VIII - EFFECT OF WATER CONTROL PLAN

8-01 GENERAL

The sole purpose of Hansen Dam is flood control, and by far the greatest effect and benefit of the dam is the protection of life and property downstream of the facility. The major aspects of flood control at Hansen Dam for both the reservoir and spillway design floods, as well as several major historical floods, are discussed in section 8-02. Any other effects or benefits of Hansen Dam are decidedly secondary to those of flood control, but they are briefly described in sections 8-03 through 8-08.

8-02 FLOOD CONTROL

a. Original Reservoir Design Flood. The design of Hansen Flood Control Basin was based upon what was called, in those days, a "maximum probable flood". The hydrologic bases used in the development of the original reservoir design flood is briefly summarized as follows:

1. The design flood was computed from a four-day design storm, with the volume and intensity at their maximum on the fourth day.

2. The design storm had an average maximum 24-hour rainfall of 10.57 inches over the drainage area.

3. The rainfall for the 3 days preceding the maximum (fourth) rainfall day was based on a statistical analysis of rainfall data which indicated percentages of 20, 30, and 50 percent of the maximum day. To represent the most adverse conditions, these percentages were appraised in the order of increasing magnitudes, culminating in the fourth (100 percent) day.

4. Runoff coefficients for the modified rational procedure used were based on the rainfall to runoff relations computed for the adjacent drainage area above San Gabriel Dam No. 2, which indicated the highest runoff coefficients for the March 1938 flood.

5. Base flows on the fourth day of 40 ft^3/s/square mile for the drainage area above Big Tujunga Dam and 20 ft^3/s/square mile for the drainage area below Big Tujunga Dam were assumed.

6. The Big Tujunga Dam was assumed full (to spillway crest) at the start of the storm, and the flood was routed over the spillway.

The original reservoir design flood was routed through Hansen Flood Control Basin using the adopted method of operation as follows:

(a) At the beginning of the flood, all gates were open;

(b) When the water surface elevation (WSE) reached 1,024.5, the gates would be operated to maintain a constant outflow of 12,000 ft^3/s, including the ungated outlets;

(c) After the reservoir receded below WSE 1,024.5, all gates would be fully opened. Using this method of operation, the maximum WSE reached was 1,059.7.

b. Standard Project Flood. When Hansen Dam was originally designed, the SPF concept had not yet been developed. Sometime later, probably in about 1946, before the improvements to Tujunga Wash downstream from Hansen Dam were designed, a SPF was determined for Hansen Dam.

The standard project storm (SPS) selected was the 21-25 January 1943 storm which was centered in the mountains and foothills a few miles east - northeast of Hansen Dam. The storm was transposed to the drainage area above Hansen Dam using mean annual precipitation as a transposition factor.

Unit hydrographs, shown on plates 4-9A and 4-9B, were determined using the average Mountain S-graph and basin n-values of 0.055 above Big Tujunga Dam and 0.050 above Hansen Dam below Big Tujunga Dam. The Big Tujunga Dam subarea hydrograph was routed through Big Tujunga Reservoir assuming the reservoir was full to spillway crest at the beginning of the flood. The outflow hydrograph was then channel routed using the Modified Puls Method to Hansen Dam Reservoir and combined with the hydrograph for the intervening subarea. The resulting Hansen Reservoir inflow hydrograph has a peak inflow of 53,000 ft^3/s and a direct runoff (excludes baseflow) 4-day volume of 57,200 ac-ft. With baseflow, the total 4-day volume is 92,500 ac-ft. This inflow hydrograph is still considered appropriate.

With the improvement of Tujunga Wash below Hansen Dam, the maximum release could be increased from 12,000 ft^3/s to 22,000 ft^3/s. A reservoir routing performed with a maximum release of 22,000 ft^3/s, assuming the original 50-year sediment allocation of 5,000 ac-ft, would yield a maximum WSE of less than 1,057. However, the 1969 survey revealed that sediment accumulation had already exceeded 5,000 ac-ft. Therefore, a new sediment yield estimate based on the survey data was used to revise the 50-year sediment allowance to 10,500 ac-ft and calculate a 100-year sediment allowance of 21,000 ac-ft. Routing the SPF through Hansen Reservoir with the revised sediment allocations yield maximum WSEs of 1,057.7 and 1,064.76 for the 50-year sediment and 100-year sediment allowances, respectively.

