and maintenance activities to occur over a range of, say, 3-6 years when lake elevations are already below 1110 feet, the need for reservoir drawdowns may be greatly reduced.

V. PROPOSED PLAN

A. PLAN COMPONENTS

The alternative with the 1125-foot target elevation (A1125D05) was the consensus selection of the Technical Committee as the preferred operating plan. The selected plan provided the best overall performance with respect to the evaluation criteria presented in Table 13 and Subcommittee recommendations.

1. LAKE ELEVATION

Under the proposed alternative, Alamo Lake levels would be managed for a target elevation of 1125 feet. If a storm event raises the lake above that elevation, water would be released rapidly to return the lake to 1125 feet. When the lake elevation is below 1125 feet, water would only be released to meet maintenance base flows in the Bill Williams River and to satisfy downstream water rights. Large releases would not be made for storm events until lake elevations exceeded 1125 feet.

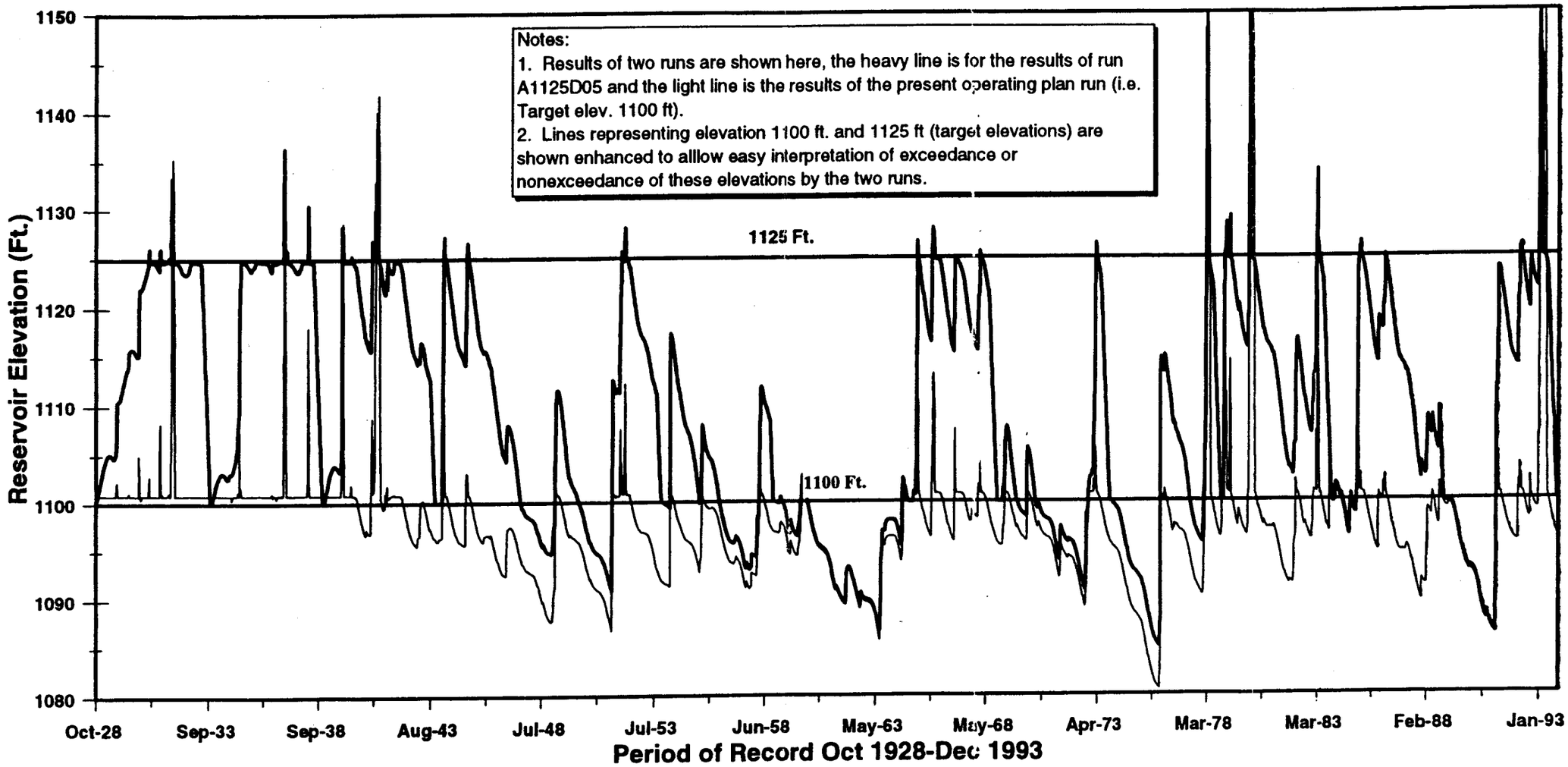
Table 15 illustrates comparative differences in Alamo Lake elevations over time for the proposed 1125 foot plan and the present 1100 foot plan. The impact of the five year inspection drawdowns (modeled to occur in years ending in a 3 and 8) on lake elevations is apparent in Table 15. For the proposed 1125 foot plan, the rate of drawdown for lake elevations in the 1100-1125 foot range is considerably less than for current operating conditions. Based on analysis of model runs for the period of hydrologic record, Alamo Lake elevations could remain below 1125 feet for long periods of time when inflow is minimal (i.e., extended drought periods). For the period of record from 1953-64, Alamo Lake elevations never exceeded 1118 feet and for nearly four consecutive years remained below 1100 feet (Table 15).

