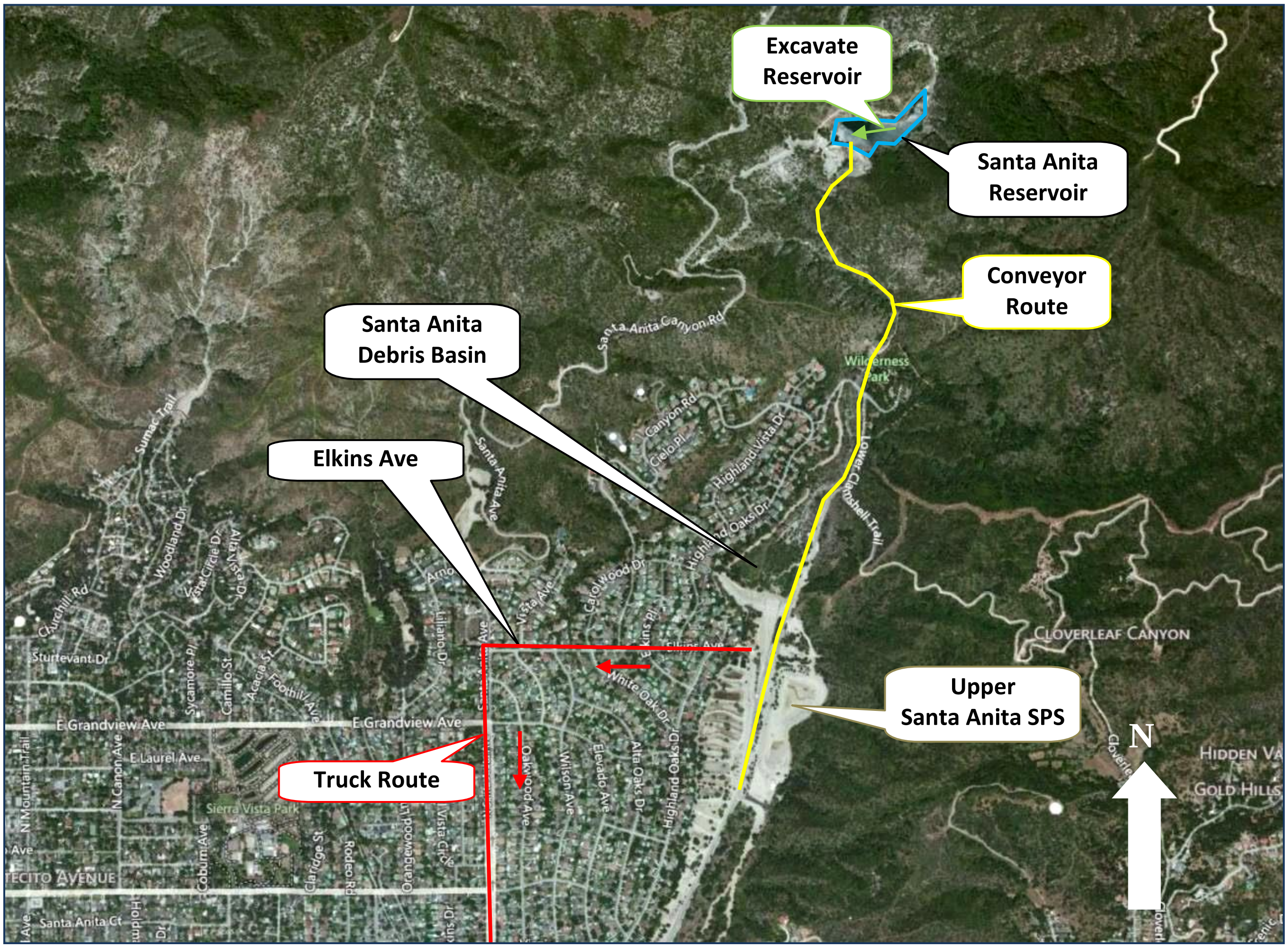



Figure 8-80 Santa Anita Reservoir Management Alternative 1 – Map 2 of 2

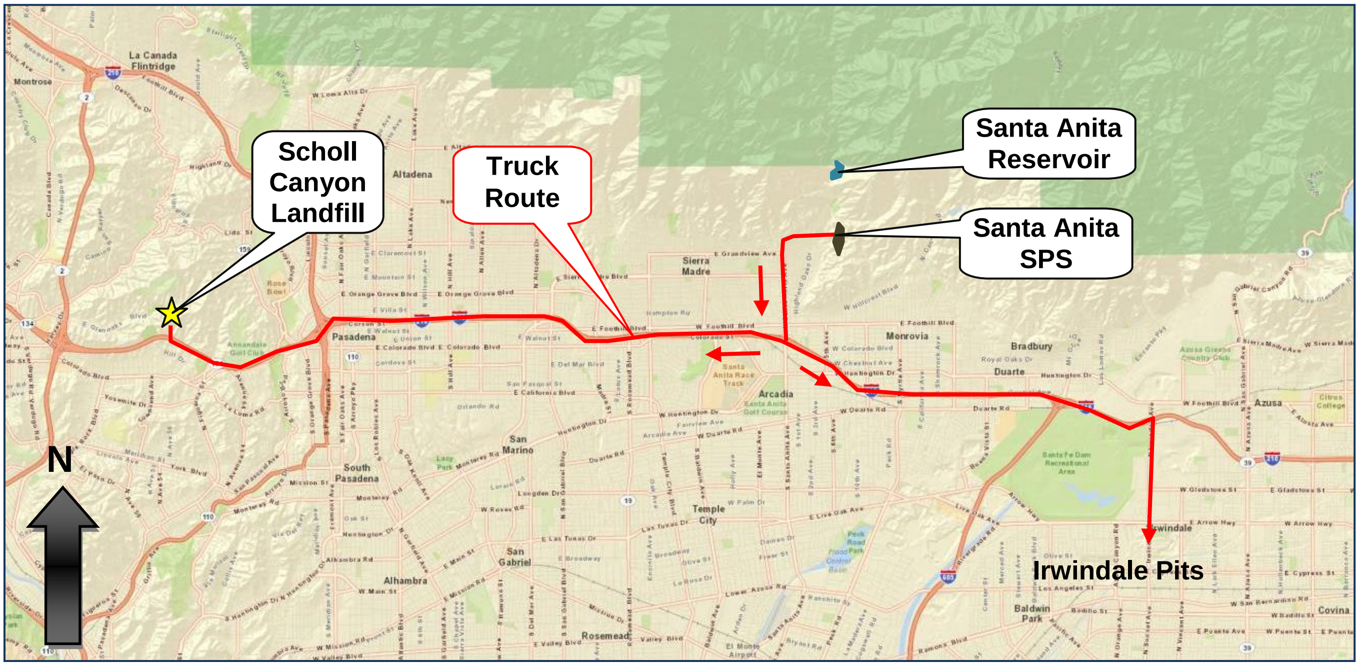


**Table 8-30 Santa Anita – Alternative 1 Cost Estimate**

| Activity | Amount (MCY) | Distance (MI) | Unit Cost | Unit | Total Cost ($ Millions) |
|---|---|---|---|---|---|
| Excavation at Santa Anita Reservoir | 1.2 | | $ 3.00 | CY | $ 3.6 |
| Conveyor System from Reservoir to SPS | | 1.3 | $ 800.00 | LF | $ 5.5 |
| Spreading Sediment at SPS | | | $ 2.00 | CY | $ 2.4 |
| Excavation at SPS | | | $ 7.50 | CY | $ 9.2 |
| Double Dump Truck to Pits/Landfills | | 24 | $ 0.30 | MI-CY | $ 8.8 - 9.0 |
| Pit or Landfill Placement Fee | | | $ 3.00 - $ 7.00 | CY | $ 1.2 – 2.8 |
| | | | | **Total** | **$ 30** |

