3.4 WATER SUPPLY

3.4.1 INTRODUCTION

This section discusses the water supply available to the Lower Division states and Mexico under baseline conditions and the interim surplus criteria alternatives. It provides an evaluation of the effectiveness of meeting the water delivery objectives previously articulated by the Lower Division states and notes the states' contingency plans in the event of shortages. Water supply deliveries are the deliveries of Colorado River water by Reclamation to entities in the seven basin states and Mexico, in accordance with the *Law of the River*.

3.4.2 METHODOLOGY

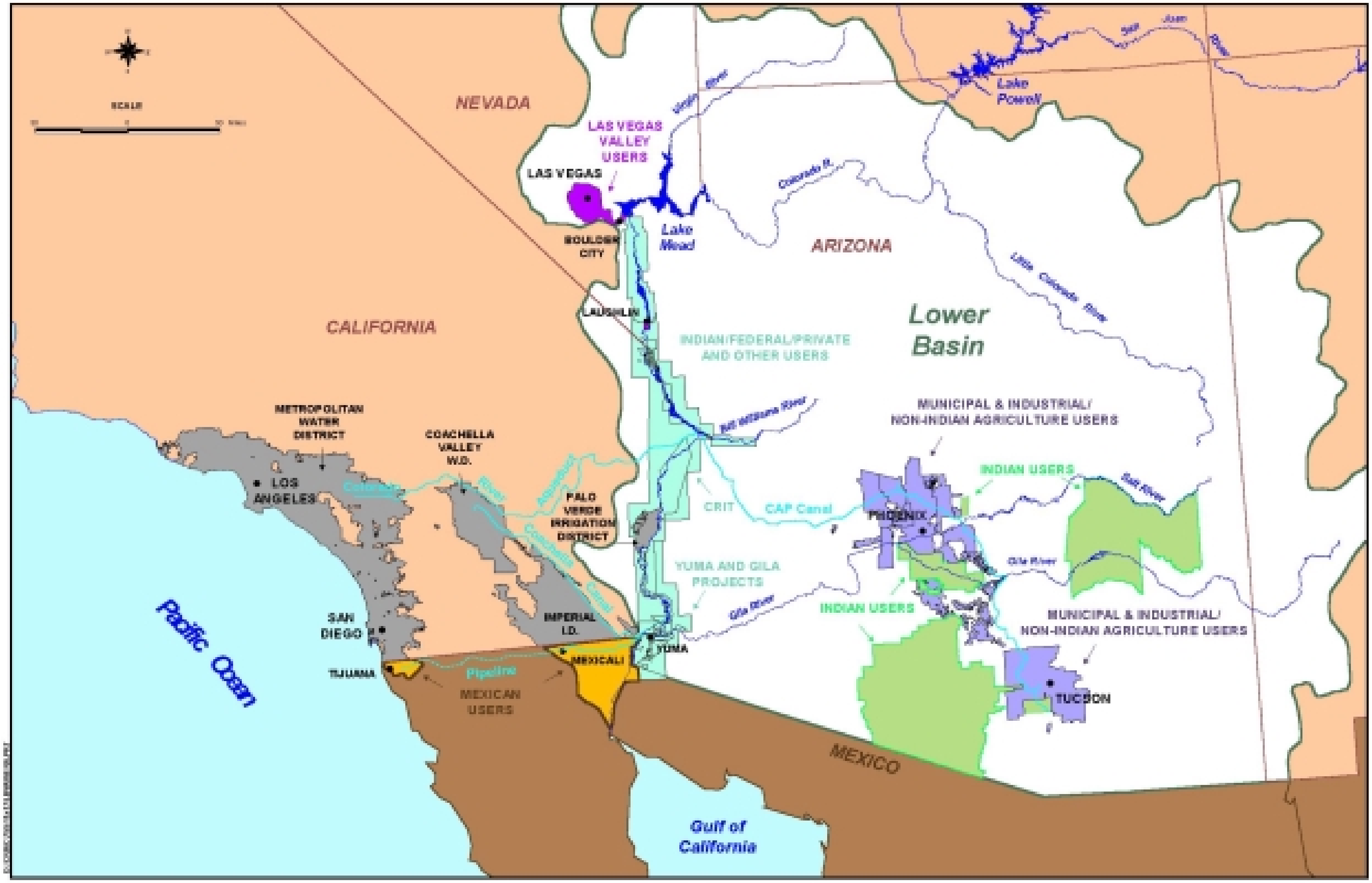
The model was used to produce estimates of future water supply deliveries for the Lower Division states and Mexico under the modeled hydrologic conditions. The modeled water demands of the Lower Division states reflect demand projections provided by the water users as described in Section 3.3.3. A copy of the demand schedule used to model the Lower Division states' depletions is included in Attachment G. The demand schedule used to model the Upper Basin states depletions is included in Attachment J.

The output from each model run included monthly and annual diversions, return flows and depletions for the Colorado River water users in af. The water supply data was analyzed using statistical methods and focused upon the comparison of the model results of the surplus alternatives to baseline conditions. See Section 3.3 for a further explanation of the modeling process.

3.4.3 AFFECTED ENVIRONMENT

The affected environment for water supply consists of the Colorado River from Lake Powell to the NIB, including the mainstream reservoirs. Geographically, the affected environment is bounded by the reservoir shorelines at maximum reservoir levels and the 100-year flood plain of the affected intervening sections of the Colorado River. This zone includes all the diversion points for water users in the Lower Division states and Mexico. Map 3.4-1 presents the water service areas in the Colorado River Lower Basin.

Map 3.4-1
Colorado River Water Service Areas in the Lower Basin



3.4.3.1 WATER USE PROJECTION PROCESS

Three Colorado River water supply conditions are recognized in the operation of the river system: surplus, normal, and shortage conditions, as discussed in Section 1.3.4.1. The Basin States provide Reclamation with an estimate of projected water use under each of the three water supply conditions as shown in Attachment G. Second level shortage amounts are computed within the model as described in Section 3.3.3.4. The states' requests are distributed by diversion point along the river system. The projections for normal water supply conditions typically reflect state's water supply apportionment from the Colorado River.

3.4.3.2 STATE OF ARIZONA

The portions of Arizona in the Lower Basin that depend on Colorado River mainstream water consist of the following areas: the lower Colorado River from Lake Mead to the NIB; the Gila River Valley upstream from Yuma, Arizona; and a large area in the central part of the state served by facilities of the CAP. In addition, Arizona is also charged for use of water pumped from Lake Powell under the state's Upper Basin apportionment of 50,000 afy. Numerous districts and other entities that divert and distribute the water administer the contractual arrangements for the use of Colorado River water in Arizona. The Central Arizona Water Conservation District (CAWCD) administers the CAP water diversions. The Director of the Arizona Department of Water Resources has state statutory authority to represent the state in Colorado River water supply matters.

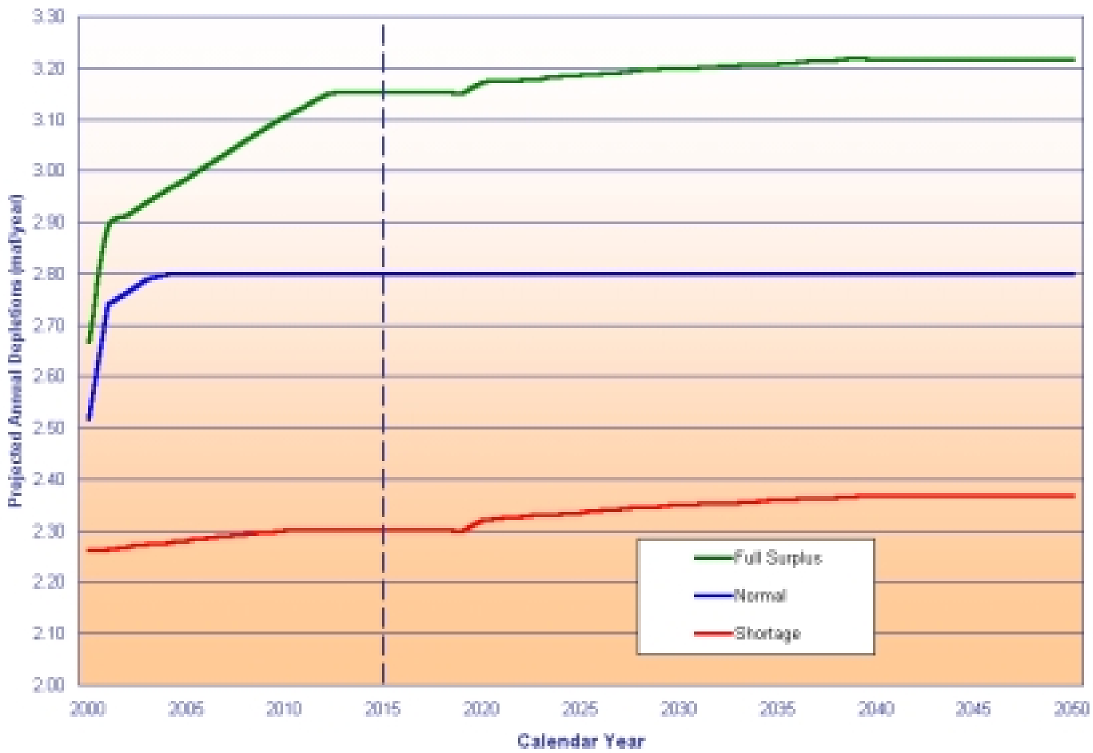
Arizona established the Arizona Water Banking Authority (AWBA) in 1996. The State legislation that authorized the AWBA states that it was created: 1) to increase Arizona's use of Colorado River water by delivering though the CAP system and storing water that otherwise would be unused by Arizona; 2) to ensure an adequate water supply to CAP municipal and industrial (M&I) users in times of shortages or disruptions of the CAP system; 3) to meet water management plan objectives of the Arizona state groundwater code; 4) to assist in settling Indian water rights claims; and 5) to provide an opportunity for authorized agencies in California and Nevada to store unused Colorado River water in Arizona for future use.

Arizona has numerous users of Colorado River water. The largest diversion of water is the CAP that delivers water to contractors in the central part of the state. CAP's diversion is located at Lake Havasu. The next three largest diversions are those of the Colorado River Indian Reservation at Headgate Rock Dam and the Gila and Yuma Projects, whose diversions are located at Imperial Dam. The remaining diversions serve irrigated areas and community development along the river corridor, including lands of the Fort Mojave Indian Reservation, water used by federal agencies in Arizona, the cities of Bullhead, Lake Havasu and Parker, Mojave Valley Irrigation District and Cibola Irrigation District. A portion of the water from the river corridor is diverted by wells located along the river.

The CAP and other Arizona users that contracted for Colorado River water after September 30, 1968, have the lowest priority. The exceptions are lower priority contractors that contracted for unused normal year entitlement and surplus year supplies when available. Included in the CAP category are Bullhead City, Lake Havasu City, Mojave Valley Irrigation District and others. For the most part, the non-CAP contracts total 164,652 afy. The non-CAP users include present perfected rights or other rights that predate the BCPA and users that contracted before September 30, 1968.

Under shortage conditions, the first diversions to be reduced would be contracts for unused entitlements of normal year supplies followed by contractors for CAP water. For this DEIS, the analysis of Arizona's water supply under baseline conditions and the interim surplus criteria alternatives has been limited to an analysis of the effects of water availability on total Arizona diversions. Figure 3.4-1 presents a graphical illustration of Arizona's normal, full surplus and first level shortage condition depletion schedules that were used as input for the model.

Figure 3.4-1
Arizona Projected Colorado River Water Demand Schedules
(Full Surplus, Normal and Shortage Water Supply Conditions)



Arizona's consumptive use of Colorado River water, including that used for groundwater banking, reached its normal year entitlement of 2.8 maf in 1997. However, its consumptive use since then has been less than this amount.

As shown on Figure 3.4-1, Arizona's normal year depletion schedule is projected to reach 2.8 maf in 2004, and remains at that level thereafter. The CAP's projected normal year depletions are approximately 1.5 maf until approximately 2020, which represent approximately 54 percent of the state's total normal demand. Thereafter, the CAP portion of the 2.8 maf normal demand is projected to decline, reaching 1.433 maf, or approximately 51 percent of the state's normal demand in year 2050.

