VIII - EFFECT OF WATER CONTROL PLAN

8-01 General. The Water Control Plan contained in this manual is an adapted version of the design document plan as specified in the Phase II GDM, which provides objectives for flood control, dam safety, and mitigating for impacts to downstream water users. If hydrologic conditions warrant, flexibility has been added to this plan to allow measures for environmental mitigation and enhancement purposes. These measures will be further defined and overseen by a collaborative multi-agency committee of environmental experts and agency officials and will be modified periodically based on species and habitat monitoring.

8-02 Flood Control. Seven Oaks Dam was designed to help provide flood protection on the lower Santa Ana River below Prado Dam by reducing the peak inflow and volume into Prado reservoir. In addition, Seven Oaks Dam provides flood control protection to the communities between Seven Oaks and Prado Dams. The dam was designed to control the Reservoir Design Flood (RDF)) without spilling, and to pass the Probable Maximum Flood without overtopping the dam embankment. These theoretical floods are discussed as follows:

a. Reservoir Design Flood (RDF). The RDF generally is based on the results of a planning study that establishes the project level of protection that provides the maximum net project benefits. In the case of Seven Oaks Dam, trial RDFs were based upon ratios of the Standard Project Flood (SPF).

The SPF represents the flood that would result from the most severe combination of meteorologic and hydrologic conditions considered reasonably characteristic of the geographical area. The SPF is normally larger than any past-recorded flood in the area and would be exceeded in magnitude only on rare occasions. The SPF, therefore, constitutes a standard for design that provides a high degree of flood protection.

The SPF is generally computed by determining the following: (a) unit-time precipitation for each subarea; (b) effective precipitation by subtraction of loss rates considering imperviousness cover as applicable; (c) subarea surface-runoff hydrograph by application of subarea synthetic unit-hydrograph values to the effective unit period precipitation; (d) subarea total-runoff hydrograph by addition of base flow; and (e) total flood hydrograph by reservoir and channel routing, subtraction of percolation losses, and combining subarea hydrographs as required. The SPF peak discharge for the Seven Oaks Dam drainage area was computed using pertinent subarea drainage characteristics, and by critically centering the January 1943 general standard project storm over the San Bernardino Mountains upstream of the damsite. The SPF peak inflow for this site was calculated to be 82,000 cfs with a 4-day volume of 110,500 acre-feet.

Routing of the SPF itself results in a calculated maximum reservoir pool elevation of 2,574.3 feet, NGVD. After the SPF was derived, a benefit-cost analysis was conducted using ratios of the SPF to represent events of various frequencies in order to determine the optimum level of protection. The result of this analysis determined that a project that controls an event resulting in a maximum pool elevation of 2,580 would provide the maximum net benefits. This event was therefore the RDF and established the project spillway crest elevation. The elevation of 2580 feet, NGVD, is 5.3 feet higher than the SPF's maximum water surface elevation. The RDF, therefore, is slightly larger than the SPF. The RDF peak inflow, peak outflow, and total volume were linearly adjusted from the SPF values to 85,000 cfs and 7,000 cfs, and 115,000 acre-feet respectively. Plates 8-01 and 8-01A show the SPF and RDF inflow and outflow hydrographs for Seven Oaks Dam.

b. <u>Probable Maximum Flood</u>. The probable maximum flood (PMF) is defined as the flood that can be expected from the most severe combination of meteorologic and hydrologic conditions considered to be reasonably possible in the region. The probable maximum flood, as the name implies, is an estimate of the upper

boundary of flood potential for a drainage area. This hypothetical flood was used for designing the spillway and setting the top of dam elevation for Seven Oaks Dam.

The description of the official Probable Maximum Flood and the reservoir routing used in the design of the Seven Oaks Dam and the Prado Dam spillways is contained in a Corps' document entitled, Probable Maximum Flood Update, Supplement No. 1 to Design Memorandum No. 1, Phase II GDM on the Santa Ana River Mainstem including Santiago Creek, dated August 2001 and is summarized as follows:

The Probable Maximum Precipitation (PMP) for the drainage areas for both dams was based on a general winter storm, with average depths for 1-hr, 12-hr, 24-hr, 48-hr, and 72-hr of 3.68 inches, 22.68 inches, 30.65 inches, 42.30 inches and 45.97 inches for Seven Oaks Dam, and 1.36 inches, 11.21 inches, 24 inches, 23.77 inches, and 25.98 inches for Prado Dam. Routing of this PMF resulted in a peak inflow of 185,000 cfs and a total inflow volume of 326,000 acre-feet at Seven Oaks Dam, and a peak inflow of 630,000 cfs and a total inflow volume of 1,300,000 acre-feet at Prado Dam. At Seven Oaks Dam, the resulting maximum water surface elevation was 2604.7 feet, NGVD with the peak outflow of 180,000 cfs. At Prado Dam, the resulting maximum water surface elevation was 587.3 feet, NGVD, with the peak outflow of 480,000 cfs. Plate 8-02 shows the PMF routing at Seven Oaks Dam.

8-03 Recreation. Seven Oaks Dam is not operated for recreation purposes, and since there is very limited public access, recreation opportunities in the area in and around Seven Oaks reservoir are limited to hiking, backpacking, and other nature related activities, to be consistent with the San Bernardino National Forest management plan. The Seven Oaks Dam Water Control Plan has a no significant effect on recreation.

8-04 Water Quality. Due to the hydrology of its watershed, long-term impoundment of water at Seven Oaks reservoir is unlikely. The reservoir is expected

to be empty during many months for the majority of an average year. The Water Control Plan includes the formation and maintenance of a debris pool during the flood season. The top elevation of the debris pool will be periodically adjusted to provide sufficient pool volume and water depth to induce sediment to deposit away from the intake structure and to at least partially protect the multi-level withdrawal structure trash racks from floating debris. As a result, the reservoir forms a still (low velocity) impoundment that avoids the movement of heavy bedload material into the outlet works. Starting on 1 October of each year, releases will be limited to a maximum of 3 cfs, creating an impoundment for the debris pool. The debris pool is to be drained starting in June and should be drained by the end of August of each year. In theory, an impoundment could exist for eleven months during a very wet year.

In general, there is no significant effect on long-term water quality anticipated at Seven Oaks Reservoir. However, during a very wet year, water quality could be degraded by extended impoundment in long, deep storage pools, primarily within the debris pool, especially during the summer months when higher temperatures cause stratification and associated low levels of dissolved oxygen (DO). Along with severe anaerobic conditions, the generation of hydrogen sulfide typically commences when materials containing sulphur (biological detritus and mineral sulfides) are available. Trace metals found in bottom sediments may be released by the lowering of pH, which occurs as a result of anaerobic conditions. Local nuisance conditions, such as algal blooms and mosquito breeding may also occur. Mitigating these adverse effects of impoundment are benefits to water quality including the settling out of suspended solids and detritus. These factors may outweigh those detriments associated with the potential low levels of dissolved oxygen and pH.

The extent to which adverse effects to water quality are realized is highly dependent on the length of retention within the debris pool. During an average runoff year, the debris pool retention may experience stratification if wind action is not strong enough to induce mixing. Also, the frequency of flood flows into the reservoir during the summer will not be sufficient to disrupt the stratification process. Should

stratification develop, however, the hypolimnion (layer near the lake bottom) is not likely to become anaerobic. The main reason for this premise is that water from levels at or near the hypolimnion will be released to satisfy downstream requirements during the summer months. Also, the quality of water flowing into the reservoir is good, biological oxygen demand and chemical oxygen demand are generally low, and dissolved oxygen is high. If a portion of the retained water becomes anaerobic, acidic conditions would tend to be counteracted by the buffering capability (high pH) of the inflowing water.

As part of their operation and maintenance tasks, the Local Sponsors will perform water quality monitoring as detailed in the Seven Oaks Dam Operations and Maintenance Manual, Volume I, Part II, Chapter 4, entitled "Environmental Commitments and Mitigation". The results of the water quality monitoring program shall be analyzed each year to determine necessary changes to the following year's monitoring program.