#### 8.6.7.2 <u>COMBINED ALTERNATIVE 2:</u> <u>SLUICING > SANTA ANITA SPS > EXCAVATE > TRUCKING > IRWINDALE PITS & LANDFILLS</u> <u>+ EXCAVATION > CONVEYOR BELT > SANTA ANITA SPS > EXCAVATE > TRUCKING > IRWINDALE PITS & LANDFILLS</u>

Two thirds of the sediment can be sluiced from the reservoir and into Santa Anita Wash and eventually placed at Santa Anita SPS, as shown in Figure 8-81. The material will be dewatered at the debris basin, transported to the SPS, and gradually transported out via trucks to the final placement location at a pit in the Irwindale area or a landfill at a rate that reduces social impacts, as shown in Figure 8-82. However, the remaining one third of the larger material would not be suitable for sluicing and will have to be excavated similar to alternative 1. It would take 7 sluicing events, or a cleanout approximately every 3 years, to remove the 20-year planning quantity. The total cost is estimated to be approximately $30 million, as shown in Table 8-31 below. It is assumed that only one third of the material will be subject to a tipping or acquisition fee as discussed in Section 8.6.6.

**Figure 8-81 Santa Anita Reservoir Management Alternative 2 – Map 1 of 2**

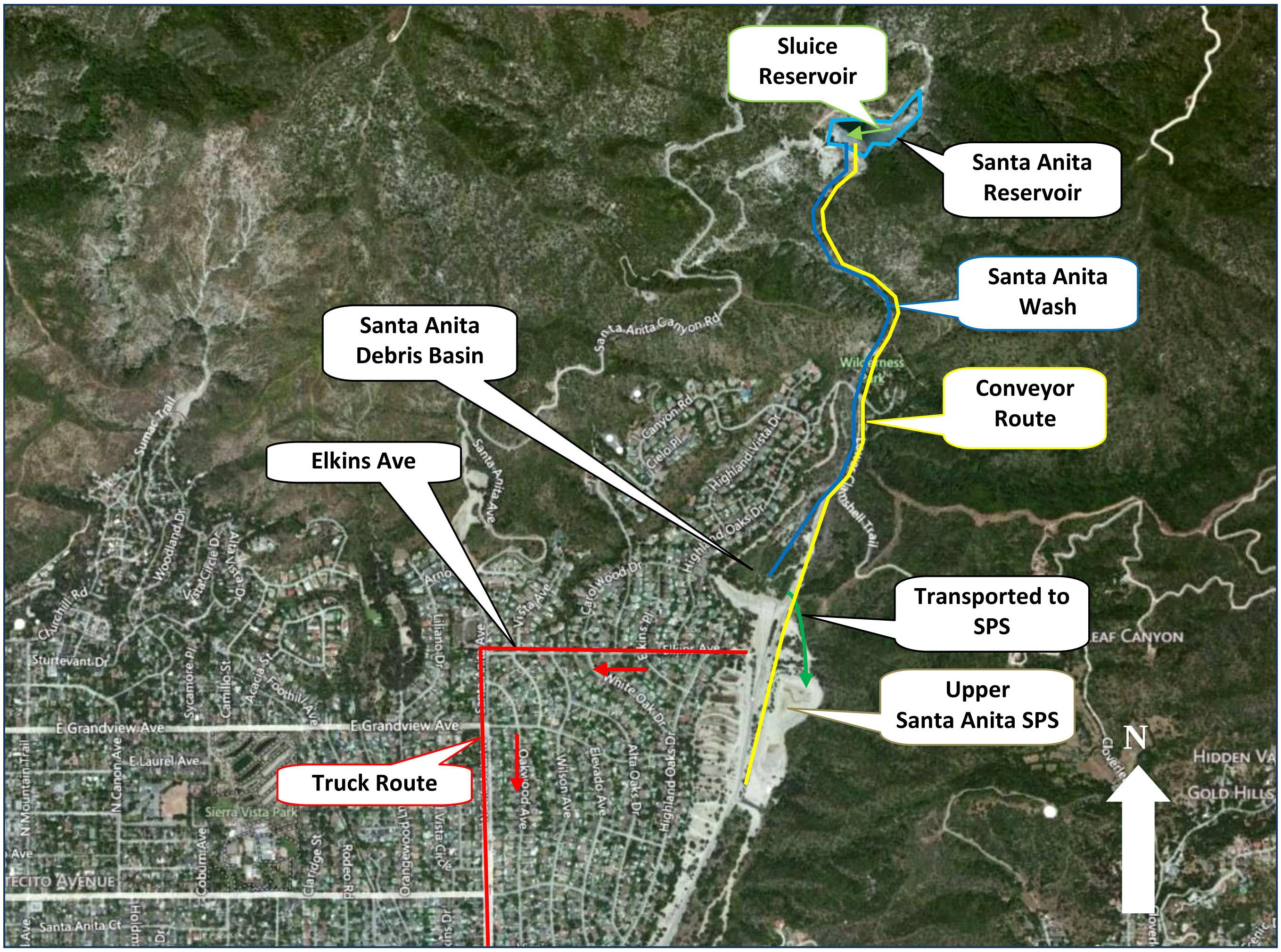



**Figure 8-82 Santa Anita Reservoir Management Alternative 2 – Map 2 of 2**

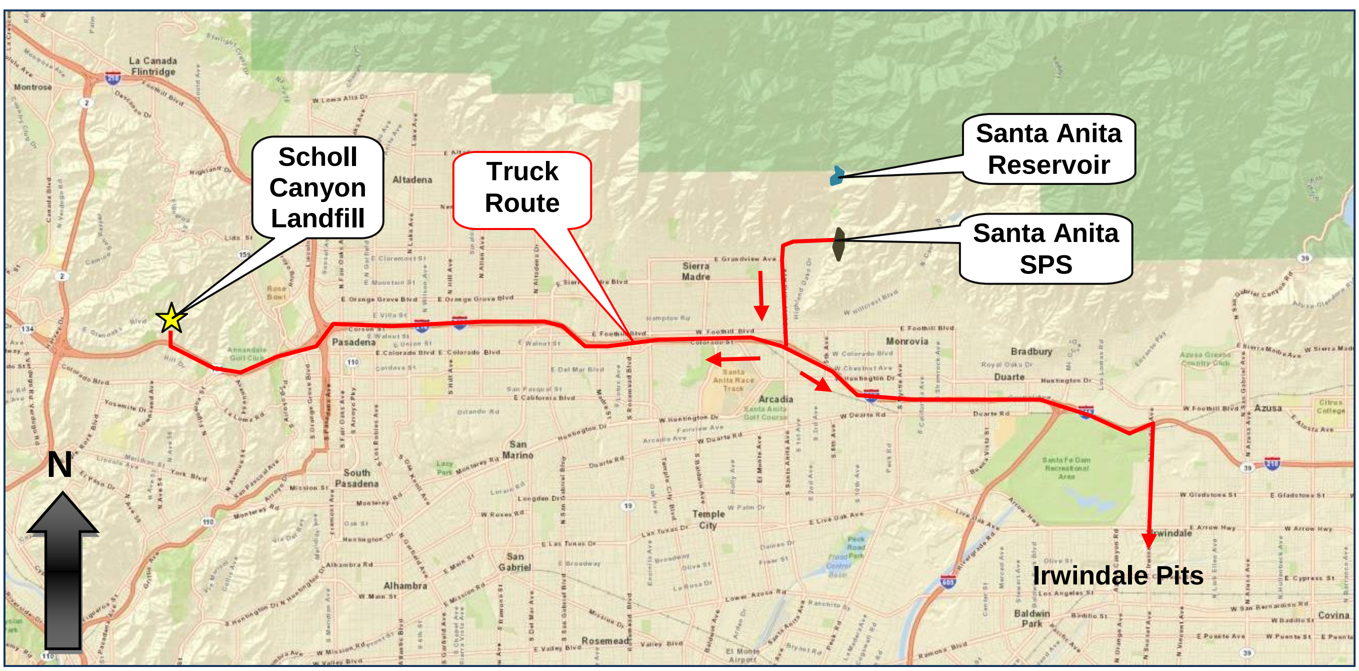


**Table 8-31 Santa Anita – Alternative 2 Cost Estimate for Existing Quarry**

| Activity | Amount (CY) | Distance (MI) | Unit Cost | Unit | Total Cost ($ Millions) |
|---|---|---|---|---|---|
| Sluicing (2/3) at Santa Anita Reservoir | 0.8 | | $ 2.50 | CY | $ 2.0 |
| Excavation (1/3) at Santa Anita Reservoir | 0.4 | | $ 3.00 | CY | $ 1.2 |
| Conveyor | | 1.3 | $ 800.00 | LF | $ 5.5 |
| Spreading Sediment at SPS | 1.2 | | $ 2.00 | CY | $ 2.4 |
| Excavation at SPS | | | $ 7.50 | CY | $ 9.2 |
| Double Dump Truck to Pits/Landfills | | 24 | $ 0.30 | MI-CY | $ 8.8 - 9.0 |
| Pit or Landfill Placement Fee | | | $ 3.00 - $ 7.00 | CY | $ 1.2 – 2.8 |
| | | | | **Total** | **$30** |