The state's projected full surplus depletions increase from 2.96 maf in 2004 to approximately 3.22 maf in 2038, after which it remains at that amount. The projected CAP surplus condition demand rises steadily from 1.535 maf to approximately 1.7 maf in 2013. Thereafter, the CAP surplus condition depletion schedule remains flat at approximately 1.7 maf. First level shortage condition depletions for Arizona increases from 2.28 maf in 2004 to approximately 2.37 maf in 2038, after which it remains at that level. The CAP shortage condition depletion schedule used for the analysis remains constant at 1.0 maf over the period of analysis. Additionally, there will also be other shortage condition reductions that affect CAP priority contractors that use water directly from the Colorado River. This quantity is not quantified; however, normal year supplies could be reduced by as much as 35 percent.

Arizona's basic strategy for meeting short-term shortages in CAP M&I supply centers on reduced uses for recharge, reduced agricultural deliveries, and an increased use of groundwater. In addition to naturally occurring groundwater, Arizona has established a groundwater bank and it is currently actively storing CAP water that is excess to its current needs for future withdrawal. As discussed above, the AWBA administers the groundwater bank. Groundwater banking is occurring with the intent of providing a source for withdrawal during periods when the amount of Colorado River water available for diversion under the CAP priority is curtailed by shortage conditions. Additionally CAWCD has stored a substantial amount of CAP water in Central Arizona.

It is projected that CAP water will be used for groundwater recharge until about 2040 under normal and surplus conditions. This use will be terminated first in case of shortage. For other interim and long term contract users, agriculture has the lowest priority. Therefore, irrigation users will be reduced before CAP M&I or Indian users in case of shortage conditions. Most irrigation users have rights to pump groundwater as a replacement supply. The increased use of this supply will cause increased overdraft of the groundwater basins and is in conflict with the state's groundwater management goals.

If CAP diversions were limited to 1.0 maf during shortage conditions, the impact before year 2020 would be to both groundwater recharge and agricultural users. After 2020, CAP M&I users would also be impacted by shortage conditions.

3.4.3.3 STATE OF CALIFORNIA

The Colorado River supplies about 14 percent of the water used in California by agriculture, industry, commercial businesses, and residential customers. All of the Colorado River water used by California is used in the Southern California region. Colorado River water is by far the most important source of water for Southern California, accounting for over 60 percent of its water supply. During the last several years, the Colorado River has supplied about 5.2 maf of the 8.4 maf of water used annually in Southern California.

Under the *Law of the River*, the Lower Division states (California, Nevada and Arizona) are collectively entitled to 7.5 maf of Colorado River water in a normal year. In 1964, a United States Supreme Court decree established California’s basic apportionment of 4.4 maf from within the Lower Division states’ 7.5 maf apportionment and granted Arizona, California and Nevada percentages of any surplus water determined available by the Secretary. The 1979 and 1984 Decrees also awarded present perfected water rights to Indian reservations along the Colorado River. Surplus water is water available for release in excess of the 7.5 maf of basic apportionments available to the three states collectively. California is entitled to receive 50 percent of the surplus water that may be determined available for use by the Lower Division states.

Agriculture and present perfected rights have highest priority to about 90 percent of California's entitlement. The balance goes to the MWD, which provides wholesale water service to most of the communities with the Southern California coastal plain. California’s largest agricultural water agencies that rely on Colorado River water include the Imperial Irrigation District (IID), Palo Verde Irrigation District (PVID) and the Coachella Valley Water District (CVWD).

Three major structures divert water from the Colorado River to California. Parker Dam impounds Lake Havasu, which supplies water for MWD's Colorado River Aqueduct on the California side of the state line and for the Central Arizona Project on the Arizona side of the state line. Palo Verde Diversion Dam supplies water to PVID’s canal system. Imperial Dam diverts water to the All American Canal on the California side of the state line and to Arizona Yuma Project users on the Arizona side of the state line. The All-American Canal is used to deliver water to the IID and the CVWD.

California has relied on the Secretary's release of unused Nevada and Arizona Colorado River apportionments in accordance with Article II(B)(6) of the Decree for more than three decades. In recent years, Nevada and Arizona depletions have approached their apportionment amounts as a result of the completion of the CAP and rapid population growth in these states. Additionally, Arizona has started to bank its water (such as by groundwater storage) to protect against future shortages. Meanwhile, California's consumptive use of Colorado River water has exceeded its apportionment by up to 800,000 af in recent years. As a result, there is currently not enough unused Nevada and Arizona water to be released to California to meet California's demand. Since 1996, California has received about 800,000 af above its 4.4 maf entitlement due to determinations by the Secretary of surplus conditions on the Colorado River reflecting nearly full reservoirs.

The California Department of Water Resources projects that over the next several decades, California's demand for water will continue to increase. Urban demand is expected to outweigh projected declines in agricultural demand. For example, the Department's 1993 California Water Plan projected that urban water demand will increase by 60 percent from 1990 to 2020. However, California's ability to access Colorado River water beyond its base entitlements may be limited for the following two reasons:

- Since Arizona and Nevada will be using most of their apportionments, California's access to any substantial amount of water above its apportionments will depend on surplus determinations by the Secretary on a year-by-year basis. Under current Colorado River system management practices, such determinations are not certain, as they depend on conditions which change each year—namely snowpack runoff and reservoir storage—as well as the willingness of Secretary to allow California to exceed its apportionment, as discussed below.

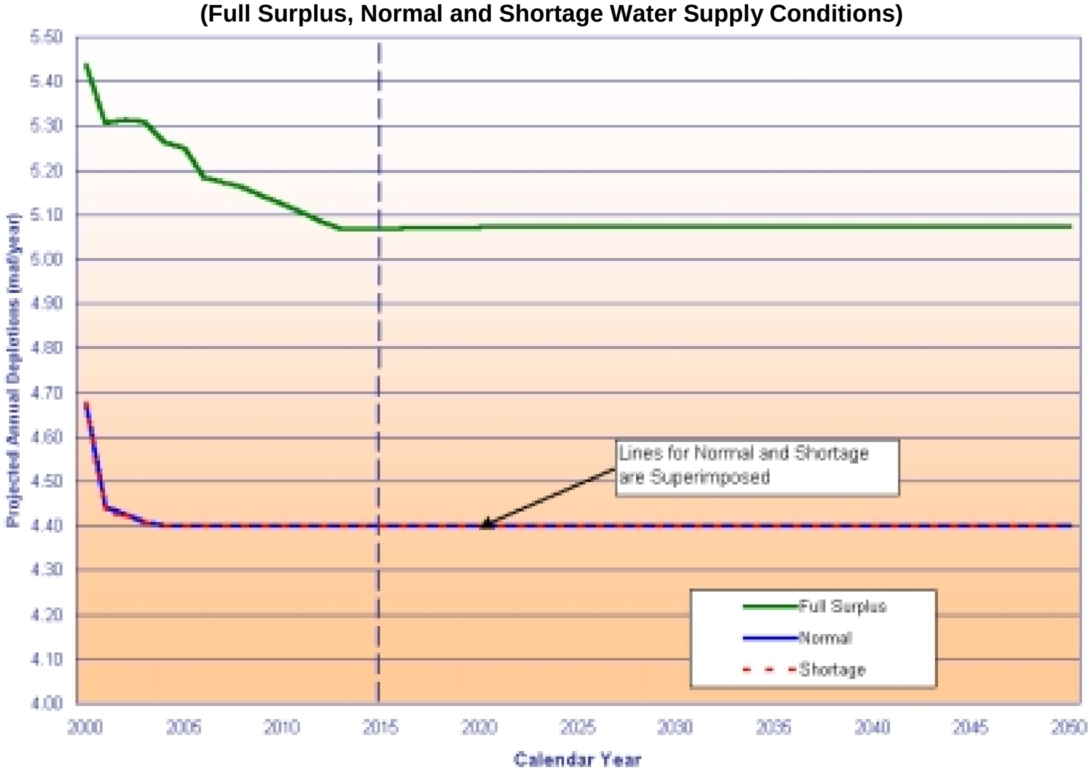
- Even with a surplus determination, California's access is limited by the capacity of its delivery systems. Currently, the existing delivery system to urban users—the Colorado River Aqueduct—is operating at near capacity (approximately 1.3 maf per year).

If California's Colorado River water supply were limited to its 4.4 maf apportionment today, the immediate impact would fall mainly on the MWD because much of the allocation to California above its entitlement now goes to urban users serviced by MWD. MWD (or its customers) would have to look to: 1) other California users of Colorado River water, namely the agriculture agencies, or 2) other sources—such as Northern California water supplies—for about 700,000 af of the approximate 2 million af of water that MWD currently delivers.

California faces other issues that may impact the quantity or quality of the supply of Colorado River water to certain users. In particular, listing of additional endangered bird and fish species could reduce the amount of water available for non-environmental purposes. Also, Colorado River salinity control projects could impact the quantity and quality of future Colorado River water. Both the type of crops produced (high market value crops generally require water that is low in salinity) and the quality of Southern California drinking water could change.

Figure 3.4-2 presents a graphical illustration of California's full surplus, normal and first level shortage demand schedules that were used as input to the model.

Figure 3.4-2
California Projected Colorado River Water Demand Schedules
(Full Surplus, Normal and Shortage Water Supply Conditions)



In accordance with the Secretary's directive, the Colorado River Board of California has developed a plan for California to live within its legal apportionment of 4.4 maf. The board's draft plan (dated August 11, 1997) addresses various water supply management issues that are focused on changes in the use, supply or transfer of Colorado River water. The plan relies first on a variety of intrastate measures that either conserve water or increase water supplies. The plan also relies on measures that would make extra water available to California. A discussion of the Colorado River Board's 4.4 Plan and the various water supply and water resources management measures contemplated therein are presented in Section 1.4.1.

California's use of Colorado River water reached a high of 5.4 maf in 1974 and has varied from 4.5 to 5.3 maf per year over the past 10 years. Limiting California to 4.4 maf per year would reduce California's annual water supply by approximately

800,000 afy. All or most of this reduction will be borne by MWD. While the water supply analysis under the DEIS is focused on the total California depletions, the assumption is made that the surplus deliveries that may become available would be managed and distributed by and between the California users in accordance with the proposed provisions of the California 4.4 Plan, the corresponding “Quantification Agreement” and associated cooperative programs. Most of these cooperative programs are between MWD or one of its member agencies and the agricultural water agencies. Under these programs, MWD will be able to use its basic entitlement plus water made available under water conservation and groundwater storage programs. These programs include the following:

- **Coachella Groundwater Storage Program -** Cooperative program with the Desert Water Agency and the CVWD that exchanges their State Water Project (SWP) entitlements for MWD's Colorado River water and provides storage of Colorado River water for future extraction by these two agencies.

- **Water Conservation Program with Imperial Irrigation District -** MWD and the IID entered into a water conservation agreement in December 1988. The agreement called for IID to implement various projects to conserve water including improving its water distribution system and on-farm management of water.

- **Test Land Fallowing Program in the Palo Verde Valley -** MWD and the PVID implemented a two-year test land fallowing program from August 1, 1992 through July 31, 1994.

- **Demonstration Project on Underground Storage of Colorado River Water in Central Arizona -** Under a cooperative program with the CAP, MWD has placed 89,000 af and the SNWA has placed 50,000 af of unused Colorado River water in underground storage (groundwater banking) in Central Arizona.

- **Agricultural-to-Urban Intrastate Water Transfers –** The San Diego County Water Authority (SDCWA) and IID have negotiated an agreement by which IID will transfer (sell) agricultural water conserved through various conservation and efficiency programs to SDCWA for urban use – where demand is growing. The agreement contemplates transfer of up to 200,000 afy. A number of bills have been introduced in the California Senate that attempt to address this and other similar intrastate water transfers, including SB 1011 (Costa), SB 1082 (Kelley), SB 1335 (Polanco) and AB 554 (Papan). To date, the Legislature has enacted only SB 1082 which would facilitate a transfer of water between the IID and the SDCWA.

3.4.3.4 STATE OF NEVADA

The portion of Nevada that depends on Colorado River water is limited to southern Nevada, primarily the Las Vegas Valley and the Laughlin area further south. The Colorado River Commission and SNWA manages Nevada's Colorado River water supply. The SNWA coordinates the distribution and use of the water by its member agencies whose systems provide retail distribution.