2. PRESCRIBED RELEASES

The prescribed releases for the 1125 foot proposed alternative are presented in Table 16. Alamo Dam releases for riparian base flow requirements would range from 25 cfs from November-January and 40-50 cfs during the spring-fall period.

The most idealistic flow releases from Alamo Dam cannot recreate the historical riparian vegetation diversity, density, and distribution along the Bill Williams River due to reduced flow magnitude, frequency, duration, and timing since Alamo Dam construction. But because the recommended (optimal) base flows are probably higher than pre-dam base flows, enhancements over historic conditions may occur in terms of riparian vegetation regeneration and recruitment. It is also known that the recommended flushing flows, while lower than pre-

Table 15. Modeled Alamo Reservoir elevations for current operations and for the proposed 1125 foot plan using hydrologic data from the 1928-93 period of record.



dam, can stimulate significant cottonwood regeneration. Therefore, the overall, long-term, effect may be an enhancement of riparian communities over pre-dam conditions.

Table 16. Generalized Alamo Dam release schedule based on recommended 1125' target elevation operating plan.

If current lake elevation ≤ 1125' (target elevation) then:

	Alamo Dam Releases (cfs)			
Lake Elev. (ft)	Oct	Nov-Jan	Feb-Apr	May-Sept
990-1070	10	10	10	10
1070-1100	15	10	25	25
1100-1125	40	25	40	50

If current lake elevation > 1125' (target elevation) then:

Lake Elevation (ft, msl)	Alamo Dam Releases (cfs)
1125-1126	transition up to 1,000
1126	1,000
1127	2,000
1128	3,000
1129	4,000
1130	5,000
1131	6,000
1132	6,621 - 7,000
1148.4	7,000
Up to 1235 (spillway crest)	7,000
From 1235 to 1265 (top of dam)	over 7,000

3. RELEASE CONSIDERATIONS

Below reservoir water surface elevation 1125 feet, the release schedule provides adequate flow for downstream riparian concerns, while minimizing lake level fluctuations and maintaining a lake elevation above 1100 feet as much as possible. At 1125 feet elevation, Alamo Lake is 3,800 surface acres with 160,500 acre-feet of storage. This is 80,000 acre-feet more water storage than at 1100 feet and an additional 1,200 surface acres. Above elevation 1125 feet, the release schedule attempts to mimic the pattern of pre-dam flood events. Pre-dam flood events typically had short duration high flows followed by long recession (tapering off) which slows the rate of water table decline, allowing tree roots to follow the dropping water.

In the case of Alamo Dam, flows are limited to a maximum of 7,000 cfs as authorized for flood control release by the project authorizing document. This type of release pattern will benefit riparian resources downstream by eliminating long duration inundation of tree stands and other vegetation while serving to help regenerate riparian vegetation. Additionally, releases with higher peaks should reduce the number of occurrences when the reservoir water surface elevation exceeds 1135 feet. This will reduce the chance of a "take" of an endangered species (by inundation of a bald eagle nest) should the bald eagles return to a nest site within the reservoir. In recent years, a bald eagle tree nest site was situated at approximately elevation 1138 feet.

Approximately every five years, the reservoir water surface elevation must be drawn down to 1100 feet to permit inspection and maintenance of Alamo Dam's outlet tunnel. It is recommended that inspection of the outlet tunnel occur in October/November, when reservoir inflows will be lowest (based on historic records) and downstream release requirements for riparian communities are lowest. The drawdown procedure for the inspection/maintenance will normally begin in June, permitting reservoir evacuation over a long (6-month) time period without excessively high flows. In most cases, releases will be less than 1,000 cfs. An objective is to avoid root zone damage to the cottonwood trees caused by saturation from long term inundation (see Inundation Restrictions, Chapter III. A.1.). If a monsoon event occurs during the drawdown period, outflows would mimic inflows as much as possible so as to provide the monsoon flow effect downstream. If, during a drawdown period, no monsoon event occurs and it is deemed that such an event will benefit the riparian zones, an artificial monsoon sequence of flows can be simulated. Normally such a simulated monsoon sequence would be scheduled for early September, to mimic nature. Base flow releases after the artificial monsoon release would, most likely, be much less than prior to the monsoon release to ensure that the reservoir water surface elevation does not drop below elevation 1100 feet.