### 8.6.7.3 COMBINED ALTERNATIVE 3: DREDGING → SLURRY PIPELINE → SANTA ANITA DEBRIS BASIN/SANTA ANITA SPS → EXCAVATION > TRUCKING → LANDFILLS & PITS + EXCAVATION → CONVEYOR BELT → SANTA ANITA SPS → EXCAVATION → TRUCKING → LANDFILLS & PITS

Combined Alternative 3 involves dredging and transporting two thirds of Santa Anita Reservoir's planning quantity via a 12-inch HDPE slurry pipeline to Santa Anita Debris Basin, as shown in Figure 8-83. The material would be dewatered at the debris basin and then temporarily stored at Santa Anita SPS. From the SPS, the sediment would be transported out gradually via trucks to the final placement location, either a landfill or a pit in the Irwindale area, at a rate that would reduce social impacts, as shown in Figure 8-84. The remaining one third of the planning quantity that would not be suitable for dredging would be excavated similar to Alternative 1. It would take 5 or 6 dredging events, or a cleanout approximately every 3 or 4 years, to remove the expected 20-year planning quantity. The total cost is estimated to be approximately $35-40 million, as shown in Table 8-32 below. It is assumed that only one third of the material will be subject to a tipping or acquisition fee as discussed in Section 8.6.6.