8-05 **Fish and Wildlife**. The U.S. Fish and Wildlife Service has listed the Slender Horned Spine Flower, the Santa Ana Woolly Star, and the San Bernardino Kangaroo Rat, as endangered species. As these species inhabit areas affected by the construction and operation of Seven Oaks Dam, this prompted the need for official consultation with the U.S. Fish and Wildlife Service, as required by Section 7 of the Federal Endangered Species Act to determine what actions could be taken to avoid jeopardizing the continued existence of these species. The operation of Seven Oaks Dam is expected to alter the quality of habitat due to a reduction in flood processes of scour and sand deposition, which are important to the renewal and succession of listed species habitat. The Water Control Plan is mainly based on the original flood control operation as described in the 1988 Phase II GDM/SEIS. That design document included several compensating measures for impacts to the Santa Ana Woolly Star, the Slender Horned Spine Flower, and other listed species. Flexibility was added to this plan, however, to operate the dam to allow additional conservation measures that will

further avoid, minimize, or compensate for impacts to these species, as well as newly listed species such as the San Bernardino Kangaroo Rat.

Throughout the effective period of the Water Control Plan, further evaluation and adjustment to the regulation for environmental mitigation and enhancement will be made, as necessary so effects to the endangered species are kept to a minimum. An example of this adjustment may be that the pool within the reservoir will be held longer so that additional head will be available for releases greater than what is scheduled in the water control plan. The Woolly Star Preserve Area (WSPA) Steering Committee, the Local Sponsors, and the U.S. Army Corps of Engineers will meet annually to evaluate and adjust the environmental regulation plan as necessary. The annual environmental regulation will utilize water stored in the Intermediate Pool, the Trash Rack Pool, and the Flood Control Pool, and be consistent with the project flood control operation and safety objectives. For instance, the frequency, duration, and extent of water diversions on the WSPA may be changed over time.

8-06 Water Supply. The Water Control Plan currently does not include or preclude regulation* for water supply purposes. The plan may be modified in the future to accommodate water conservation. The contemplated operation of the dam within the debris pool was negotiated with the downstream water users during the preparation of the Phase II GDM in order to mitigate potential impacts of the flood control operation on those users. Releases made from the debris pool during the flood season, and the draining of the debris pool during the summer months mitigates the estimated impacts to downstream water users caused by building the debris pool during the flood season. Above the debris pool, temporary impoundment of water occurs during the wet years. This water, which would have discharged from the canyon at much larger rates under natural conditions, could also incidentally enhance water conservation.

* In this manual, the term "regulation" is limited to the decision making process for water control operations at the dam performed by the water control managers.

At this time, neither the Sponsors nor the corps has actively pursued implementation of a program to store water for water conservation purposes. In any given year, water may or may not be available for such purpose after Seven Oaks Dam flood control operation requirements, including biological and endangered species mitigation (i.e., habitat inundation), are met. Implementation of a water conservation program at Seven Oaks Dam would be subject to various conditions, as generally summarized in the "Seven Oaks Dam Water Conservation Feasibility Report and Environmental Impact Statement/Environmental Impact Report, dated June 1997, ("Feasibility Report"), which includes, but is not limited to, the following:

- All hydrological requirements for flood control and related environmental mitigation purposes for Seven Oaks Dam are met before water conservation is implemented. The Corps and Sponsors must ensure that flood control operations, including endangered species requirements, are not adversely affected by any water conservation proposals.
- The interested water agencies, and not the Sponsors or the Corps, are responsible for the costs for assessing the potential impacts of their proposed water conservation program, and to pay for all costs, including potential mitigations costs, associated with a proposed program.
- The water agencies must ensure that all permits and any other applicable authorization necessary to implement their proposed water conservation program have been issued, and pay all Federal and non-Federal costs, including but not limited to all costs associated with acquiring permits and other applicable authorizations, conducting new feasibility studies and further environmental review. A list of permits or other requirements that may be necessary may be found at pages 6-7 and 6-8 of the Feasibility Report.
- The water agencies must ensure that existing water rights are not impacted by their proposed water conservation program, and must acquire additional rights, if necessary, in accordance with existing law and decisions by the SWRCB.
- As the Sponsors are responsible for Seven Oaks Dam operations and maintenance, the Corps will not consider supporting implementation of water

conservation unless requested by the Sponsors. Therefore, the water agencies must enter into an agreement with the Sponsors to implement a water conservation program at Seven Oaks Dam. The Sponsors may require conditions or terms in addition to those listed above.

It appears that existing Congressional authorities are fairly broad and that additional congressional authorization may not be required. It should be noted that implementing water conservation at Seven Oaks Dam requires both congressional authorization for water conservation (which appears to be in place) and approval of a specific water conservation plan at Seven Oaks Dam. The foregoing conditions relate to approval of water conservation at Seven Oaks Dam.