The larger spring and monsoon flushing releases would be coordinated with USBR operations on the Colorado River, similar to the present operating plan. If an excessive runoff condition occurred on the Colorado River, as happened in the early 1980's, releases from Alamo Dam would be limited to the amount the USBR can incorporate into its river operation plan. However, base flows would be maintained and if the water surface elevation of Alamo Reservoir rises into the flood control pool, releases would be increased as necessary to effect the necessary flood control operation. In a flood control operation, outflow may be as high as 7,000 cfs.

In a similar manner, base flow releases would be coordinated with the resource agencies downstream, as appropriate. If a specified seasonal release below the target elevation was deemed unnecessary to sustain downstream riparian needs, releases would be adjusted accordingly.

B. BENEFITS OF PLAN

A diagrammatic comparison of current and recommended dam operation is provided in Figure 8. Storage allocation amounts are shown as unchanged with the recommended operation plan, and Alamo Dam operations in both the recreation and flood control pools remain unchanged as well. Within the water conservation pool the recommended operation plan calls for reservoir releases

that vary with season and reservoir elevation that provide positive benefits for fish, wildlife, riparian habitat, recreation, and flood control.

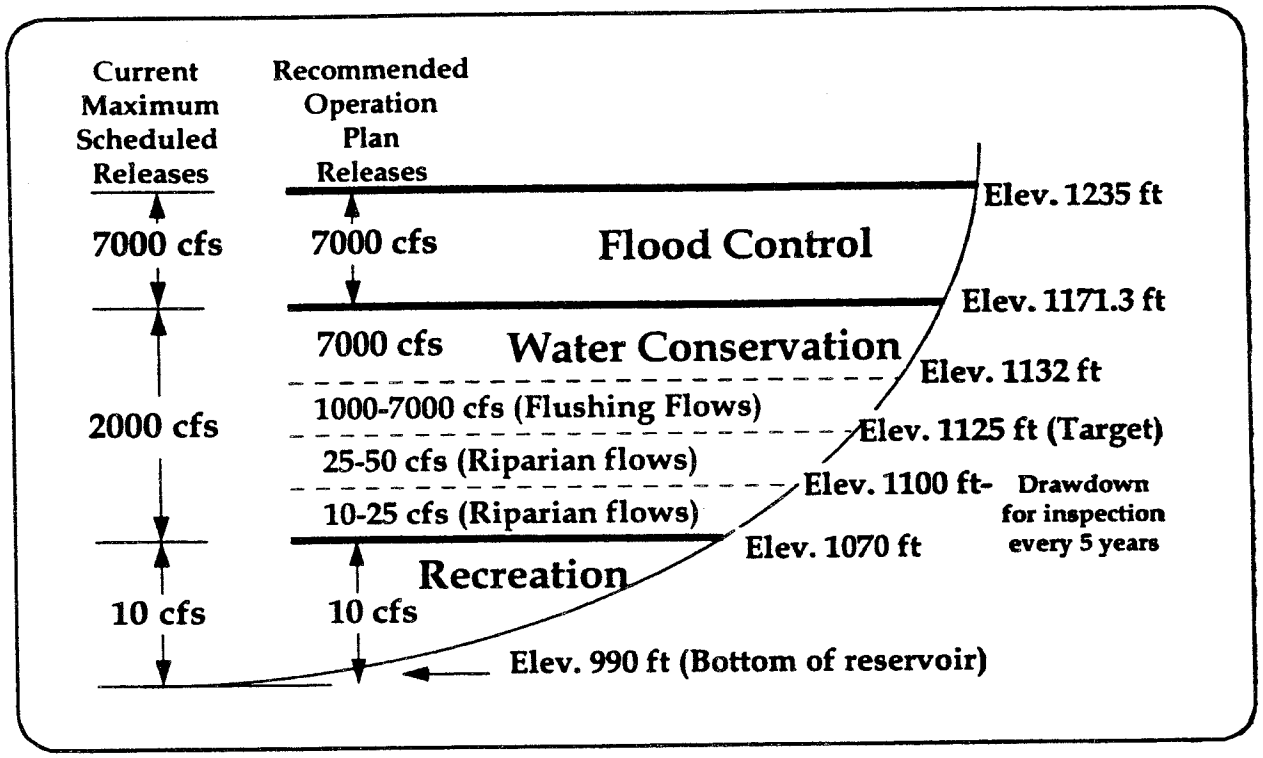


Figure 8. Comparison of current and recommended Alamo Dam operations.

In changing from current operations to the proposed 1125 foot plan, improvements in evaluation criteria occur for all categories, except water conservation (Table 13). A general summary of the effects of the proposed plan, by major resource group, is listed in Table 17.

Table 17. Summarization of effects/impacts of recommended reoperation plan.