**Figure 8-83 Santa Anita Reservoir Management Alternative 3 – Map 1 of 2**

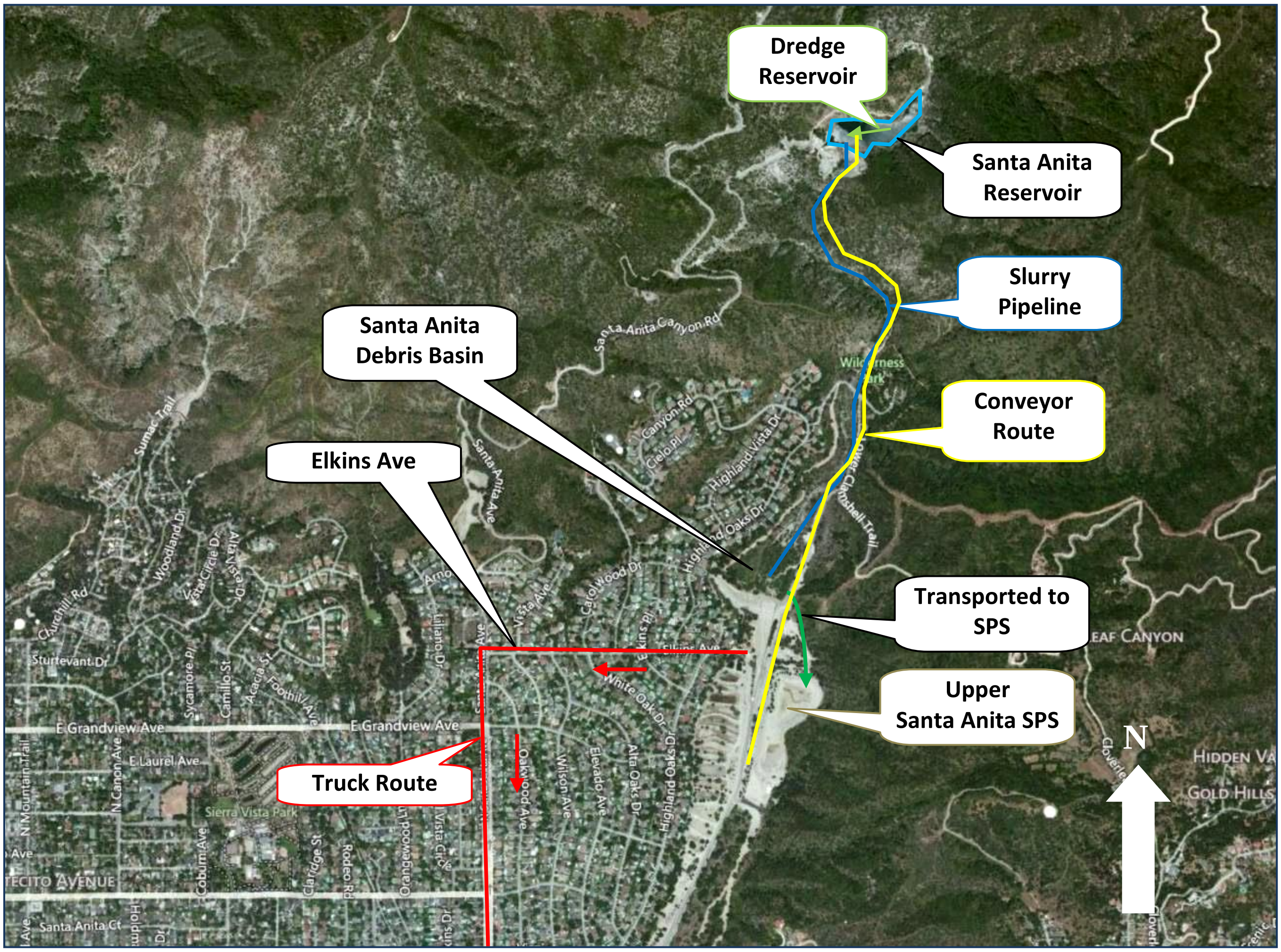



**Figure 8-84 Santa Anita Reservoir Management Alternative 3 – Map 2 of 2**

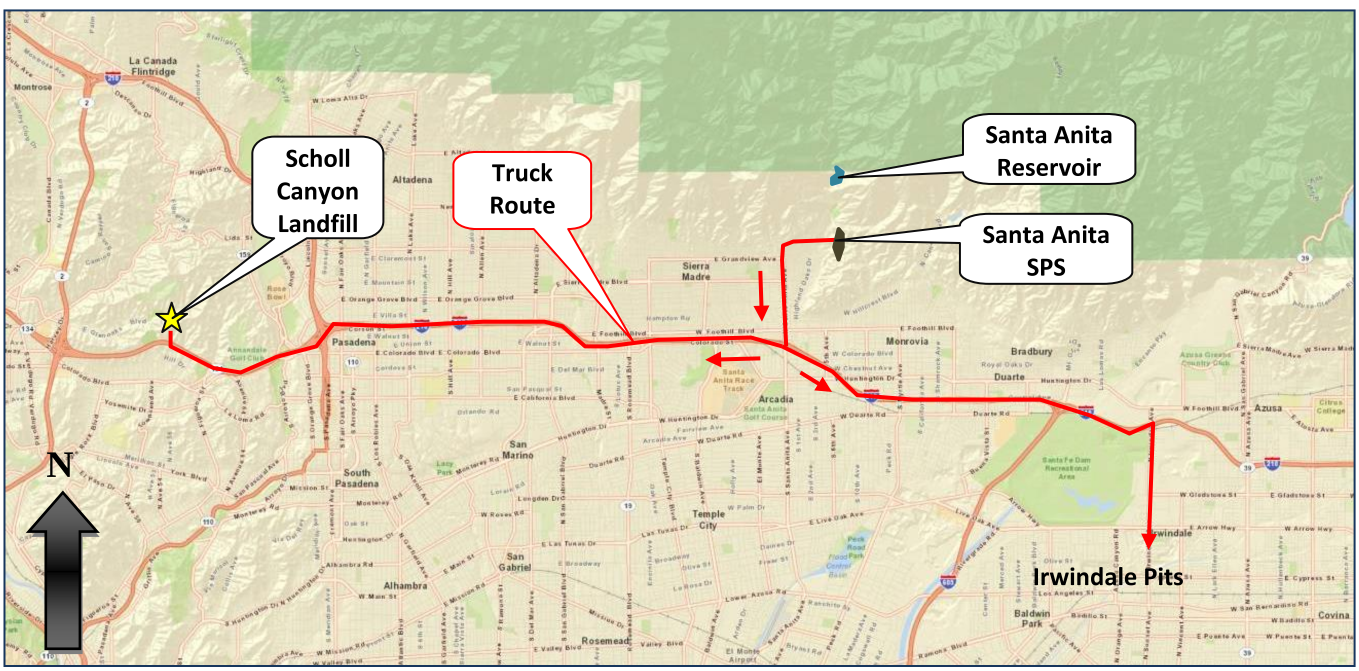


**Table 8-32 Santa Anita – Alternative 3 Cost Estimate for Existing Quarry**

| Activity | Amount (MCY) | Distance (MI) | Unit Cost | Unit | Total Cost |
|---|---|---|---|---|---|
| Dredging (2/3) at Santa Anita Reservoir | 0.8 | | $ 10.50 | CY | $ 8.5 |
| Slurry Pipeline | | 1.3 | $37.50 | LF | $ 0.3 |
| Excavation (1/3) at Santa Anita Reservoir | 0.4 | | $ 3.00 | CY | $ 1.2 |
| Conveyor from Reservoir to SPS | | 1.3 | $ 800.00 | LF | $ 5.5 |
| Spreading Sediment at SPS | 1.2 | | $ 2.00 | CY | $ 2.4 |
| Excavation at SPS | | | $ 7.50 | CY | $ 9.2 |
| Double Dump Truck to Pits/Landfills | | 24 | $ 0.30 | MI-CY | $ 8.8 - 9.0 |
| Pit or Landfill Placement Fee | | | $ 3.00 - $ 7.00 | CY | $ 1.2 – 2.8 |
| | | | | **Total** | **$ 35 – 40** |

## 8.6.8 SUMMARY AND RECOMMENDATIONS

### 8.6.8.1 SUMMARY

Over the next 20 years, 1.2 MCY of sediment is planned to be removed from Santa Anita Reservoir. The different management alternatives are briefly explained below and the impacts are shown in Table 8-33. All the alternatives will use Santa Anita SPS as a temporary storage area where the sediment can be transported out gradually in order to reduce traffic impacts.

