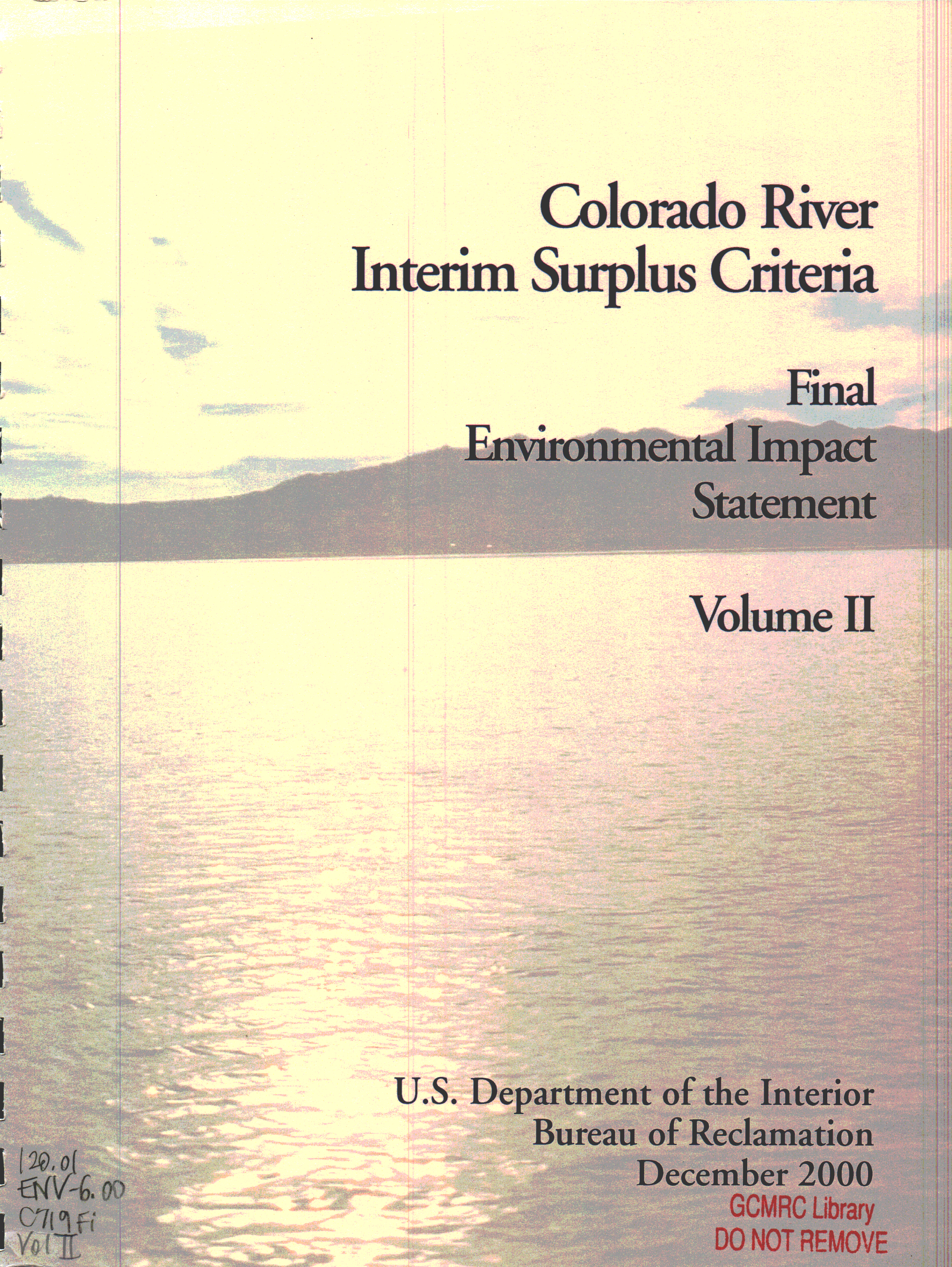

Colorado River Interim Surplus Criteria

Final Environmental Impact Statement

Volume II

U.S. Department of the Interior
Bureau of Reclamation
December 2000

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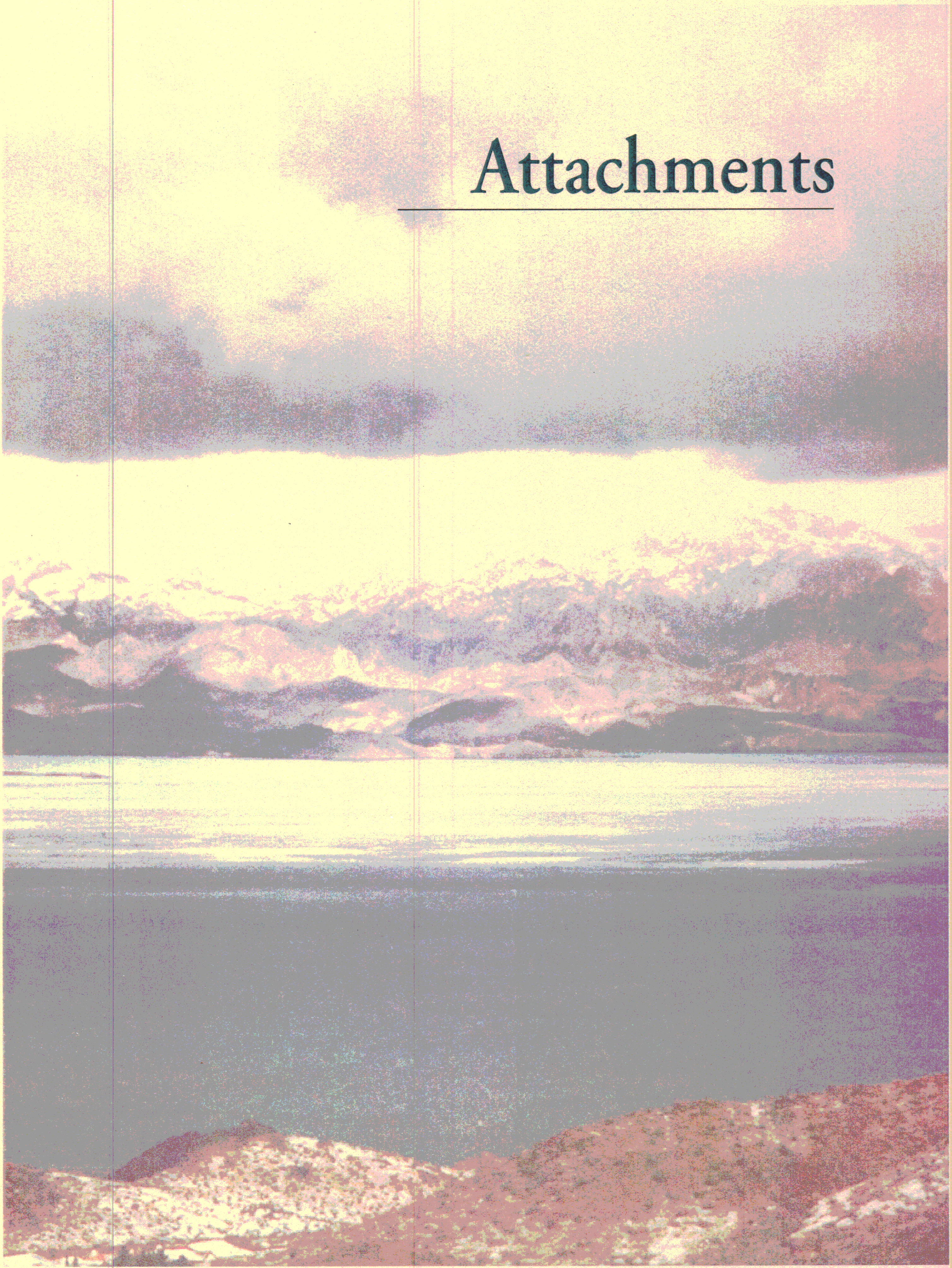
Attachments



ATTACHMENT A

Long Range Operating Criteria

This attachment consists of a document referred to as the Long Range Operating Criteria for Colorado River Reservoirs, which controls the annual determinations of Colorado River water available for delivery to the Lower Division States. This document is subject to review at five-year intervals by the Secretary in consultation with the Basin States and others as required by applicable federal law.