The regulation schedule for Hansen Dam was revised in 1988 to conform to a revised downstream channel capacity of 20,800 ft^3/s.

Plate 8-1 depicts the results of routing the SPF at Hansen Dam for the 50- and 100-year sediment distributions, using the 1988 revised regulation schedule and the revised sediment allowances. The maximum inflow to the dam is still 53,000 ft^3/s on the second day of the flood, with a maximum discharge through the outlet works now controlled to 20,800 ft^3/s. For a 50-year sediment allowance, the maximum WSE is 1,057.38, or 2.6 ft. below the spillway crest. For a 100-year sediment allowance, the maximum WSE is 1,065.50 ft., having a spillway discharge of 12,000 ft^3/s, but a combined discharge of 20,800 ft^3/s, equal to the downstream channel capacity. Using the 1983 survey results to determine the elevation-storage relationship and the 1988 revised Regulation Schedule, the maximum WSE is 1057.38. Note on plate 8-1 that for a

50-year sediment allowance, the water surface reaches an elevation of 1,010.5 and then begins to recede prior to the peak. This occurs in accordance with the Regulation Schedule shown on plate 3-4, which requires all gates to be at 8.0 ft. at a water surface elevation of 1,010.5. Following the Regulation Schedule, the gates would remain open until the water surface rises to the point requiring a gate change or the reservoir is drained. In this case, the Schedule causes outflow to exceed inflow for a short period and a dip in the curve results.

c. Spillway Design Flood. The spillway at Hansen Dam was designed in 1939 for a peak outflow of 101,000 ft^3/s, having a surcharge of 21.8 ft. on the ogee crest. An additional 5.2 ft. of freeboard to account for wave runup and wind setup set the top of the dam at elevation 1,087 ft.

1. Original Criteria. The original spillway design flood was based on a "computed spillway flood," determined from rainfall 25 percent greater than the Reservoir Design Storm. The "computed spillway flood," resulted from a hypothetical four-day storm that had a basin average of 13.2 inches of rain during the maximum 24 hours. The adopted spillway design flood was determined by increasing the "computed spillway flood" by 50 percent, resulting in a peak inflow of 129,600 ft^3/s and a maximum one-day volume of 76,800 ac-ft.

In recent times, spillways have been designed using the PMF concept, with the National Weather Service (NWS) providing the Probable Maximum Precipitation. In a 1978 study, the adequacy of the Hansen Dam spillway was reviewed under modern criteria. This led to the development of a PMF for Hansen Dam.

2. PMF Criteria. Plate 8-2 depicts the hydrograph of the computed inflow for the Probable Maximum Flood over the drainage area above Hansen Dam, reservoir water surface elevation, and outflow that results when the PMF is routed through Hansen Reservoir.

The probable maximum precipitation was based upon a hypothetical 72-hour rain storm developed from the criteria published by the NWS in Hydrometeorological Report No. 36, entitled "Interim Report - Probable Maximum Precipitation in California" (1961, revised 1969). This storm was critically centered over the drainage above Hansen Dam.

The unit hydrograph was the same as for SPF except that lag times were reduced by 15 percent.

For the PMF routing, the reservoir was assumed initially full to elevation 1,060.0 ft. (spillway crest) and the flood control outlet works were considered completely blocked by debris.

The PMF generates a maximum inflow to Hansen Reservoir of 105,000 ft^3/s late on the third day of the storm (see pl. 8-2) and a total volume of 246,000 ac-ft. The maximum water surface elevation in the reservoir rises to 1,081.2 ft., storing 44,990 ac-ft behind the dam. The maximum outflow over the spillway is 99,700 ft^3/s.

d. Other Floods.

1. 22-26 January 1943. The storm of 22-26 January 1943 was in many respects the most severe of record in the coastal drainages of southern California. It occurred when a series of warm Pacific cyclones from Hawaii collided with a cold storm moving south from British Columbia, Canada producing strong winds and heavy rain over most of California.