Nevada has five principal points of diversion for Colorado River water. The largest of these is the Las Vegas Valley that pumps water from Lake Mead at Saddle Island (on the west shore of the lake's Boulder Basin) through facilities of SNWA. The water is pumped at two adjacent pumping plants. The Lake Mead minimum water surface elevations for each intake are 1050 feet msl and 1000 feet msl, respectively. The pumped water is treated before being distributed to the Las Vegas Valley and to Boulder City water distribution systems. Three other diversion points are downstream of Davis Dam. They serve the community of Laughlin, Southern California Edison's coal fired Mojave Generating Station and uses on that portion of the Fort Mojave Indian Reservation lying in Nevada. The fifth diversion consists of water used by federal agencies in Nevada, primarily the National Park Service and its concessionaires at various points on lakes Mead and Mohave.

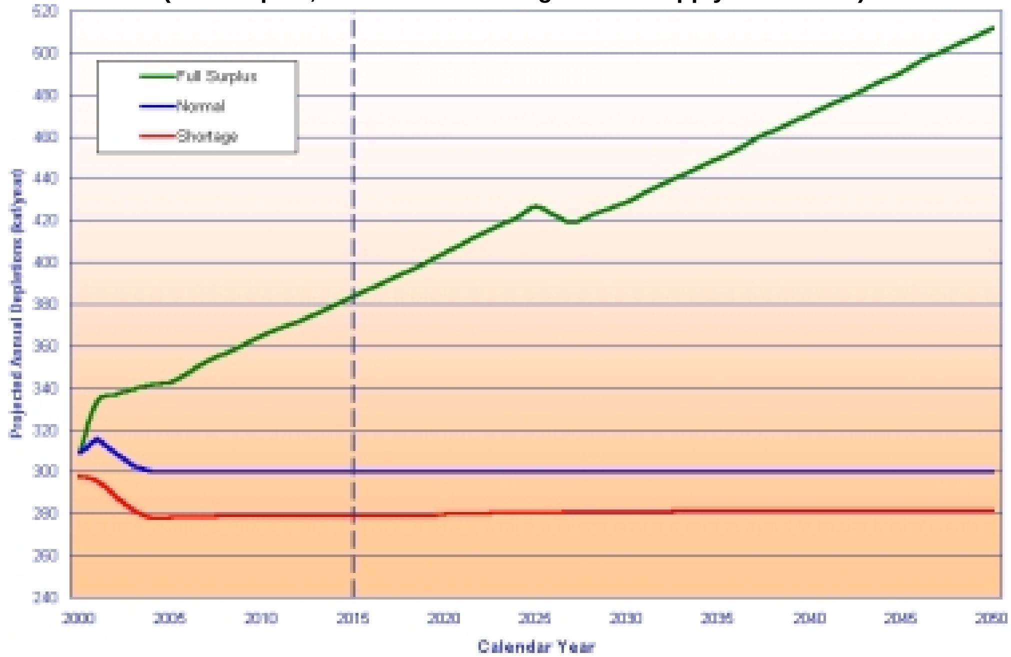
Nevada is on the threshold of reaching its Colorado River water apportionment. Consequently, Nevada's projections of depletions under normal years are 300,000 afy, of which the projected SNWA depletions are approximately 88 percent. Figure 3.4-3 presents a graphical illustration of the full surplus, normal and first level shortage demand schedules for Nevada that were used as input to the model.

Nevada's projections for surplus years rise steadily from a current value of approximately 300,000 af to approximately 512,000 af in 50 years, the end of the period of analysis for this DEIS. Projected depletions under shortage conditions are approximately 280,000 afy over the period of analysis, reflecting the fact that Nevada’s reduction in consumptive use of Colorado River water is 4 percent of Arizona’s reduction during shortage years.

The SNWA's Integrated Resource Plan calls for optimizing both the use of Colorado River water and the use of the Las Vegas Valley shallow aquifer before developing water from additional sources, including the lower Virgin River and Muddy River.

The SNWA has been supporting groundwater recharge in the Las Vegas Valley through facilities of member agencies. The artificial recharge of Colorado River water into the Las Vegas Valley groundwater basin is intended to help meet summer peak demands, provide an interim future water supply and stabilize declining groundwater tables. Water agencies in the valley will be able to withdraw water to meet temporary shortfalls in supply. However, such withdrawals would be coupled with the opportunity for replenishment of the aquifer.

Figure 3.4-3
Nevada Projected Colorado River Water Demand Schedules
(Full Surplus, Normal and Shortage Water Supply Conditions)



Nevada also proposes to bank water in Arizona through arrangements with the AWBA using available groundwater storage capacity as described above in the discussion of alternate supplies for Arizona.

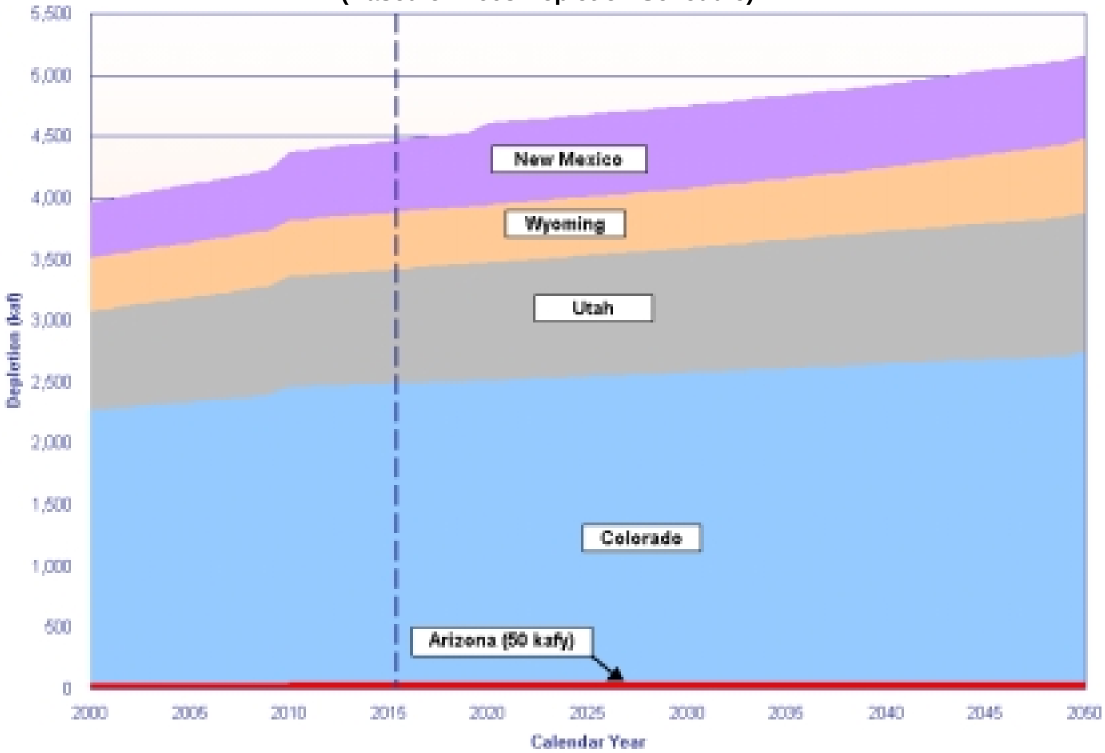
3.4.3.5 UPPER BASIN STATES

The depletions of the Upper Basin states were developed in 1996 and were provided by the Upper Colorado River Commission (Commission). Figure 3.3-4 shows that the depletions are approximately at 4.0 maf in 2000 and increase gradually to approximately 5.2 maf in 2050. These depletions are presented in tabular form in Attachment J. The Commission developed a new schedule in December 1999 that will be used in the FEIS.

3.4.3.6 MEXICO

As discussed earlier in Section 1.3.2.2.3, Mexico has treaty entitlement to Colorado River water. This entitlement is set forth in Article 10 of the 1944 Water Treaty with Mexico that states the following:

Figure 3.4-4
Upper Basin Depletion Projections
(Based on 1998 Depletion Schedule)



"Of the waters of the Colorado River, from any and all sources, there are allotted to Mexico:

(a) A guaranteed annual quantity of 1,500,000 af (1,850,234,000 cubic meters) to be delivered in accordance with the provisions of Article 15 of this Treaty.

(b) Any other quantities arriving at the Mexican points of diversion, with the understanding that in any year in which, as determined by the United States Section, there exists a surplus of waters of the Colorado River in excess of the amount necessary to supply uses in the United States and the guaranteed quantity of 1,500,000 af (1,850,234,000 cubic meters) annually to Mexico, the United States undertakes to deliver to Mexico, in the manner set out in Article 15 of this Treaty, additional waters of the Colorado River system to provide a total quantity not to exceed 1,700,000 af (2,096,931,000 cubic meters) a year. Mexico shall acquire no right beyond that provided by this subparagraph by the use of the waters of the Colorado River system, for any purpose whatsoever, in excess of 1,500,000 af (1,850,234,000 cubic meters) annually. In the event of extraordinary drought or serious accident to the irrigation system in the United States, thereby making it difficult for the United States to deliver the guaranteed quantity of 1,500,000 af (1,850,234,000 cubic meters) a year, the water allotted to Mexico under subparagraph (a) of this Article will be reduced in the same proportion as consumptive uses in the United States are reduced."

3.4.4 ENVIRONMENTAL CONSEQUENCES

The following discussion is based on the results of analysis of water supply data generated by the model. The data evaluated consisted principally of data relating to the amount of water available for consumptive use in the Lower Division states under baseline conditions and the surplus alternatives during the 50-year period of analysis. Because differences between alternatives are at times small in relation to the quantities and time periods, it was necessary to compare the data in precise terms. However, it should be noted that the analysis is based on assumptions of water supply and operation conditions, as described earlier in Section 3.3, and that the results described below represent approximations of probable future conditions that become increasingly uncertain over time.

The time period for the analysis is 2001 through 2050. The analysis is based on state depletion schedules for those years. Protection was provided for the water level of Lake Mead at elevation 1083 feet msl. As discussed earlier in Section 3.3, the elevation of 1083 feet msl is assumed to be the lower elevation at which the Hoover Powerplant can efficiently operate.

The results are portrayed graphically in two ways. As discussed earlier in Section 3.3, the modeling process involved making 85 separate runs (traces) which were then examined for the range of water supply available in a given year under baseline conditions and the alternatives. One way that these results can be portrayed graphically is to plot the 90th percentile values (meaning that 90 percent of the values produced by the model were less than shown), the 50th percentile values (the median value) and the 10th percentile values (that 10 percent of the values produced by the model were less than shown). Plots of the maximum and minimum depletion values produced by the model for any given year were added to this "90-50-10" array. The plots for the annual depletions for the Lower Division states and Mexico under baseline conditions are presented in this section. The plots that depict the annual depletions under each of the four surplus alternatives are included in Attachment M.

A second way that the results are portrayed is derived by first ranking all the values for the entire interim surplus criteria period (2001 through 2015) and the subsequent period (2016 through 2050). The depletion values can then be plotted versus the percent of values that are greater than or equal to. This type of plot provides a cumulative distribution of the respective state's depletion and allows for a generalized comparison of the water supply available under baseline conditions and the surplus alternatives, for each period of time.

An important modeling assumption needs to be restated to provide a better understanding of the model results for the alternatives. The interim surplus criteria used for the Six States, California and Shortage Protection alternatives become null and void after year 2015. At year 2016, the operating criteria for these surplus alternatives revert to a process that approximates the baseline conditions. The criteria used to model the baseline conditions and the Flood Control Alternatives is effective throughout the 50-year period of analysis.