- **Flood Control [Positive]**
- **Water Conservation [Positive and Negative]**
  - Net increase in water provided for in-stream riparian habitat
  - Net reduction in water delivery to Lower Colorado River
  - Small increase in salinity of water in Bill Williams River
- **Recreation [Positive]**
- **Fisheries [Positive]**
- **Riparian Habitat [Positive]**
- **Wildlife and Threatened & Endangered Species [Positive]**
- **Power [No Change]**

The river/reservoir simulation performed by the Technical Committee was limited to the Bill Williams River system. Therefore, predicted water deliveries in the lower Colorado River do not account for adjustments in mainstem reservoir operation to accommodate the various Alamo Dam operation alternatives. The limited scope of modeling undertaken is sufficient to identify the best overall Alamo operation plan.

Figures 9 through 14 graphically compare selected evaluation criteria between the General Design Memorandum (GDM), Current Operation, and the proposed operation with a target elevation of 1125 feet (the selected alternative). Dramatic improvements occur with the selected alternative over the current operation for flood control, recreation, fisheries, riparian and wildlife criteria.

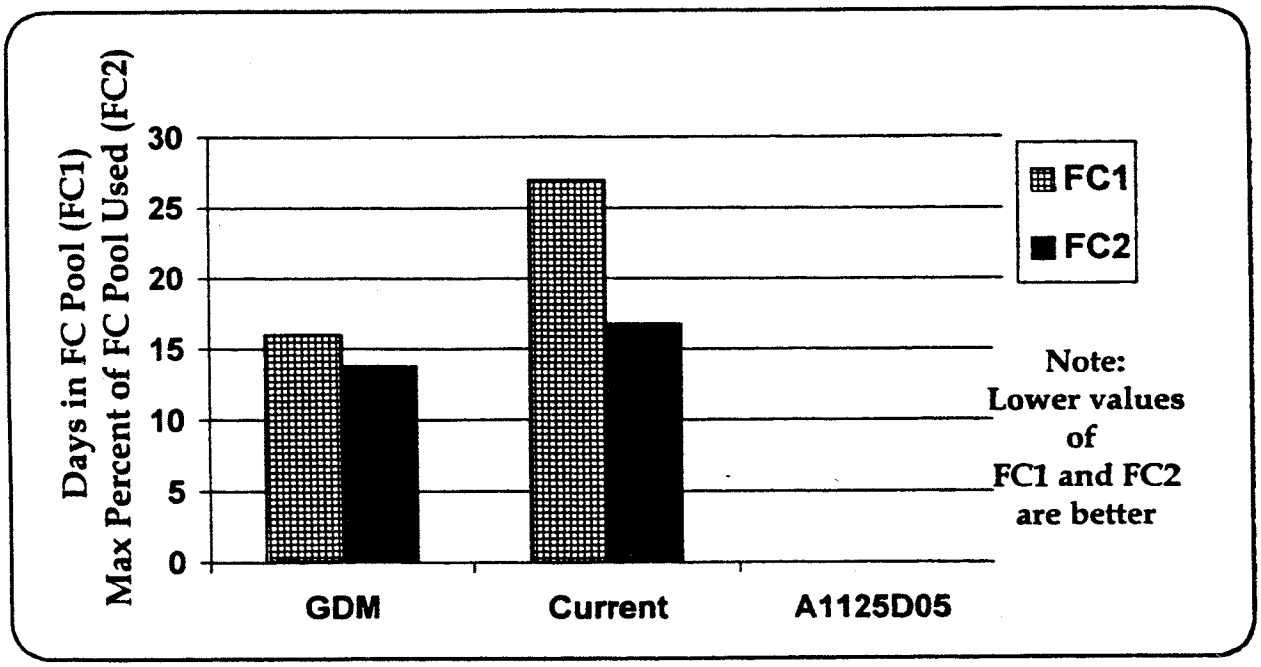


Figure 9. Comparison of success in meeting flood control goals by GDM, current operation, and recommended 1125' target. FC1 = Number of days WSE above 1171.3' during period of record; FC2 = Maximum percent of flood control space used during period of record. NOTE: values for A1125D05 for both FC1 and FC2 are zero during period of record.