Through one of the Sponsors, the San Bernardino County Flood control District (SBCPW&FCD), two water agencies paid for a feasibility study on the potential for future water conservation at Seven Oaks Dam. This feasibility study was completed in June 1997 and resulted in the Feasibility Report, but a Record of Decision was not signed, pending resolution of the Section 7 consultation on Seven Oaks Dam operations and an official requires from the Sponsors. Per Corps requirements, it was necessary for the Sponsors to request the study, rather than the water agencies. Therefore, the two water agencies requested that SBCPW&FCD act on their behalf in participating with the Corps in the water conservation feasibility study. The purpose of this study, however, was only the evaluation of hypothetical water conservation at Seven Oaks Dam after completion of construction and all requisite environmental compliance. This feasibility study does not contain any non-Federal requests for water conservation approval, nor connote any such approvals for water conservation operation. Rather, this document concluded that water conservation would be physically and economically feasible, based on the circumstances existing at the time, and offers technical information to the Sponsors.

During construction of the dam, the same two water agencies determined that, if at some time in the future, a water conservation program was requested approved,

and implemented at Seven Oaks Dam, it would be significantly more cost effective to construct certain improvements needed for water conservation during dam construction. Such improvements, however, did not constitute approval for water conservation, nor do they preclude other uses of the dam or uses of water behind the dam in the future. The two water agencies were willing to take the risk to expend funds for the modification (extension of a blanket drain), even though a water conservation program might never be approved at Seven Oaks Dam. Pursuant to Corps regulations, SBCPW&FCD requested the modification on their behalf. Any request for Corps approval of specific projects for water conservation can be made only by the Sponsors. It is anticipated that such requests will be handled in the same fashion as the blanket drain; i.e., that the Sponsors will transmit proposals from the water agencies to the Corps.

The water agencies have maintained a strong interest in water conservation at Seven Oaks Dam, and are actively pursuing necessary permits and appropriations from the State Water Resources Control Board.

8-07 **Hydroelectric Power**. The Water Control Plan does not include hydroelectric power objectives nor does it have any effect upon hydroelectric power generation. The original construction of Seven Oaks Dam resulted in the removal of one hydroelectric power generating facility in the Santa Ana Canyon and relocation of Southern California Edison's electrical transmission lines to above the reservoir rim. An access road along the streambed was also relocated over the dam. Edison's water flume/tunnel was replaced by a 42-inch diameter pressurized steel pipeline along the streambed and through the dam's left abutment. Upstream of the dam the pipeline runs along high ground in the left bank of the streambed. The depth of the pipeline is about four feet below ground. At the dam, the pipeline goes through the left abutment, into Edison's old tunnel, which is at elevation 2314 feet, NGVD, and daylights out downstream of the dam embankment. Edison's tunnel is sealed around the new pipeline. Bear Valley Mutual Water Company also had a water wheel at the old powerhouse #2, which was removed and the water company compensated.

8-08 Navigation. There is no navigation on the Santa Ana River or in the Seven Oaks Reservoir.

8-09 Downstream Water Users. The construction of Seven Oaks Dam resulted in the interruption of groundwater flow to the downstream aquifer by forcing this flow to the surface behind the dam. During the development of the Phase II GDM, a consensus between the Corps, the local sponsors and downstream water agencies was reached that, in general, the dam will be operated at all times, to pass this flow through the project. Therefore, the Water Control Plan includes releases to minimize impacts to downstream water uses. Several design features were incorporated in the Seven Oaks Dam project in order to allow the continuous delivery of water to replenish the downstream aquifer as under the pre-project condition. The minimum downstream release requirement was determined to be 3 cfs. During the start of the flood season, releases are cut back to the release requirement rate of 3 cfs, until the debris pool is filled. At the end of the flood season, the debris pool is drained consistent with the rates coordinated with the downstream water users, and the release schedule as defined by the Phase II GDM. During the month of June, the required releases will equal inflow plus 10 cfs, and during the months of July and August, the required releases will equal inflow plus 20 cfs. The process of determining the proper release rate to drain the debris pool will involve trial and error, as the gates and valve settings will need to be constantly adjusted to release the calculated value. Also, these adjustments may be needed on a regular basis to accommodate varying inflow rates. By 1 September, the debris pool shall be completely drained, using higher than calculated release rates, if needed.