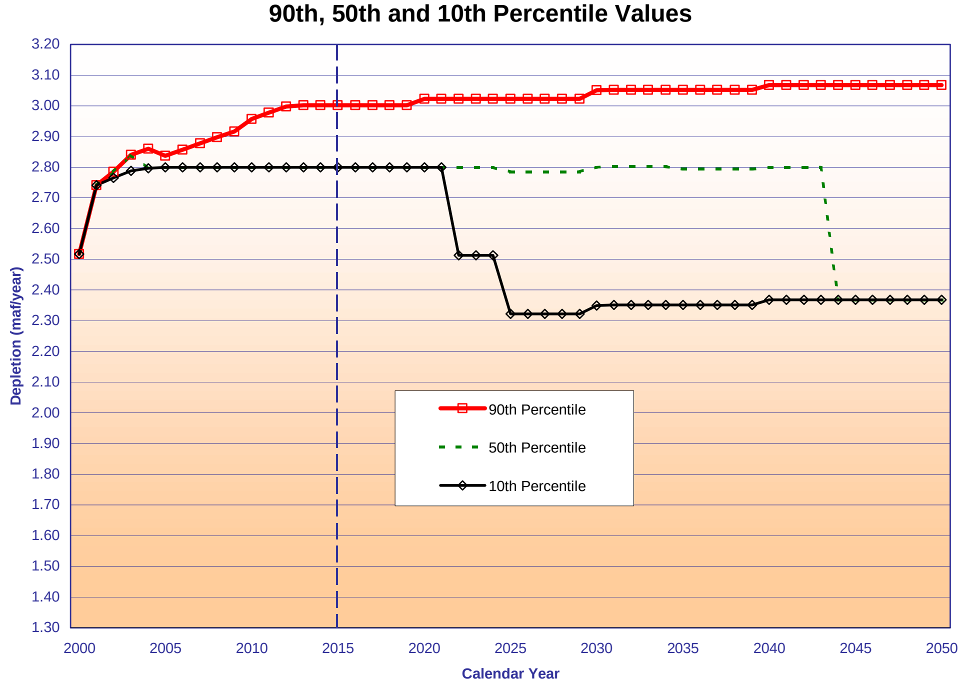
3.4.4.1 STATE OF ARIZONA

This section presents the simulated water deliveries to Arizona under the baseline conditions and surplus alternatives. The analysis of Arizona's water supply concentrated on total Arizona water depletions.

3.4.4.1.1 Baseline Conditions

The water deliveries to Arizona are projected to fluctuate throughout the 50 year period of analysis reflecting variations in hydrologic conditions. The 90th, 50th and 10th percentile ranking of modeled water deliveries to Arizona under the baseline conditions are presented in Figure 3.4-5.

Figure 3.4-5
Arizona Modeled Annual Depletions Under Baseline Conditions
90th, 50th and 10th Percentile Values



The 90th percentile line coincides with Arizona's depletion schedule during full surplus water supply conditions. As indicated by this 90th percentile line, the probability that the baseline conditions would provide Arizona's full surplus depletion schedule is at least 10 percent throughout the 50-year period of analysis.

The 50th percentile line represents the median annual depletion values. This 50th percentile line generally coincides with Arizona's projected depletion schedule under normal water supply conditions through year 2044 (see Figure 3.4-1). After 2044, the median values drop to approximately 2.37 maf and remain at that level for the remainder of the analysis period. As previously noted and as reflected by the graph, Arizona's demands are not anticipated to reach its 2.8 maf entitlement until 2004.

As noted in Section 3.4.3, the CAP takes essentially all the reductions in water deliveries during shortage conditions because they hold the lowest priority of the Arizona users. The model sets the CAP's shortage condition deliveries at 1.0 maf when the Lake Mead water level is between elevation 1000 feet msl and the assumed shortage protection line as discussed in Section 3.3.3.4. This modeling assumption kept Arizona' annual deliveries above 2.3 maf until further cuts to the CAP were necessary to maintain the Lake Mead water level above the 1000 feet msl elevation. Under the baseline conditions, deliveries to Arizona below 2.3 maf occurred less than 1 percent of the time.

Figure 3.4-6 provides a comparison of the cumulative distribution of Arizona's depletions under the surplus alternatives to those of the baseline conditions during the interim surplus criteria period (years 2001 to 2015). The results presented in Figure 3.4-6 indicate a 99 percent probability that Arizona's depletions would meet its normal depletion schedule during this period under the baseline conditions. The probability that Arizona would receive surplus condition deliveries during this period was approximately 32 percent. The maximum surplus condition depletions under the baseline conditions were 3.0 maf during this period. The probability that Arizona would receive shortage condition deliveries was less than 1 percent. The minimum shortage condition depletion was 2.3 maf.

Figure 3.4-7 provides a comparison of the cumulative distribution of the water deliveries to Arizona under the surplus alternatives to those of the baseline conditions for the 35-year period (years 2016 to 2050) that would follow the interim surplus criteria period. The results presented in Figure 3.4-7 indicate a 70 percent probability that water deliveries to Arizona would meet its normal depletion schedule during this period under the baseline conditions. The probability that Arizona would receive surplus condition deliveries during this same period under the baseline conditions was approximately 26 percent. The maximum surplus condition depletions under the baseline conditions were 3.07 maf during this period. The

Figure 3.4-6
Arizona Modeled Depletions
Comparison of Surplus Alternatives to Baseline Conditions
Years 2001 to 2015

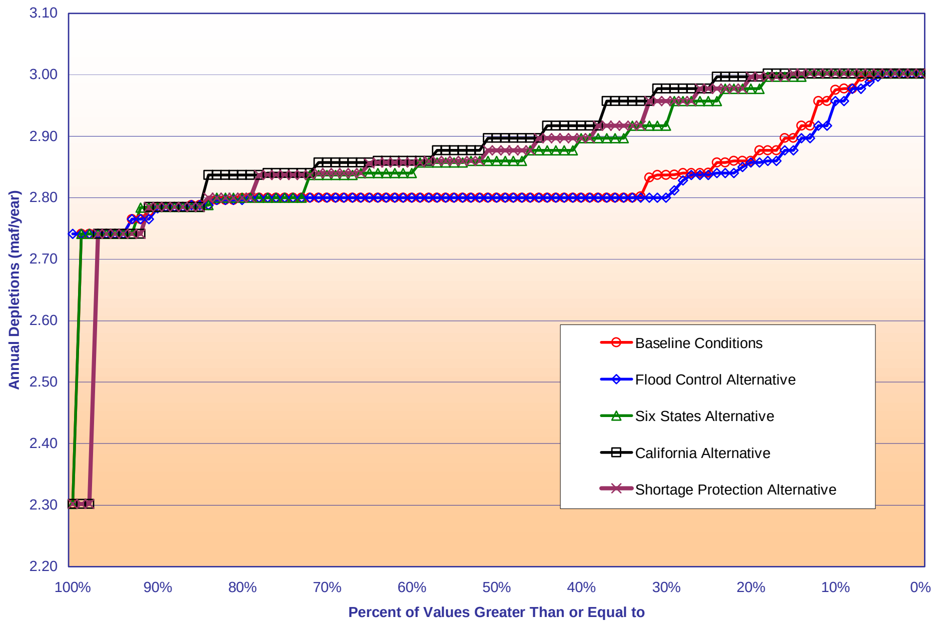
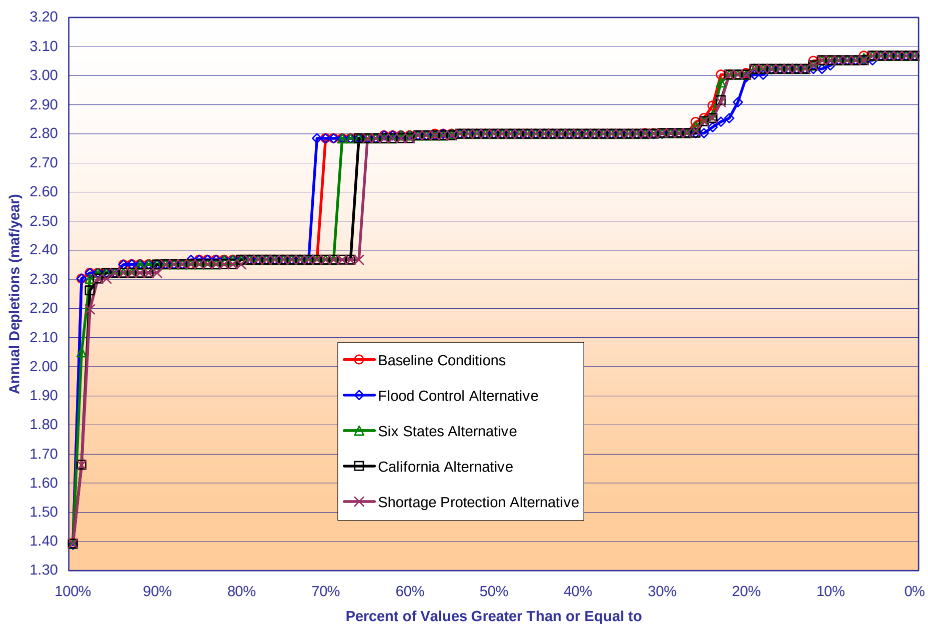


Figure 3.4-7
Arizona Modeled Depletions
Comparison of Surplus Alternatives to Baseline Conditions
Years 2016 to 2050



probability that Arizona would receive shortage conditions deliveries was approximately 30 percent. The minimum shortage condition depletion was 1.39 maf, representing second level shortage conditions that occurred less than one percent of the time.

3.4.4.1.2 Comparison of Surplus Alternatives to Baseline Conditions

Figure 3.3-8 provides a comparison of the 90th, 50th and 10th percentile values for Arizona's depletions under the baseline conditions to those of the surplus alternatives.

As noted in Figure 3.4-8, there is no difference in the 90th percentile lines resulting from the surplus alternatives to those of the baseline conditions. The 90th percentile lines coincide with Arizona's surplus depletion schedule.

The 50th percentile lines for the Flood Control Alternative and the baseline conditions are essentially the same during the interim surplus criteria period and coincide with Arizona's normal depletion schedule. The 50th percentile lines for the Six States, California and Shortage Protection Alternatives are identical to each other during the interim surplus criteria period and coincide with Arizona's surplus depletion schedule. After 2015, the 50th percentile lines for the baseline conditions and all surplus alternatives are the same.

During the interim surplus criteria period, the 10th percentile lines for the baseline conditions and the surplus alternatives are essentially at or above Arizona's normal depletion schedule. The 10th percentile lines for the baseline conditions and the surplus alternatives converge after 2025.

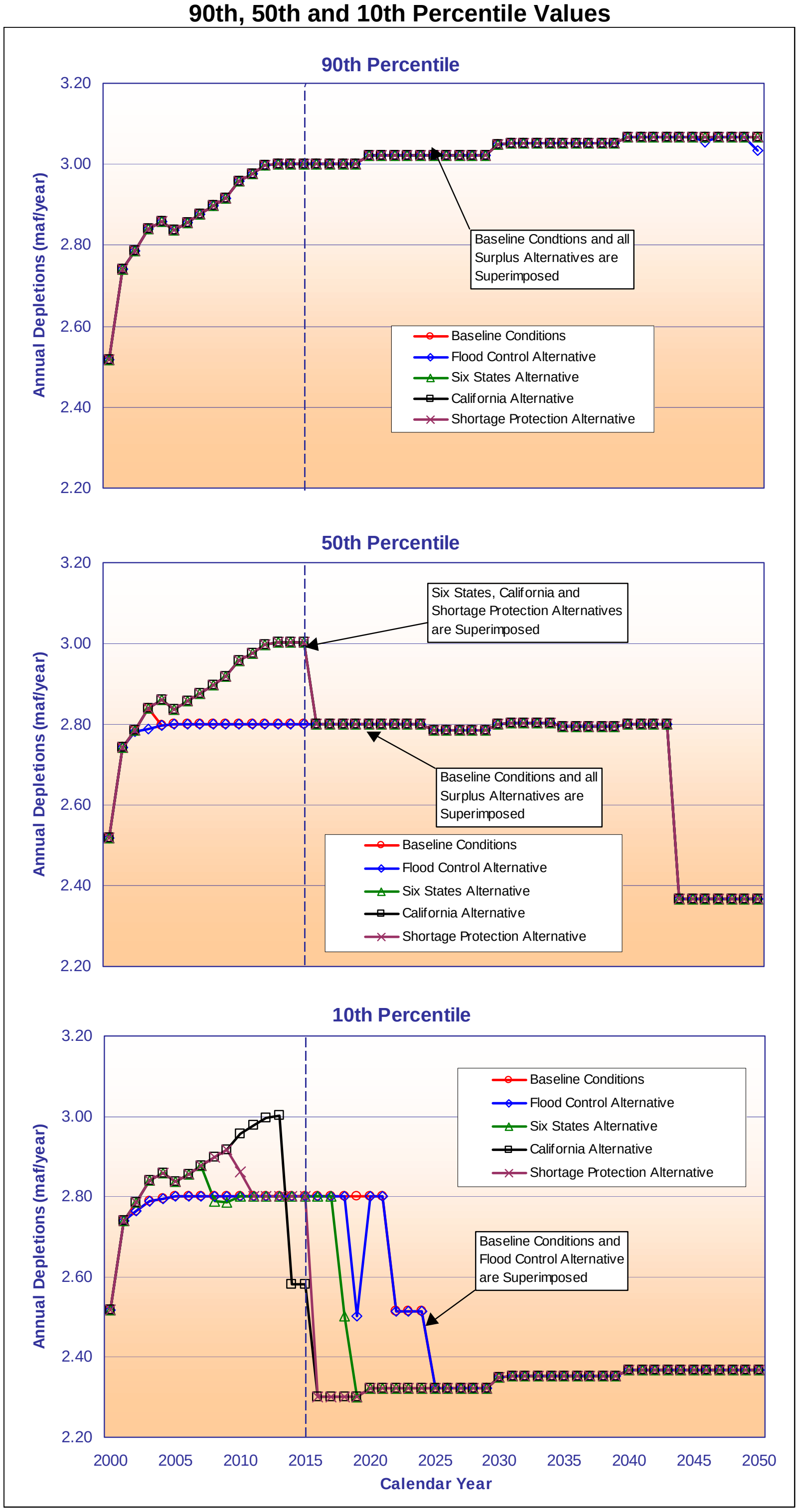
Figures 3.4-6 and 3.4-7 presented comparisons of the cumulative distribution of Arizona's depletions under the surplus alternatives to those of the baseline conditions during the interim surplus criteria period (years 2001 to 2015) and the 35-year period that follows the interim surplus criteria (years 2016 to 2050), respectively.
Table 3.4-1 provides a summary of the comparison for these two periods.