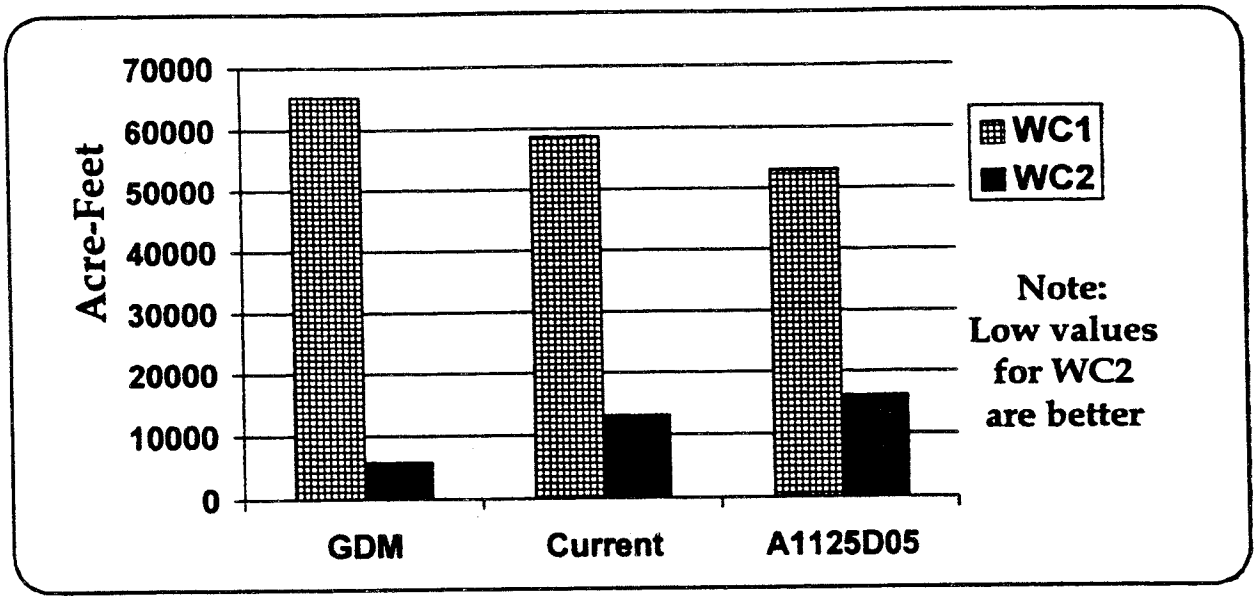


Figure 10. Comparison of success in meeting water conservation goals by GDM, current operation, and recommended 1125' target. WC1 = Average annual delivery of water to lower Colorado River (Lake Havasu); WC2 = Average annual Alamo Reservoir evaporation in Acre Feet for period 1929-93.

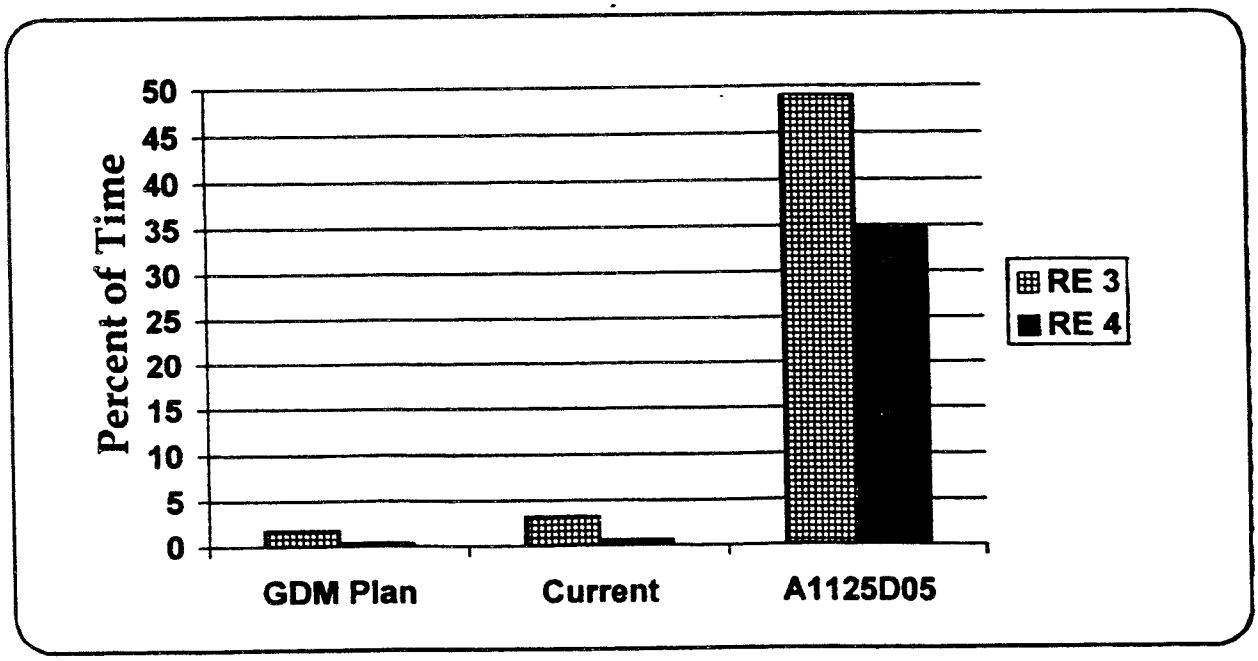


Figure 11. Comparison of success in meeting recreation goals by GDM, current operation, and recommended 1125' target. RE3 = Percent of time water surface elevation at or above 1108'; RE4 = Percent of time water surface elevation between 1115' and 1125'.