Plate 8-3 depicts the runoff of this storm. The total 21-23 January precipitation ranged from less than 11 inches in the northern and central San Fernando Valley to more than 25 inches in the Santa Monica Mountains of Sepulveda Dam. Rainfall was heaviest during the first few hours of 23 January, with a less intense but longer-lasting period of generally heavy rain during the last 6 hours of that day.

Because of unseasonably dry antecedent conditions, infiltration rates were high at the beginning of the storm. This is reflected in a relatively moderate peak inflow rate to Hansen Dam following the intense burst of rain early on 22 January. Progressive saturation of the ground, brought on by prolonged and increasingly heavy rain on 22 January, resulted in an increasing rate of inflow late in the day. The maximum of the computed mean hourly inflow values was 18,900 ft^3/s during the third hour of 23 January.

The maximum water surface elevation of 1,036.5 ft. was reached at noon on the 24th, when 18,743 ac-ft of water was stored behind the dam. The outflow released to the channel downstream was regulated to 1,600 ft^3/s until the pool was drained.

2. 23-26 January 1969. The period of 18-27 January 1969 was exceptionally wet throughout southern California, as a series of warm storms from south of Hawaii were funneled into this area. After moderate to heavy rain 18-22 January, (followed by a one-day break), rain resumed 23 January, with several moderate rain bands and one long-lasting, heavy band that climaxed early 25 January. The flood hydrographs are shown on plate 8-4. The total precipitation for the period of 23-26 January in southern California ranged from just over 6 inches at Hansen Dam to more than 23 inches in the San Gabriel Mountains southeast of Big Tujunga Dam, according to an isohyetal map prepared by Los Angeles County Flood Control District.

By the time of the 24-25 January rain, the ground throughout the Hansen Basin and elsewhere was heavily saturated, with a high runoff potential. Hansen basin runoff potential was high due to the heavily saturated ground when the 24-25 January storm began. Big Tujunga Dam measured a peak inflow rate of 19,500 ft^3/s from 1000 to 1100 hours on the 25th, and inflow at Hansen peaked three hours later, averaging 17,970 ft^3/s from 1300 to 1400 hours (pl. 8-4). At 1700 hours the Hansen Reservoir water surface peaked at 1,018.3 ft. NGVD, with 9,015 ac-ft of water stored; the maximum outflow of 11,040 ft^3/s occurred at 1800 hours 25 January.

3. 23-25 February 1969. In late February 1969 several back-to-back storms moved into southern California from the west, with the rainfall of early 25 February by far the heaviest. The total precipitation for 23-25

February ranged from less than 5 inches at Hansen Dam to 20 inches along Angeles Crest Highway southeast of Big Tujunga Dam.

The combination of a thoroughly saturated watershed from the heavy January 1969 rains and continued moderate rain and snow during February 1969 resulted in a very high runoff potential when the very heavy rain burst occurred on the morning of 25 February. The flood down Big Tujunga Canyon pushed the water surface level behind Big Tujunga Dam to a height of 2,301.4 ft., 11.4 ft. above its spillway. Outflow there reached an average of 17,200 ft^3/s from 0500 to 0600 hours Mean hourly inflow at Hansen peaked at 26,012 ft^3/s from 0700 to 0800 (pl. 8-5), and its highest water surface elevation was 1,030.8 ft. NGVD at 1100 hours. Maximum storage was 14,872 ac-ft at 1100 hours, and maximum outflow from Hansen was 16,000 ft^3/s at noon on 25 February.

4. 9-11 February 1978. After several moderately heavy storms during January and early February 1978, one low-latitude Pacific storm developed west of southern California and moved into the area during the night of 9-10 February. After a day of heavy rain in the San Gabriel Mountains on 9 February, in which Opid's Camp (near the San Gabriel-Big Tujunga watershed divide) received 10.8 inches, a major cloudburst struck the Hansen and adjacent watersheds during the first two hours of 10 February, with generally 1.0 to 1.5 inches of rain. Some stations measured up to 1.4 inches in 30 minutes. Total precipitation in and around the Hansen watershed ranges from 5-6 inches at the dam to 14 inches in the higher mountains southeast of Big Tujunga Dam.