Table 3.4-1
Summary of Arizona Modeled Annual Depletions
Comparison of Surplus Alternatives to Baseline Conditions

Alternative/Conditions	Years 2001 to 2015			Years 2016 to 2050		
	Normal*	Surplus	Shortage	Normal*	Surplus	Shortage
Baseline Conditions	> 99%	32%	< 1%	70%	26%	30%
Flood Control Alternative	100%	29%	0%	71%	24%	29%
Six States Alternative	> 99%	72%	< 1%	68%	26%	32%
California Alternative	> 97%	84%	< 3%	66%	25%	34%
Shortage Protection Alternative	> 97%	78%	< 3%	65%	26%	35%

*The values under normal represent the total percentage of time that depletions would be at or above the normal depletion conditions.

Figure 3.4-8
Arizona Modeled Annual Depletions
Comparison of Surplus Alternatives to Baseline Conditions
90th, 50th and 10th Percentile Values



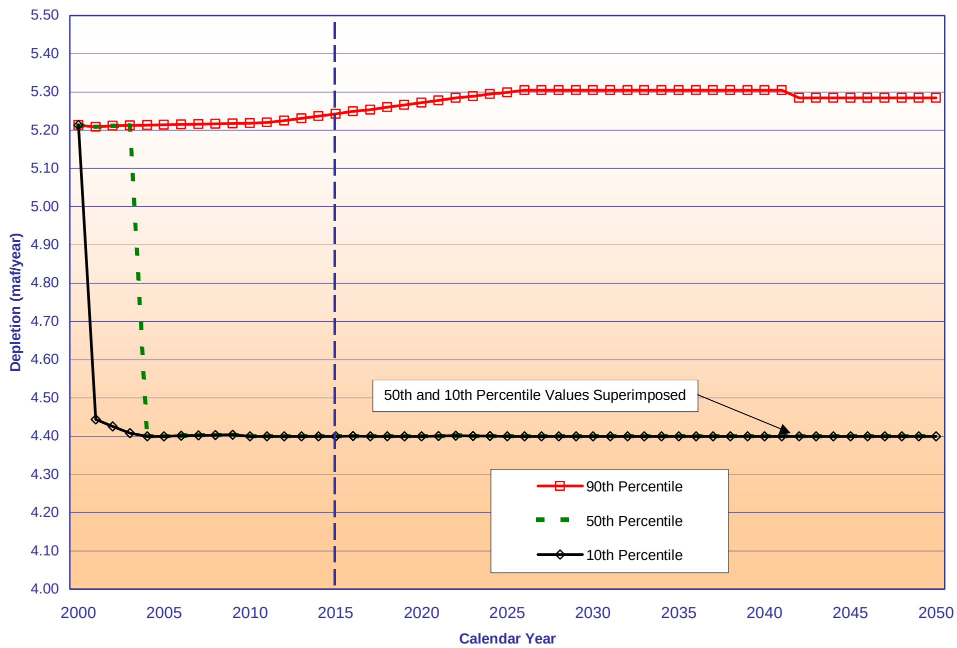
3.4.4.2 STATE OF CALIFORNIA

This section presents the simulated water deliveries to California under the baseline conditions and surplus alternatives. The analysis of California's water supply concentrated on total California water depletions. The underlying assumptions for California's depletions under the baseline conditions include: 1) California's normal annual depletion is 4.4 maf; 2) there are no water transfers; and 3) surplus deliveries are made during flood control operations and under 75R criteria. A significant difference between the surplus alternatives and the baseline conditions is that the surplus alternatives (except for the Flood Control Alternative) consider water transfers and exchanges between MWD and the agricultural agencies.

3.4.4.2.1 Baseline Conditions

The water deliveries to California are projected to fluctuate throughout the 50-year period of analysis reflecting variations in hydrologic conditions. The 90th, 50th and 10th percentile rankings of modeled water deliveries to California under the baseline conditions are presented in Figure 3.4-9.

Figure 3.4-9
California Modeled Annual Depletions Under Baseline Conditions
90^{th}, 50^{th} and 10^{th} Percentile Values



The 90^{th} percentile line coincides with California's depletion schedule during full surplus water supply conditions. As indicated by this 90^{th} percentile line, the probability that the baseline conditions would provide California's full surplus depletion amount is at least 10 percent throughout the 50-year period of analysis.

From 2001 through 2004, under baseline conditions, the 50th percentile line for California is at its full surplus schedule. After 2004, the 50th percentile line generally coincides with California's normal depletion schedule.

Annual water deliveries to California never fall below its 4.4 maf entitlement. Therefore, no shortage condition deliveries to California were observed.

Figure 3.4-10 provides a comparison of the cumulative distribution of California's depletions under the surplus alternatives to those of the baseline conditions during the interim surplus criteria period (years 2001 to 2015). The results presented in Figure 3.4-10 indicate a 100 percent probability that California's depletions would meet its normal depletion schedule during this period under the baseline conditions. The probability that California would receive surplus condition deliveries during this period was approximately 49 percent. The maximum surplus condition depletions under the baseline conditions were 5.24 maf during this period. It should be noted that the small number of occurrences falling below 4.4 maf for the Six States and Shortage Protection alternatives are the result of depletion schedules that were used as model input and that total slightly less than 4.4 maf (See Attachment G). These schedules will be adjusted for the FEIS.

Figure 3.4-10
California Modeled Depletions
Comparison of Surplus Alternatives to Baseline Conditions
Years 2001 to 2015

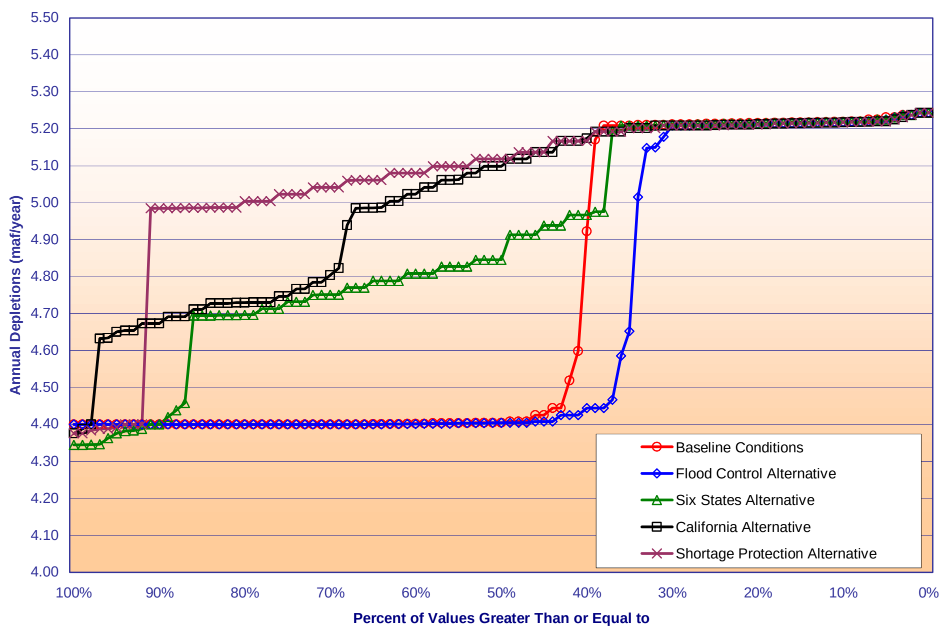
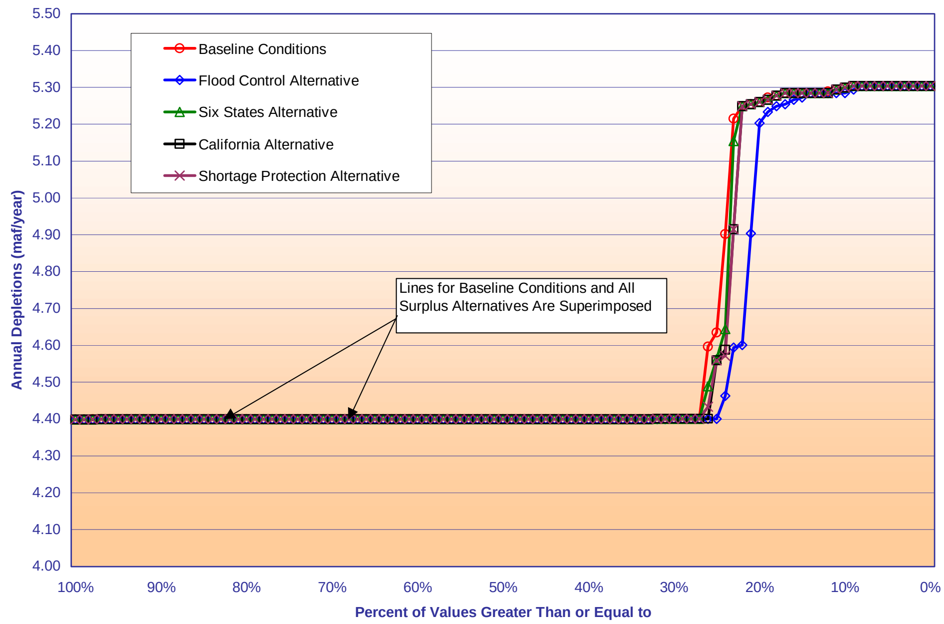


Figure 3.4-11 provides a comparison of the cumulative distribution of the water deliveries to California under the surplus alternatives to those of the baseline

conditions for the 35-year period (years 2016 to 2050) that follows the interim surplus criteria period. The results presented in Figure 3.4-11 indicate a 100 percent probability that water deliveries to California would meet its normal depletion schedule during this period under the baseline conditions. The probability that California would receive surplus condition deliveries during this same period under the baseline conditions was approximately 26 percent. The maximum surplus condition depletions under the baseline conditions were 5.3 maf during this period. During this period, California did not receive shortage condition deliveries.