**Management Alternatives**

1 Excavation → Conveyor → Santa Anita SPS → Excavate → Trucks → Irwindale Pits & Landfill
Excavate the sediment and place it on a conveyor where it will transport the sediment to the Santa Anita SPS. The sediment can be gradually transported out to a pit in the Irwindale area or landfill.

2 Sluice (0.8 MCY)→Santa Anita Debris Basin→Santa Anita SPS→Excavate→Trucks→Irwindale Pits & Landfill + Excavate (0.4 MCY) → Trucks → Irwindale Pits
Sluice the smaller sediment (0.8 MCY) from the Santa Anita Reservoir to the Santa Anita Debris basin where the sediment can be dewatered. The dewatered sediment can be placed at the Santa Anita SPS using excavation equipment where it can be excavated and transported out gradually via trucks to a pit in the Irwindale area or a landfill. The larger sediment (0.4 MCY) must be removed via alternative one.

3 Dredge(0.8 MCY)→Santa Anita Debris Basin→Santa Anita SPS→Excavate→Trucks→Irwindale Pits & Landfill + Excavate (0.4 MCY) → Trucks → Irwindale Pits
Dredge the smaller sediment from the Santa Anita Reservoir where it can be transported via a slurry pipeline to the Santa Anita Debris Basin where it can be dewatered. The dewatered sediment can be placed at the Santa Anita SPS using excavation equipment where it can be excavated and transported out gradually via trucks to a pit in the Irwindale area or a landfill. The larger sediment (0.4 MCY) must be removed via alternative one.

**Table 8-33 Santa Anita Reservoir Summary Table**

| | | | Environmental | | | | Social | | | Implementability | Performance | | Cost |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Alternative | Quantity Removed (MCY) | Habitat | Water Quality | Groundwater Recharge | Air Quality[(a)] | Traffic | Visual | Noise | Special Permit/Agreement Required[(b)] | Previous Experience | # of Operations Required in Next 20 years | $ Millions |
| 1 | Excavation | 1.2 | ◑ | | ○ | ◑ | | ○ | ○ | | Yes | 3 | 30 |
| | Conveyor | | | | | | | ◑ | | | | | |
| | Santa Anita SPS | | ○ | | | | | ◑ | ◑ | | | | |
| | Trucks | | | | | ● | ● | ● | ● | | | | |
| | Irwindale Pits/Landfill | | | | | | | | | Yes | | | |
| 2 | Sluice | 0.8 | ● | ● | ◑ | | | ◑ | | | Yes | 7 | 30 |
| | Santa Anita DB/SPS | | ● | ● | ○ | ◑ | | ◑ | ◑ | | | | |
| | Conveyor | 0.4 | | | | | | ◑ | | | | | |
| | Excavation | 1.2 | ◑ | | | ◑ | | | ◑ | | | | |
| | Trucks | | | | | ● | ● | ● | ● | | | | |
| | Irwindale Pits/Landfill | | | | | | | | | Yes | | | |
| 3 | Dredge | 0.8 | ◑ | ◑ | ○ | ◑ | | | ○ | | No | 6 | 35-40 |
| | Slurry Pipeline | | | | | | | ◑ | | | | | |
| | Santa Anita DB/SPS | | ● | ● | ○ | ◑ | | ◑ | ◑ | | Yes | | |
| | Conveyor | 0.4 | | | | | | ◑ | | | | | |
| | Excavation | 1.2 | ◑ | | | ◑ | | ◑ | ◑ | | | | |
| | Trucks | | | | | ● | ● | ● | ● | | | | |
| | Irwindale Pits/Landfill | | | | | | | | | Yes | | | |

Legend:

| | |
|---|---|
| ● | significant impact |
| ○ | possible impact |
| ◑ | some impact |
| | no impact |

Notes: (a) Use of low-emission trucks would reduce air quality impacts from significant impact (●) to some impact (◑).
(b) All options require environmental regulatory permit.

### 8.6.8.2 RECOMMENDATION

It is recommended that all the alternatives be considered for future sediment removal projects at Santa Anita Reservoir.