As the result of the 10 February cloudburst, which occurred on saturated ground just beginning to recover from a major burn in November 1975, several streams in the Hansen watershed experienced severe flash floods and mud flows. Some campgrounds were totally washed away, with several fatalities. Inflow to Hansen Dam averaged 40,220 ft^3/s from 0300 to 0345 hours on 10 February (pl. 8-6), and the mean of 35,050 ft^3/s for the hour ending at 0400 is the greatest on record. The maximum water surface elevation for this flood event reached 1,023.9 ft. NGVD at 0630 hours on 10 February. At this time, 8,211 ac-ft of water was stored behind the dam, according to the storage/elevation survey of August 1969. The maximum outflow from the dam increased to 13,540 ft^3/s at 0600 hours on 10 February.

5. March 1978 - February 1980. Four more significant storm and flood periods occurred in southern California during the following two years. These occurred 28 February - 5 March 1978, 5 January 1979, 30 January - 2 February 1979, and 13-21 February 1980. The Hansen watershed experienced heavy rain, and the inflow to Hansen Dam was significant in each of these events.

6. Storm and Flood of 28 February - 3 March 1983. A low-latitude Pacific storm, reminiscent of those of 1938 and 1978, moved into southern California at the end of February and first of March 1983, with generally 10-20 inches of rain over the Hansen watershed. Big Tujunga Dam recorded 18.40 inches for the period. The heaviest rainfall occurred with the passage of a strong occluded cold front during the morning of 1 March, with peak intensities well in excess of 1 inch per hour.

The inflow to Hansen Reservoir consisted of three peaks between 2000 hours 1 March and 0500 hours 2 March (pl. 8-7). The middle peak, which occurred at midnight 1-2 March, was the greatest, with an estimated maximum inflow of 27,900 ft^3/s. The maximum water surface elevation of 1,039.7 ft. NGVD at 0700 hours, 2 March is the highest yet observed for Hansen Reservoir. The storage of 13,261 ac-ft is the third greatest amount of water ever impounded Hansen Dam. The maximum outflow from the reservoir was 18,100 ft^3/s at the time of the maximum water surface elevation.

8-03 RECREATION AND AGRICULTURE

a. Recreation. None of the recreational facilities in Hansen Reservoir depend upon runoff water impounded behind the dam, though there is a proposal to excavate a small lake in the basin at this time. Thus there are no direct recreational benefits that result from the dam or its operation at present. The recreational facilities were constructed because the land within the reservoir could not be used for other purposes. Thus there is an indirect recreation benefit accruing to the project.

The effects of the dam and its operation upon the recreational facilities within the reservoir are by necessity all negative; that is, some of these facilities are occasionally flooded by the impoundment of water behind the dam for flood control. These recreational facilities, however, were constructed and are operated with this understanding.

b. Agriculture. The same arguments cited above regarding recreation also apply to the agricultural products that are cultivated on Hansen Reservoir lands. Because the overall acreage of agriculture within the reservoir basin is small compared to the needs of the local populations, the impact of Hansen Dam and its operation upon the overall food production and consumption in the region is negligible.

8-04 WATER QUALITY

There are no benefits of Hansen Dam to water quality of Tujunga Wash. On the other hand, Hansen Dam and its operation should not in any way contribute to the degradation of the water quality of the river.

8-05 FISH AND WILDLIFE

The reservoir lands that constitute the Hansen Flood Control Basin are characterized by natural vegetation which survive in the environment of a flood control basin where there is no objective to operate the dam to reduce inundation damages to improved reservoir or recreational lands. The flood control basin contains several vegetational associations including willow riparian woodland, riparian scrub, alluvial wash, coastal sage scrub, oak woodland and oil field grassland. Additionally, established areas of vegetation occur at landscaped areas and in places on the dam face itself.

Associated wildlife include the side-blotched lizard, cottontail rabbit, jackrabbit, California ground squirrel, gopher, coyote and mule deer. About 24 resident bird species have been identified along with numerous migrant species. There are no fish within the flood control basin, though Big Tujunga wash is a perennial stream and supports the small native fish species; arroyo chub, Santa Ana sucker and speckled dace.