Figure 3.4-11
California Modeled Depletions
Comparison of Surplus Alternatives to Baseline Conditions
Years 2016 to 2050

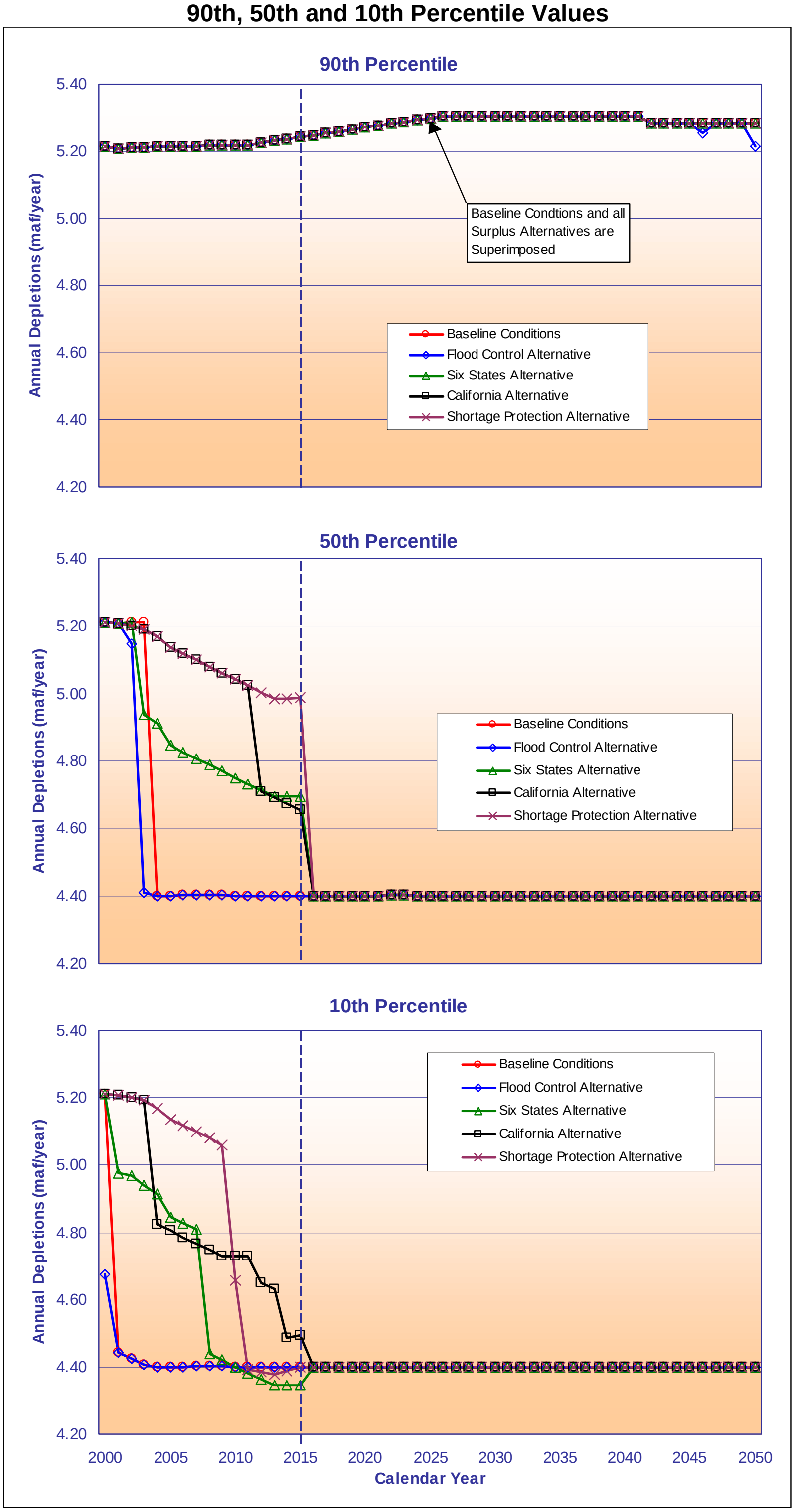


3.4.4.2.2 Comparison of Surplus Alternatives to Baseline Conditions

Figure 3.4-12 provides a comparison of the 90th, 50th and 10th percentile values for California's depletions under the surplus alternatives to those of the baseline conditions.

As noted in Figure 3.4-12, there is no difference in the 90th percentile lines resulting from the surplus alternatives to those of the baseline conditions. The 90th percentile lines coincide with California's surplus depletion schedule.

Figure 3.4-12
California Modeled Annual Depletions
Comparison of Surplus Alternatives to Baseline Conditions
90th, 50th and 10th Percentile Values



The 50th percentile lines for the Flood Control Alternative and the baseline conditions are above California's normal depletion schedule between 2001 through 2003 and 2001 through 2004, respectively. Beyond these years, the 50th percentile lines for the Flood Control Alternative and the baseline conditions coincide with California's normal depletion schedule. The 50th percentile lines for the Six States, California and Shortage Protection alternatives are above California's normal depletion schedule throughout the interim surplus criteria period (2001 through 2015). Beyond 2015, the 50th percentile lines for the Six States, California and Shortage Protection alternatives coincide with California's normal depletion schedule.

During the interim surplus criteria period, the 10th percentile lines for the baseline conditions and the surplus alternatives are essentially at or above California's normal depletion schedule. The 10th percentile lines for the baseline conditions and the surplus alternatives converge after 2015. It should be noted that the small number of occurrences falling below 4.4 maf for the Six States and Shortage Protection alternatives are the result of depletion schedules that were used as model input and that total slightly less than 4.4 maf (See Attachment G). These schedules will be adjusted for the FEIS.

Figures 3.4-10 and 3.4-11 presented comparisons of the cumulative distribution of California's depletions under the surplus alternatives to those of the baseline conditions during the interim surplus criteria period (years 2001 to 2015) and the 35-year period that would follow the interim surplus criteria (years 2016 to 2050), respectively. Table 3.4-2 provides a summary of the comparison for these two periods.

Table 3.4-2
Summary of California Modeled Annual Depletions
Comparison of Surplus Alternatives to Baseline Conditions

Alternative/Conditions	Years 2001 to 2015			Years 2016 to 2050		
	Normal*	Surplus	Shortage	Normal*	Surplus	Shortage
Baseline Conditions	100%	49%	0%	100%	26%	0%
Flood Control Alternative	100%	46%	0%	100%	23%	0%
Six States Alternative	100%	89%	0%	100%	26%	0%
California Alternative	100%	97%	0%	100%	25%	0%
Shortage Protection Alternative	100%	91%	0%	100%	25%	0%

*The values under normal represent the total percentage of time that depletions would be at or above the normal depletion conditions.

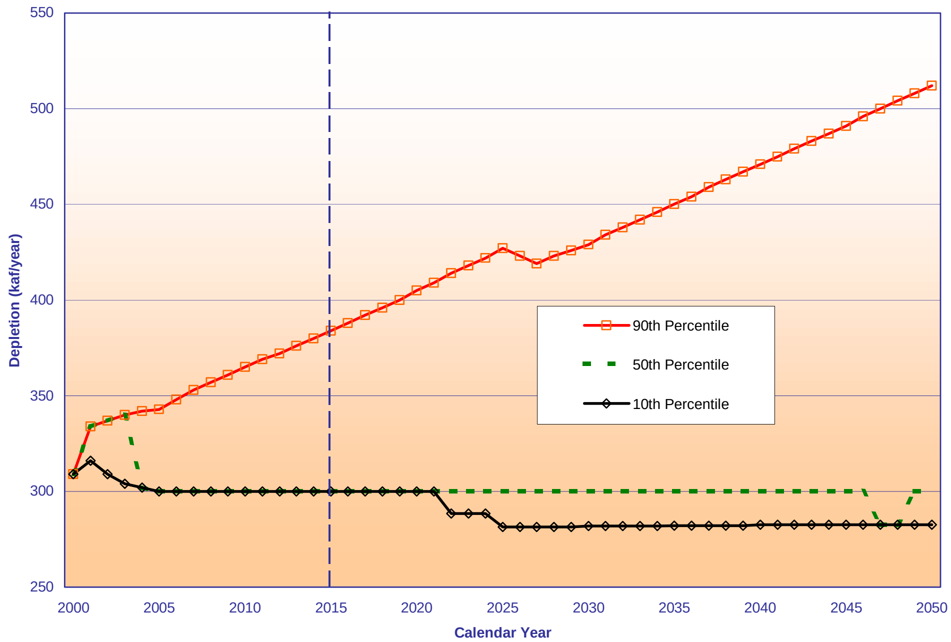
3.4.4.3 STATE OF NEVADA

This section presents the simulated water deliveries to Nevada under the baseline conditions and surplus alternatives. The analysis of Nevada's water supply concentrated on total Nevada water depletions.

3.4.4.3.1 Baseline Conditions

The water deliveries to Nevada are projected to fluctuate throughout the 50-year period of analysis reflecting variations in hydrologic conditions. The 90th, 50th and 10th percentile ranking of modeled water deliveries to Nevada under the baseline conditions is presented in Figure 3.4-13.

Figure 3.4-13
Nevada Modeled Annual Depletions Under Baseline Conditions
90th, 50th and 10th Percentile Values



The 90th percentile line coincides with Nevada's depletion schedule during full surplus water supply conditions. As indicated by this 90th percentile line, the probability that the baseline conditions would provide Nevada's full surplus depletion amount is at least 10 percent throughout the 50-year period of analysis.

The 50th percentile line generally coincides with Nevada's normal depletion schedule under baseline conditions.

As noted in Section 3.4.3, the SNWA and CAP essentially take all the reductions in water deliveries during shortage conditions. The model sets the SNWA's shortage condition delivery reductions to four percent of the CAP shortage condition delivery reduction when the Lake Mead water level is between elevation 1000 feet msl and the assumed shortage protection line as discussed in Section 3.3.3.4. This modeling assumption kept Nevada' annual delivery above 280 kaf until further cuts to the SNWA and CAP were necessary to maintain the Lake Mead water level above the

1000 feet msl elevation. Under the baseline conditions, deliveries to Nevada below 300 kaf occurred less than one percent of the time.

Under the baseline conditions, the 10th percentile line remains at or above Nevada's normal depletion schedule until 2021. Beyond 2021, the 10th percentile line drops to 280 kaf, Nevada's shortage condition depletion schedule.

Figure 3.4-14 provides a comparison of the cumulative distribution of Nevada's depletions under the surplus alternatives to those of the baseline conditions during the interim surplus criteria period (years 2001 to 2015). The results presented in Figure 3.4-14 indicate a 99 percent probability that water deliveries to Nevada would meet its normal depletion schedule during this period under the baseline conditions. The probability that Nevada would receive surplus condition deliveries during this period was approximately 42 percent. The maximum surplus condition depletions under the baseline conditions were 384 kaf during this period. The probability that Nevada would receive shortage condition deliveries under baseline conditions was less than one percent. The minimum shortage condition depletion was 280 kaf.

Figure 3.4-14
Nevada Modeled Depletions
Comparison of Surplus Alternatives to Baseline Conditions
Years 2001 to 2015

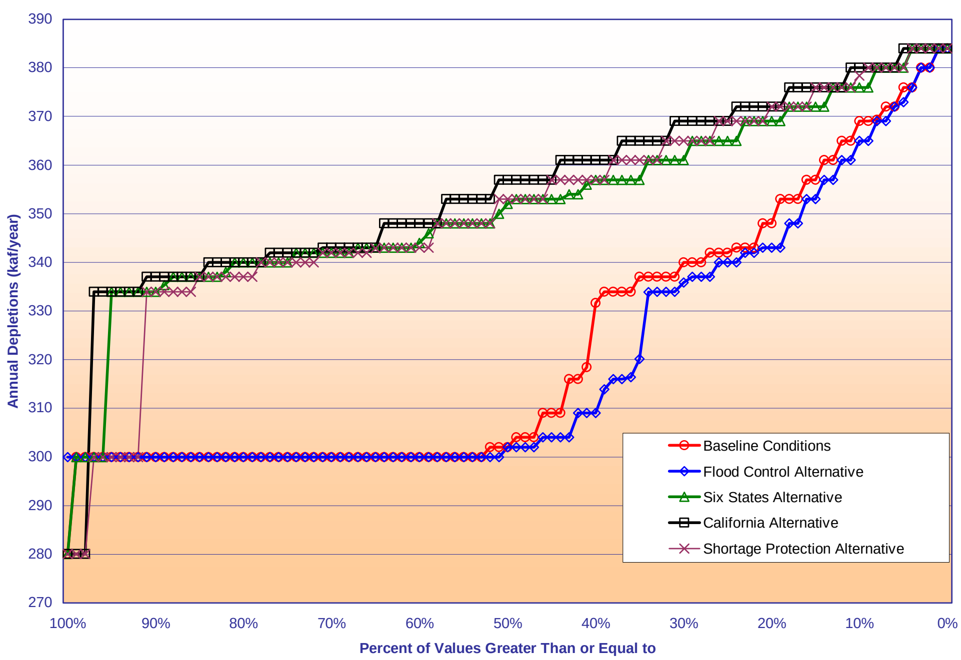
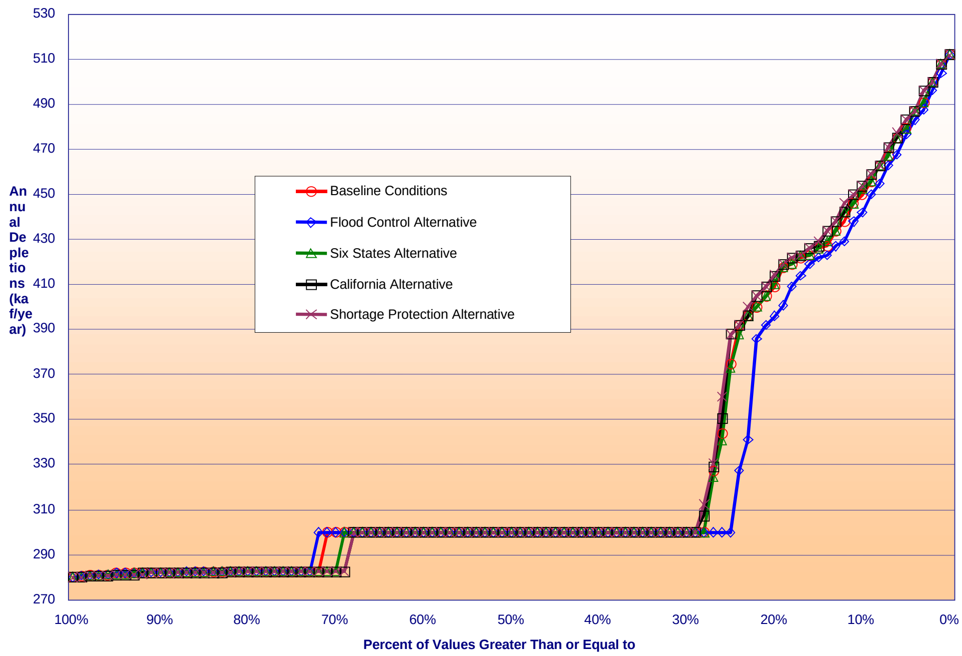