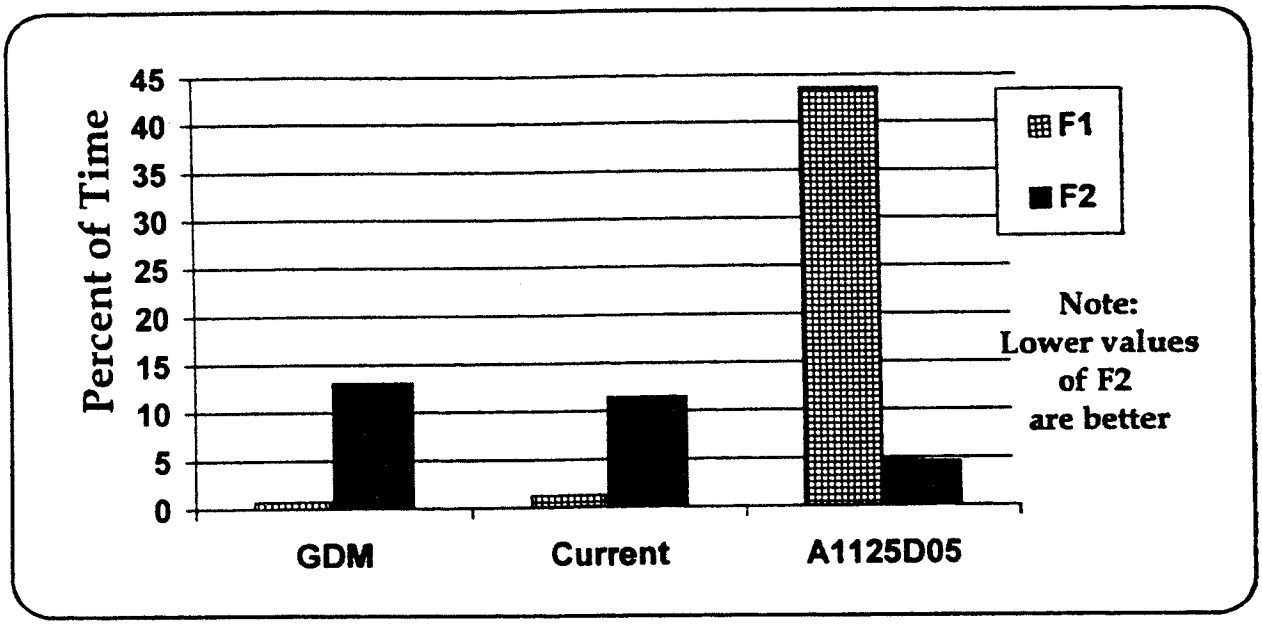


Figure 12. Comparison of success in meeting fisheries goals by GDM, current operation, and recommended 1125' target. F1 = Percent of time water surface elevation between 1110' and 1125'; F2 = Percent of time in March 15-May 31 water surface elevation fluctuates more than 2" per day.