Inundation will have the potential to kill or displace ground dwelling animals or may result in the temporary loss of willow canopy, the prime habitat of several bird species. The only listed or threatened species that can be potentially affected within Hansen reservoir is the least Bell's vireo. However, the habitat in question is not proposed critical or designated critical habitat by the U.S. Fish and Wildlife Service. Also, there is no permanent loss of habitat since some of the wildlife is migrating, many species in the basin are adapted to flooding and habitat regeneration is relatively quick.

8-06 WATER SUPPLY

Because Hansen Dam is not operated for water supply, there are no direct effects or benefits of the dam or its operation upon the water supply of the San Fernando Valley or other parts of the greater Los Angeles Basin. The District will attempt to inform LACDPW and other downstream entities when flood control releases are to be made. However, there will be no restrictions in scheduled releases to mitigate for possible adverse impacts downstream. When conditions are favorable, low releases from below the debris pool can be coordinated with Los Angeles LACDPW and Los Angeles County DWP to facilitate use of their spreading grounds.

8-07 HYDROELECTRIC POWER

There is no existing or contemplated hydroelectric power generation at Hansen Dam.

8-08 NAVIGATION

There is no navigation on Tujunga Wash or in Hansen Reservoir at any time.

8-09 FREQUENCIES

a. Peak Inflow and Outflow Probabilities. Plate 8-8 is a graph of the peak inflow and outflow frequencies at Hansen Dam, computed from 1985 Los Angeles County Drainage Area (LACDA) review study. Plate 8-9 is a graph of the peak inflow and outflow frequencies at Big Tujunga Dam, computed from a 1985 LACDA Review Study. The values of these curves at specific return periods are listed on plates 8-10 and 8-11, respectively. Comparison of historical and design floods at Hansen Reservoir are presented on plates 8-14 and 8-15. Exhibit E contains stream flow data for stations on Tujunga Creek.

Due to the newly determined downstream channel capacity of 20,800 cfs, decreased from 22,000 cfs, the elevation frequency curve using the new regulation plan would be slightly higher for events with a frequency of occurrence (exceedence interval) of less than once in 400 years.

b. Pool Elevation Duration and Frequency. Plate 8-12 is the computed elevation frequency curve for Hansen Dam. Plate 8-13 is the computed elevation frequency curve for the Big Tujunga Dam. The values of the curves at specific return periods are listed on plates 8-10 an 8-11, respectively.

c. Key Control Points. Exhibit E shows a stage/discharge rating table for the USGS stream gauge on Tujunga Wash below Hansen Dam.

8-10 OTHER STUDIES

a. Examples of Regulation. Discharge-frequency values presented in this manual were derived from on-going (1985) investigations in the U.S. Army Corps of Engineers Los Angeles County Drainage Area Study. The "Interim Report on hydrology and Hydraulic Review of Design Features of Existing Dams for Los Angeles County Drainage Area Dams," dated June 1978, presents the derivation of the PMF and SPF used in this manual. The "Los Angeles County Drainage Area (LACDA) Review" dated February 1988, revised 1989, assesses current adequacy of channel capacities in the entire LACDA system. The Corps' "LACDA Review Feasibility Study", which was commissioned by Los Angeles County to study ways to improve the flood control capabilities of the LACDA system in view of increased urbanization, is anticipated to be available in FY 1991. Alternative solutions studied included reregulation of corps reservoirs as a system, deepening channels, widening channels and increasing levee heights. There is also a mini-report being prepared which studies in greater detail reregulation of the Corps reservoir projects to improve the flood control capability of the LACDA system.

b. Channel and Floodway Improvement. No floodplain management studies addressing the downstream channel have been conducted by the U.S. Army Corps of Engineers since the downstream channel was constructed. Several Flood Insurance Studies have been completed to date by the Corps of Engineers and Los Angeles County Flood Control District (now part of the Department of Public Works) for the Federal Emergency Management Agency (FEMA). FEMA is also preparing Flood Insurance Rate Maps (FIRM Maps) to consider specific flood depths for flooded areas. The maps will have a scale of 1" = 500' and will be used as part of the National Flood Insurance Program (NFIP).