Figure 3.4-15 provides a comparison of the cumulative distribution of the water deliveries to Nevada under the surplus alternatives to those of the baseline conditions for the 35-year period (years 2016 to 2050) that would follow the interim surplus criteria period. The results presented in Figure 3.4-15 indicate a 71 percent

probability that water deliveries to Nevada would meet its normal depletion schedule during this period under the baseline conditions. The probability that Nevada would receive surplus condition deliveries during this same period under the baseline conditions was approximately 27 percent. The maximum surplus condition depletions under the baseline conditions were 512 kaf during this period. The probability that Nevada would receive shortage condition deliveries was approximately 29 percent. The minimum shortage condition depletion during this period was 280 kaf.

Figure 3.4-15
Nevada Modeled Depletions
Comparison of Surplus Alternatives to Baseline Conditions
Years 2016 to 2050



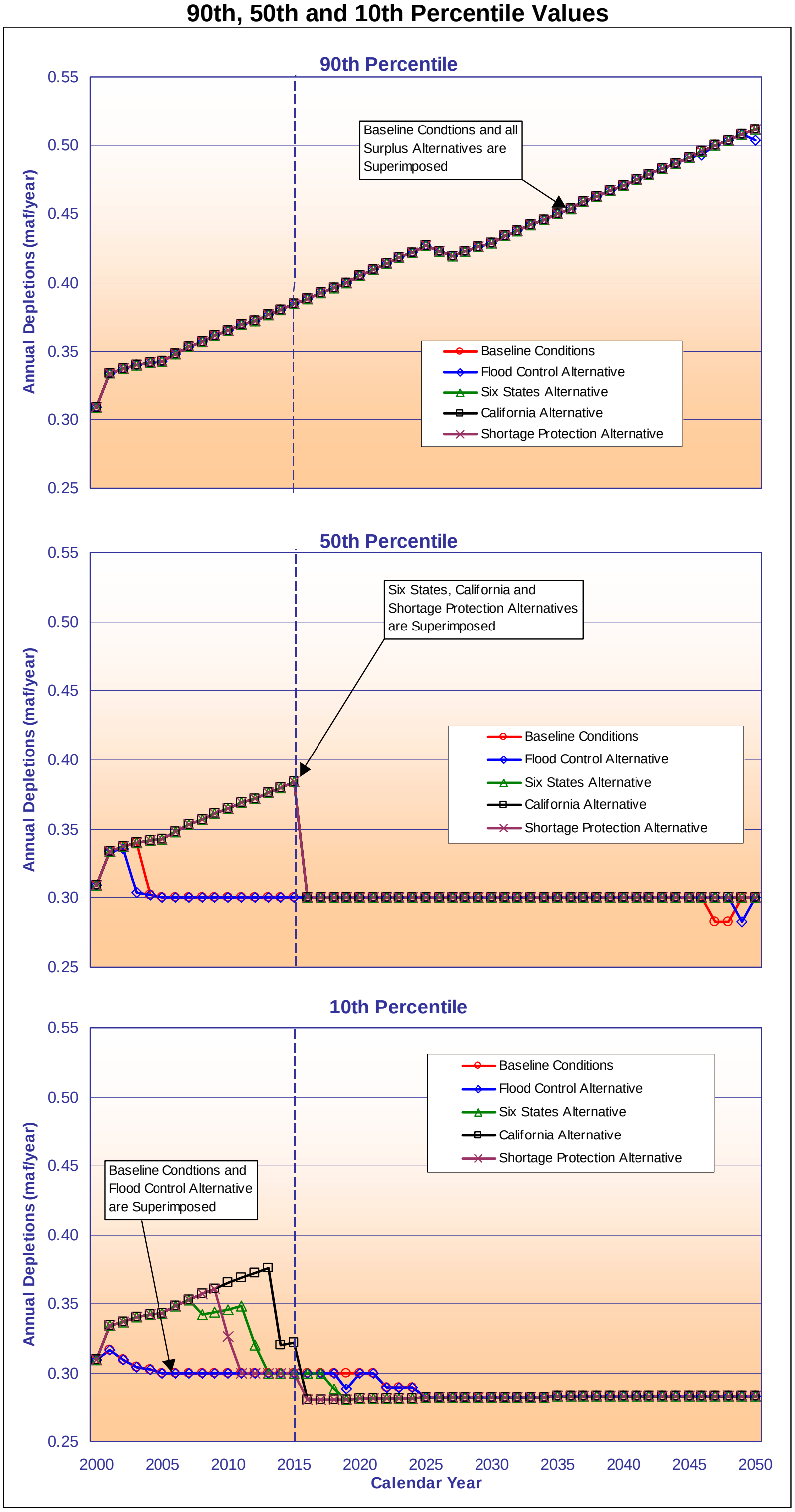
3.4.4.3.2 Comparison of Surplus Alternatives to Baseline Conditions

Figure 3.3-16 provides a comparison of the 90th, 50th and 10th percentile values for Nevada's depletions under the baseline conditions to those of the surplus alternatives.

As noted in Figure 3.4-16, there is no difference in the 90th percentile lines resulting from the surplus alternatives to those of the baseline conditions. The 90th percentile lines coincide with Nevada's surplus depletion schedule.

The 50th percentile lines for the Flood Control Alternative and the baseline conditions are essentially the same during the interim surplus criteria period and coincide with Nevada's normal depletion schedule. The 50th percentile lines for the Six States, California and Shortage Protection alternatives are identical to each other during the interim surplus criteria period and coincide with Nevada's surplus depletion schedule. After 2015, the 50th percentile lines for the baseline conditions and all surplus alternatives are the same. As previously noted and as reflected in the graph, Nevada's depletions during the first three years are more than their 300 kaf normal depletion amount as a result of their use of part of Arizona's unused apportionment.

Figure 3.4-16
Nevada Modeled Annual Depletions
Comparison of Surplus Alternatives to Baseline Conditions
90th, 50th and 10th Percentile Values



During the interim surplus criteria period, the 10th percentile line for the baseline conditions and the surplus alternatives are essentially at or above Nevada's normal depletion schedule. The 10th percentile lines for the baseline conditions and the surplus alternatives converge after 2025.

Figures 3.4-14 and 3.4-15 presented comparisons of the cumulative distribution of Nevada's depletions under the surplus alternatives to those of the baseline conditions during the interim surplus criteria period (years 2001 to 2015) and the 35-year period that would follow the interim surplus criteria (years 2016 to 2050), respectively. Table 3.4-3 provides a summary of the comparison for these two periods.

Table 3.4-3
Summary of Nevada Modeled Annual Depletions
Comparison of Surplus Alternatives to Baseline Conditions

Alternative/Conditions	Years 2001 to 2015			Years 2016 to 2050		
	Normal	Surplus	Shortage	Normal	Surplus	Shortage
Baseline Conditions	> 99%	42%	< 1%	71%	27%	29%
Flood Control Alternative	100%	91%	0%	72%	24%	28%
Six States Alternative	> 99%	95%	< 1%	69%	27%	31%
California Alternative	> 97%	97%	< 3%	68%	27%	32%
Shortage Protection Alternative	> 97%	91%	< 3%	68%	27%	32%

*The values under normal represent the total percentage of time that depletions would be at or above the normal depletion conditions.

3.4.4.4 UPPER BASIN STATES

There are no policy requirements within the *Law of the River* for surplus or shortage condition water deliveries to users within the Upper Basin states. The normal depletion schedule of the Upper Basin states would be met under most water supply conditions. The exceptions are potential reductions to certain Upper Basin users whose diversions are located upstream of Lake Powell. For these users, the potential reductions would be attributed to dry hydrologic conditions and inadequate regulating reservoir storage capacity upstream of their diversions.

The proposed interim surplus criteria were determined to have no effect on water deliveries to the Upper Basin States. Therefore, detailed analyses were not necessary for the Upper Basin States' water supply.

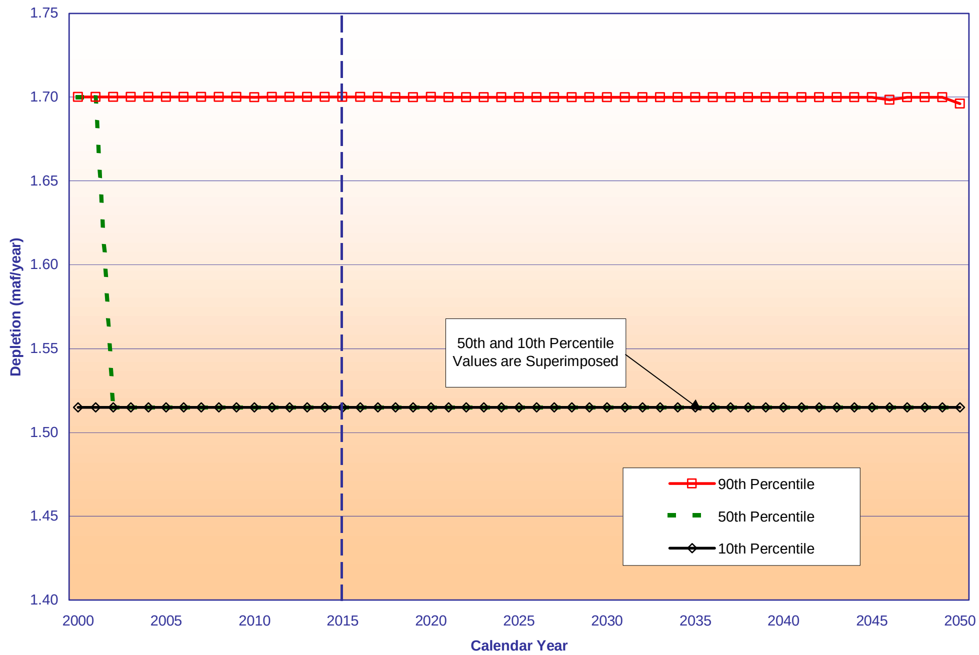
3.4.4.5 MEXICO

This section presents the simulated water deliveries to Mexico under the baseline conditions and surplus alternatives. As discussed previously, Mexico's normal depletion schedule is modeled as 1.515 maf. An additional 15,000 af is included to account for typical scheduling errors and water that is ordered by the Lower Basin users but that is not diverted. Surplus deliveries to Mexico of up to 200 kaf are delivered under baseline conditions and the surplus alternatives only when Lake Mead makes flood control releases. Shortage deliveries to Mexico would only occur if the CAP were cut to zero and further cuts to MWD and Mexico were necessary to keep the Lake Mead water elevation above 1000 feet msl. This condition was not observed under the baseline conditions or the surplus alternatives.

3.4.4.5.1 Baseline Conditions

The water deliveries to Mexico are projected to be at or above Mexico's normal delivery schedule throughout the 50-year period of analysis. The 90th, 50th and 10th percentile ranking of modeled water deliveries to Mexico under the baseline conditions are presented in Figure 3.4-17.