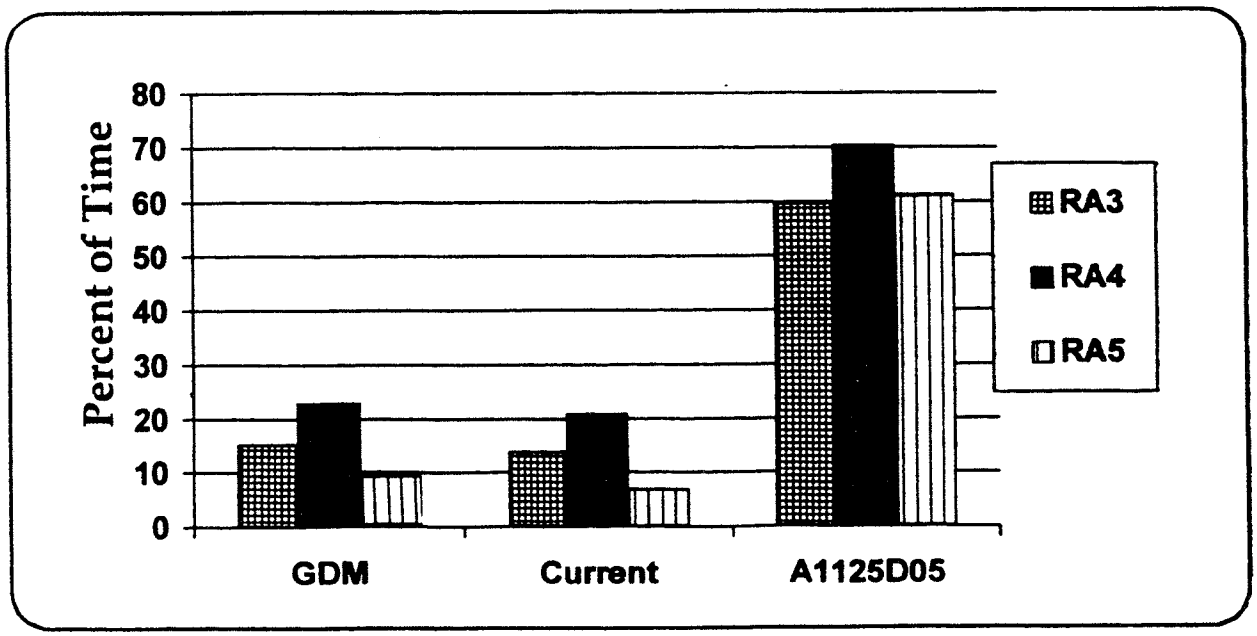


Figure 13. Comparison of success in meeting riparian goals by GDM, current operation, and recommended 1125' target. RA3 = Percent of time Alamo Dam releases greater than or equal to 25 cfs in November through January; RA4 = Percent of time Alamo Dam releases greater than or equal to 40 cfs in February through April and in October; RA5 = Percent of time Alamo Dam releases greater than or equal to 50 cfs in May through September.

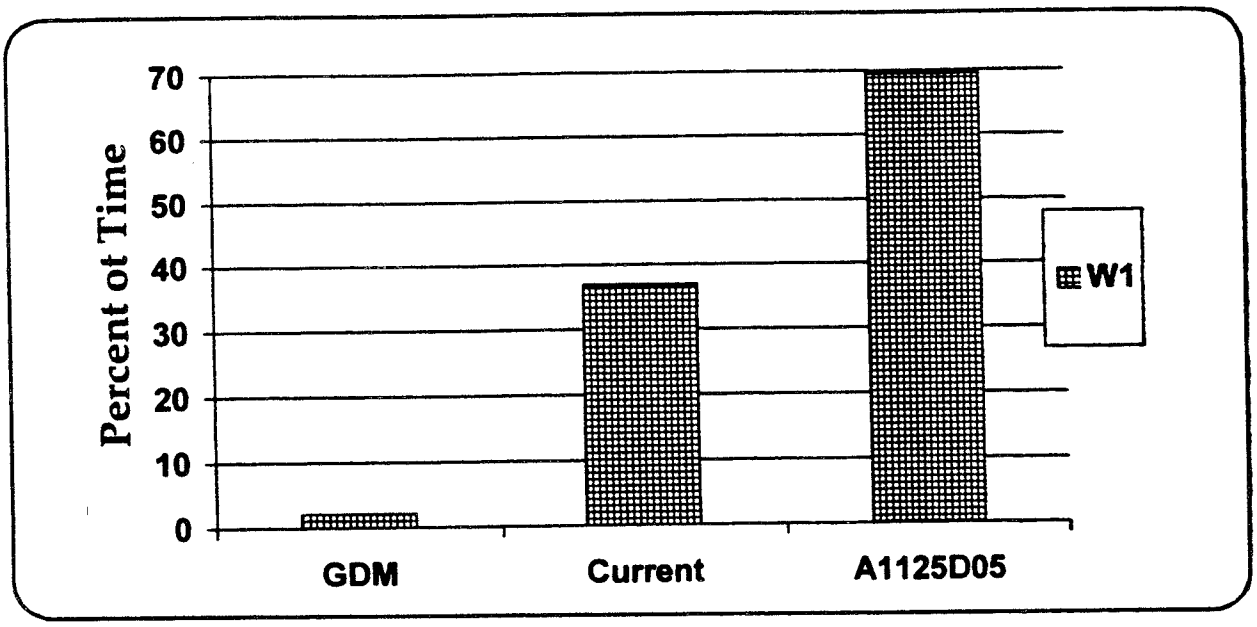


Figure 14. Comparison of success in meeting wildlife goals by GDM, current operation, and recommended 1125' target. W1 = Percent of time water surface elevation at or above 1100'.

Flood Control: Based on current operations, it is projected that lake elevations would reach the flood control pool (1171.3 feet) for 27 days for the 1929-93 period of record (FC1) and up to 16.8% of the flood control pool would be used at one point in time (FC2). Under the preferred 1125 foot plan, for the same period of record, lake elevations would never reach the flood control pool (Figure 9).

Water Conservation: The Technical Committee analysis for water conservation provides a relative comparison among alternative Alamo Dam operation plans by quantifying average annual Bill Williams River water deliveries to the Colorado River at Lake Havasu (WC1), and average annual Alamo Lake evaporation losses (WC2). Since each of the alternative plans produces higher average pool levels than the current operation plan, higher reservoir evaporation losses and reduced water deliveries to the Colorado River occur under all alternative plans (see Table 13). However, the actual reduction in water supply for the Colorado River is smaller than indicated by WC1 when the entire Colorado River system is considered. Furthermore, the consumptive use of water by riparian vegetation enhancements along the Bill Williams River under the recommended dam operation is anticipated to more closely resemble the consumptive use of water under pre-Alamo Dam conditions.