8-10 Drought Contingency Plan. The ownership and operation responsibility for Seven Oaks Dam was turned over to the Local Sponsors on October 1, 2001. According to the guidance for preparation of Drought Contingency Plans (ER 1110-2-335, dated September 2002), it is required only for Corps owned projects.

8-11 Flood Emergency Action Plan. The operation of the dam incorporates the activation of the Flood Emergency Action plan when there is an emergency condition. Potential emergency conditions identified within the Emergency Action Plan include, but are not limited to, the following: emergency spillway discharge and dam failure, post-earthquake conditions, and security alert conditions. Details of the Emergency Action Plan are provided within the document entitled, "Seven Oaks Dam, Emergency Action Plan", dated June 2001.

8-12 Flood Frequency.

a. Peak Inflow and Outflow Probabilities. Plate 8-02 presents the inflow and outflow discharge frequency curves for Seven Oaks Dam. The curves were taken from the Phase II GDM, Volume 7, Hydrology, on the Santa Ana River Mainstem dated August 1988. The frequency curves were derived from a discharge-frequency analysis of historical flows on the Santa Ana River.

b. Filling Frequency. Plate 8-03 presents the estimated present and future condition filling frequency curve. These curves are from the Phase II GDM, Volume 7, Hydrology report. The future condition curve accounts for the estimated sediment deposition within the reservoir area after 100 years.

8-13 Other Studies.

a. Additional Conservation Measures/Proposed Compensation Plan. A biological assessment addressing endangered species and their habitat with the flood control operation plan for Seven Oaks Dam was submitted in August 2000 to the U.S. Fish and Wildlife Service as required by the Section 7 consultation process. The U.S. Fish and Wildlife Service, in return issued a biological opinion, dated December 2002. The biological opinion contains recommended conservation measures, in addition to the conservation measures already identified in the 1988 Phase II GDM, to mitigate for project impacts that may jeopardize the existence of the listed species. The

additional conservation measures, also called the proposed compensation plan in the biological opinion, will focus on providing means to 1) further evaluate the impacts from the operation of the dam, 2) test and select appropriate management actions, and 3) implement management action (if warranted) with the Woolly Star Preserve Area (WSPA) and other historic floodplain areas within the local sponsors jurisdiction to sustain the endangered species. The proposed compensation plan has six distinct elements, namely 1) Memorandum of Understanding (MOU) among the appropriate stakeholders, 2) development of a multi-species Habitat Management Plan, 3) directed studies of population trends and habitat relationships, threats to the species, and life requirements, 4) experimental studies of the effectiveness of different habitat management techniques, 5) implementation of habitat management on the WSPA, and 6) expansion of habitat management measures. Details of this compensation plan and required studies are also contained in the Corps' Biological Assessment, dated August 2000, and Qualitative Assessment, dated June 2001. A copy of the December 2002 Biological Opinion is included in this document as Exhibit J.

b. Water Conservation Study. A study for the operation of Seven Oaks Dam for water conservation was completed during the construction of the dam and is documented in the Seven Oaks Dam Water Conservation Study, Final Feasibility Report EIS/EIR, dated June 1997. This report was completed prior to the listing of San Bernardino Kangaroo Rat as an endangered species, and the Record of Decision has not been signed. The Sponsors have not yet requested to implement the results of this study.

c. Prototype-Testing Program. A prototype-testing program that will evaluate the hydraulic performance of the project, identify and analyze potential operation problems, and provide data that can used to evaluate any necessary operation changes, will be performed. When an opportunity for collecting measurements exists, such as when there is a large impoundment behind the dam, or when large releases are made, data necessary for this evaluation will be collected. The water control managers notifies the Corps of Engineers, Reservoir Regulation Section,

so that proper personnel from the U.S. Army Engineers Research and Development Center, Waterways Experiment Station (WES) can be called out for data collection. This testing program was developed, based on a model study conducted by WES. Details of the model study can be found within Technical Report, HL-92-14, Outlet Works for Seven Oaks Dam, Santa Ana River, San Bernardino County, California, Hydraulic Model investigation by Deborah R. Cooper, Hydraulics Laboratory, WES, final report dated October 1992. A description of the testing program can be found in Exhibit F.