Figure 3.4-17
Mexico Modeled Annual Depletions Under Baseline Conditions
90th, 50th and 10th Percentile Values



The 90th percentile line coincides with Mexico's depletion schedule during surplus water supply conditions. As indicated by this 90th percentile line, the probability that the baseline conditions would provide Mexico's surplus depletion amount is at least 10 percent throughout the 50-year period of analysis.

Under baseline conditions, the 50th percentile line coincides with Mexico's surplus schedule during the first year only (2001). Thereafter, the 50th percentile line generally coincides with Mexico's normal depletion schedule. The modeled water deliveries to Mexico never dropped below Mexico's normal depletion schedule.

Figure 3.4-18 provides a comparison of the cumulative distribution of Mexico's depletions under the surplus alternatives to those of the baseline conditions during the interim surplus criteria period (years 2001 to 2015). The results presented in Figure 3.4-18 indicate a 100 percent probability that Mexico's depletions would meet its normal depletion schedule during this period under the baseline conditions. The probability that Mexico would receive surplus condition deliveries during this period was approximately 34 percent under baseline conditions. The maximum surplus condition depletion under the baseline conditions was 1.7 maf during this period.

Figure 3.4-18
Mexico Modeled Depletions
Comparison of Surplus Alternatives to Baseline Conditions
Years 2001 to 2015

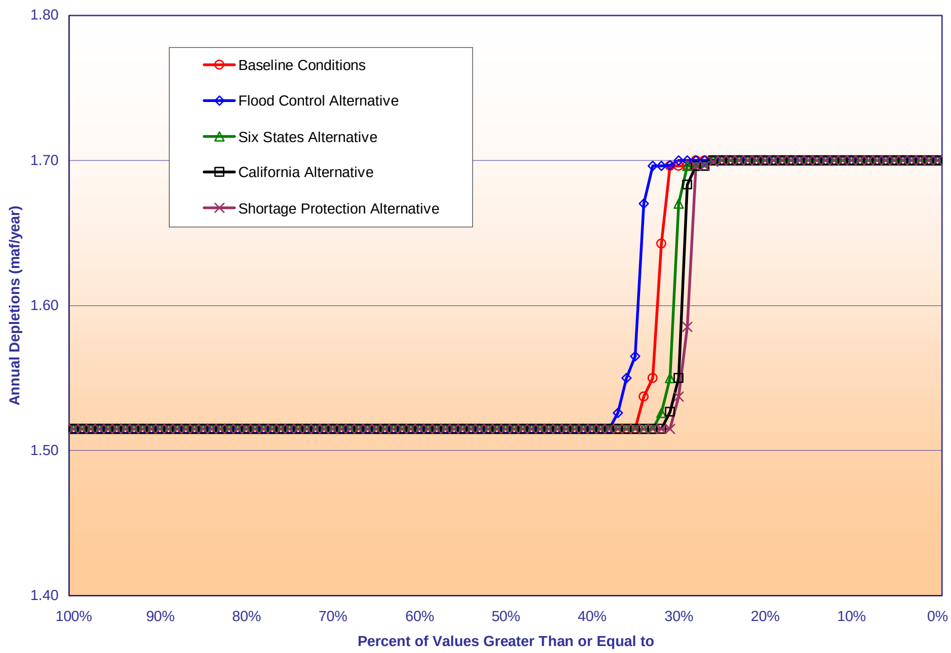
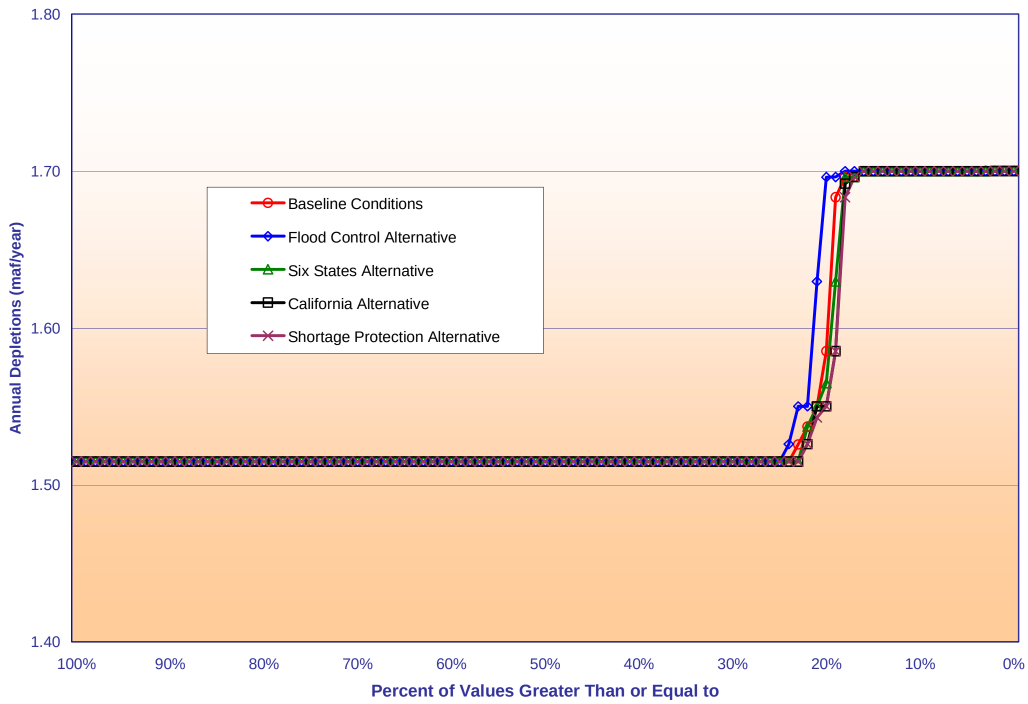


Figure 3.4-19 provides a comparison of the cumulative distribution of the water deliveries to Mexico under the surplus alternatives to those of the baseline conditions for the 35-year period (years 2016 to 2050) that would follow the interim surplus criteria period. The results presented in Figure 3.4-19 indicate a 100 percent probability that water deliveries to Mexico would meet its normal depletion schedule during this period under the baseline conditions. The probability that Mexico would receive surplus condition deliveries during this same period under the baseline conditions was approximately 23 percent. The maximum surplus condition depletion under the baseline conditions was 1.7 maf during this period.

Figure 3.4-19
Mexico Modeled Depletions
Comparison of Surplus Alternatives to Baseline Conditions
Years 2016 to 2050



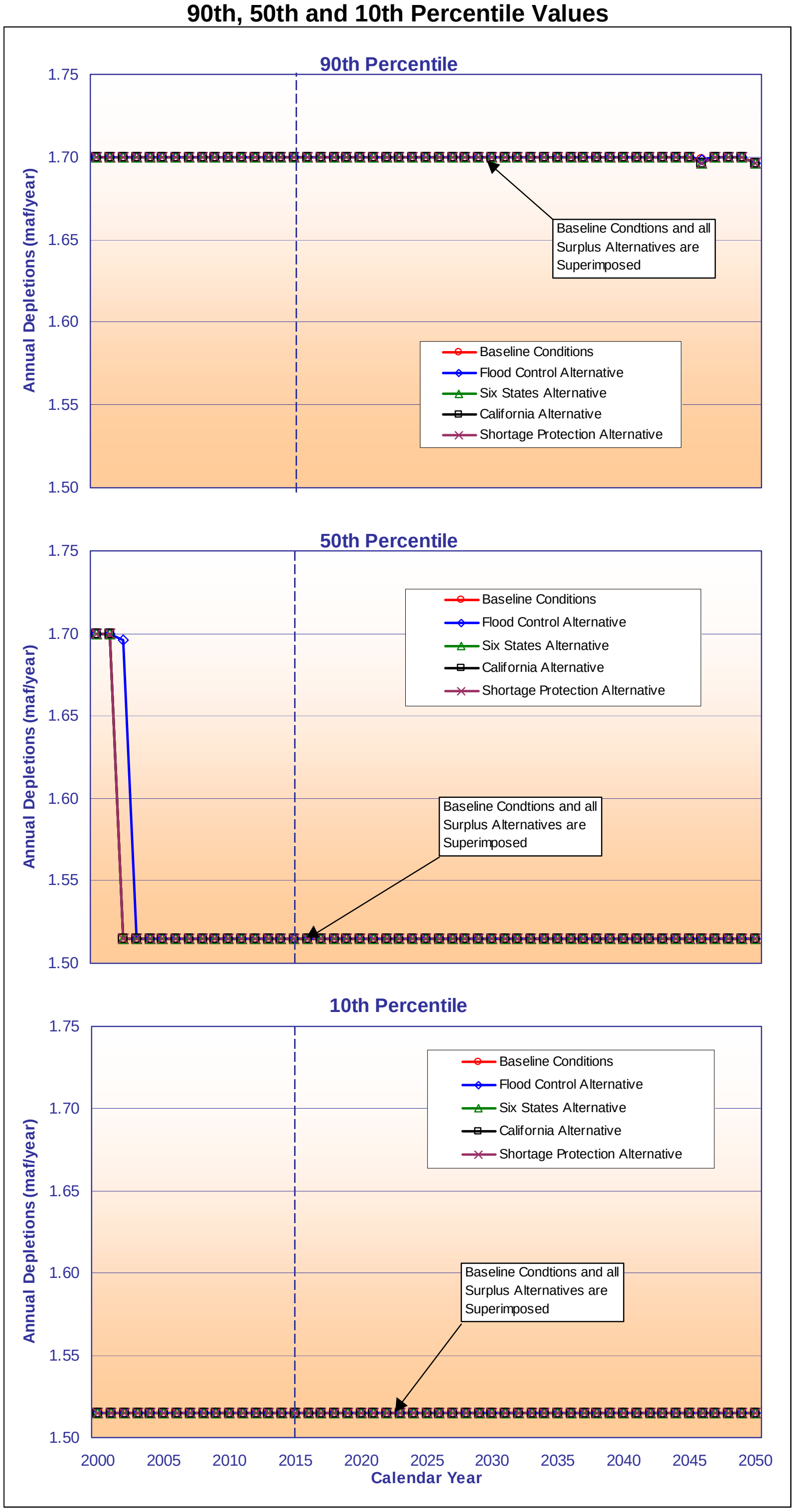
3.4.4.5.2 Comparison of Surplus Alternatives to Baseline Conditions

Figure 3.3-20 provides a comparison of the 90th, 50th and 10th percentile values for Mexico's depletions under the surplus alternatives to those of the baseline conditions.

As noted in Figure 3.4-20, there is no difference in the 90th percentile lines resulting from the surplus alternatives to those of the baseline conditions. The 90th percentile lines coincide with Mexico's surplus depletion schedule.

The 50th percentile line for the Flood Control Alternative is above Mexico's normal depletion schedule between 2000 through 2003, essentially one more year than the baseline conditions and the other surplus alternatives. Beyond 2003, the 50th percentile lines for all the surplus alternative and the baseline conditions coincide with Mexico's normal depletion schedule. Again, water deliveries to Mexico were not observed to fall below Mexico's 1.5 maf apportionment.

Figure 3.4-20
Mexico Modeled Annual Depletions
Comparison of Surplus Alternatives to Baseline Conditions
90th, 50th and 10th Percentile Values



Figures 3.4-18 and 3.4-19 presented comparisons of the cumulative distribution of Mexico's depletions under the surplus alternatives to those of the baseline conditions during the interim surplus criteria period for years 2001 to 2015 and the 35-year period that follows the interim surplus criteria (years 2016 to 2050), respectively. Table 3.4-4 provides a summary of the comparison for these two periods.

Table 3.4-4
Summary of Mexico Modeled Annual Depletions
Comparison of Surplus Alternatives to Baseline Conditions

Alternative/Conditions	Years 2001 to 2015			Years 2016 to 2050		
	Normal*	Surplus	Shortage	Normal*	Surplus	Shortage
Baseline Conditions	100%	34%	0%	100%	23%	0%
Flood Control Alternative	100%	37%	0%	100%	24%	0%
Six States Alternative	100%	32%	0%	100%	22%	0%
California Alternative	100%	31%	0%	100%	22%	0%
Shortage Protection Alternative	100%	30%	0%	100%	22%	0%

*The values under normal represent the total percentage of time that depletions would be at or above the normal depletion conditions.