When water is stored in Alamo Lake and not used for delivery to Lake Havasu, that increment of water supply for the Lower Colorado River must be provided from Lake Mead. Although a portion of any additional water stored in Alamo Lake will evaporate, a reduction in evaporation loss occurs at Lake Mead due to a slightly reduced pool size. Evaporation losses at Alamo Lake are higher than at Lake Mead for a given volume of storage because of the greater increase in surface area at Alamo Lake versus the larger Lake Mead. A reservoir system simulation that

included Lake Mead would be required to precisely determine the net reduction in Colorado River system water supply that would occur with adoption of the recommended Alamo Dam operation. The values of average annual Alamo Lake evaporation losses (WC2) in Table 13 likely overestimate the net reduction in Colorado River system water supply by 15 to 35 percent.

Comparing the recommended Alamo operation versus the current operation, and considering that the appropriate difference in water availability to the Colorado River is reflected by the net change in system-wide evaporation losses, then adoption of the recommended plan would result in an estimated reduction in water supply of about 2,000 to 2,500 acre-feet annually.

A small salinity increase on the Bill Williams River may occur because of longer reservoir retention times with the recommended plan. This results from more evaporation losses (WC2, Figure 10) and resultant concentration of salts. The salinity increase is negligible relative to the salt load in the Colorado River, based on an average annual contribution of 53,000 acre feet of water from the Bill Williams versus average annual lower Colorado River flows of 7 million acre feet. Salinity levels of the Bill Williams River are far below those of the lower Colorado River mainstem and will continue to remain low under the recommended plan.

Recreation: The percent of time lake elevations are above 1108 feet (RE3) improves from 3.2% (current operations) to 49% for the recommended plan (Figure 11). Improvements to the percent of time lake elevations are between 1115 and 1125 feet (RE4) are also significant. The recommended plan maintains higher lake elevations over a greater period of time, which translates into greater utilization of the existing boat ramps and recreational facilities at Alamo Lake. While these improvements are considerable, it should be noted that even under the recommended plan, lake elevations will be below 1108 feet for 51% of the time. These lower lake elevations are a reflection of drought periods and drawdown impacts projected over a 65 year period of hydrologic record. Eliminating the need for drawdowns or decreasing the frequency of drawdowns will improve the percent of time lake elevations are above 1108 feet to 61.8% (Table 14).

Fisheries: Improvements in percent of time lake elevations are held between 1110 and 1125 feet (F1) are similar to those just described under recreation for RE3. Lake fluctuations during the March-May spawning season affect fish reproduction success. The incidence of lake fluctuations greater than 2 inches per day during the spawning season (F2) decreases from 11.5% of the time under current operations to 4.6% of the time for the recommended plan (Figure 12).

Riparian: Riparian resources will greatly benefit from significant increases in base flow amounts and duration for all seasons (Figure 13). The percent of time recommended base flows are met or exceeded range from 6.8-20.9% under current operations to 59.6-70.3% for the 1125 foot plan. Additionally, the percent of time streamflows at the Refuge exceed 18 cfs is improved from 27.8% to 51.3% with the recommended plan (Table 13). The 1125 foot recommended plan also reduces the number of occurrences when Alamo Dam releases subject downstream riparian vegetation to stressful inundation conditions.

Wildlife and threatened and endangered species: For the wildlife criteria, dramatic improvement is achieved in keeping the lake above 1100 feet (W1) although nest inundation at an 1138 foot elevation site will increase (W2). Since nesting eagles used alternative sites away from

lake disturbance, after inundation of previously used nests in 1993, the significance of the inundation may be less than previously believed. Other wildlife species will benefit from the anticipated improvements to riparian resources.

VI. IMPLEMENTATION OF PLAN

A. IMMEDIATE STEPS

Once the Steering Committee approves the final proposed water management plan for Alamo Dam and the Bill Williams River, a public involvement process should begin that includes briefings with the Congressional delegation, regional legislative members, county and local officials, downstream landowners, and the City of Scottsdale. A press release on the Steering Committee-approved water management plan is recommended.

B. REMAINING ISSUES

Table 18 lists issues that may require consideration and resolution prior to final reservoir reallocation and reoperation steps.

Table 18. Remaining issues for the implementation of a revised Water Control Manual for Alamo Dam.

- **Public involvement process**
- **Instream water rights for the riparian habitat**
- **Reallocation of reservoir storage vs. reoperation**
- **Economic analysis of impacts and costs of reoperation vs. status quo**
- **Cost sharing requirements**
- **Planet Ranch pumping**
- **Threatened and Endangered species**
- **Biological and ecological monitoring studies**
- **Securing Alamo storage rights and downstream base flows**

A public involvement process will be decided by the Steering Committee. If significant public interest results from the press release, then informational, open house meetings should be held to advise the public of the process to date, the proposed changes, and probable implementation strategies. It is expected that any operational changes to Alamo Dam will require formal documentation by the Corps, which will necessitate full public involvement and National Environmental Policy Act compliance. Thus, a more formal public involvement process will occur prior to any changes in Alamo Dam operations.