Long-Range Operating Criteria

CRITERIA FOR COORDINATED LONG-RANGE OPERATION OF COLORADO RIVER RESERVOIRS PURSUANT TO THE COLORADO RIVER BASIN PROJECT ACT OF SEPTEMBER 30, 1968 (P.L. 90-537)

These Operating Criteria are promulgated in compliance with Section 602 of Public Law 90-537. They are to control the coordinated long-range operation of the storage reservoirs in the Colorado River Basin constructed under the authority of the Colorado River Storage Project Act (hereinafter "Upper Basin Storage Reservoirs") and the Boulder Canyon Project Act (Lake Mead). The Operating Criteria will be administered consistent with applicable Federal laws, the Mexican Water Treaty, interstate compacts, and decrees relating to the use of the waters of the Colorado River.

The Secretary of the Interior (hereinafter the "Secretary") may modify the Operating Criteria from time to time in accordance with Section 602(b) of P.L. 90-537. The Secretary will sponsor a formal review of the Operating Criteria at least every 5 years, with participating by State representatives as each Governor may designate and such other parties and agencies as the Secretary may deem appropriate.

I. ANNUAL REPORT

(1) On January 1, 1972, and on January 1 of each year thereafter, the Secretary shall transmit to the Congress and to the Governors of the Colorado River Basin States a report describing the actual operation under the adopted criteria for the preceding compact water year and the projected plan of operating for the current year.

(2) The plan of operation shall include such detailed rules and quantities as may be necessary and consistent with the criteria contained herein, and shall reflect appropriate consideration of the uses of the reservoirs for all purposes, including flood control, river regulation, beneficial consumptive uses, power production, water quality control, recreation, enhancement of fish and wildlife, and other environmental factors. The projected plan of operation may be revised to reflect the current hydrologic conditions, and the Congress and the Governors of the Colorado River Basin States shall be advised of any changes by June of each year.

II. OPERATION OF UPPER BASIN RESERVOIRS

(1) The annual plan of operation shall include a determination by the secretary of the quantity of water considered necessary as of September 30 of each year to be in storage as required by Section 602(2) of P.L. 90-537 (hereinafter "602(a) Storage"). The quantity of 602(a) Storage shall be determined by the Secretary after consideration of all applicable laws and relevant factors, including, but not limited to, the following:

(a) Historic streamflows;
(b) The most critical period of record;
(c) Probabilities of water supply;
(d) Estimated future depletions in the upper basin, including the effects of recurrence of critical period of water supply;
(e) The "Report of the Committee on Probabilities and Test Studies to the Task Force on Operating Criteria for the Colorado River," dated October 30, 1969, and such additional studies as the Secretary deems necessary;
(f) The necessity to assure that upper basin consumptive uses not be impaired because of failure to store sufficient water to assure deliveries under Section 602(a)(1) and (2) of P.L. 90-537.

(2) If in the plan of operation, either:

(a) The Upper Basin Storage Reservoirs active storage forecast for September 30 of the current year is less than the quantity of 602(a) Storage determined by the Secretary under Article II(1) hereof, for that date;
(b) The Lake Powell active storage forecast for that date is less than the Lake Mead active storage forecast for that date:

The objective shall be to maintain a minimum release of water from Lake Powell of 8.23 million acre-feet for that year. However, for the years ending September 30, 1971 and 1972, the release may be greater than 8.23 million acre-feet if necessary to deliver 75,000,000 acre-feet at Lee Ferry for the 10-year period ending September 30, 1972.

(3) If, in the plan of operation, the Upper Basin Storage Reservoirs active storage forecast for September 30 of the current water year is greater than the quantity of 602(a) Storage determination for that date, water shall be released annually from Lake Powell at a rate greater than 8.23 million

acre-feet per year to the extent necessary to accomplish any or all of the following objectives:

(a) To the extent it can be reasonably applied in the States of the Lower Division to the uses specified in Article III(e) of the Colorado River Compact, but no such releases shall be made when the active storage in Lake Powell is less than the active storage in Lake Mead;
(b) To maintain, as nearly as practicable, active storage in Lake Mead equal to the active storage in Lake Powell, and
(c) To avoid anticipated spills from Lake Powell.

(4) In the application of Article II(3)(b) herein, the annual release will be made to the extent that it can be passed through Glen Canyon Powerplant when operated at the available capability of the powerplant. Any water thus retained in Lake Powell to avoid bypass of water at the Glen Canyon Powerplant will be released through the Glen Canyon Powerplant as soon as practicable to equalize the active storage in Lake Powell and Lake Mead.

(5) Releases from Lake Powell pursuant to these criteria shall not prejudice the position of either the upper or lower basin interests with respect to required deliveries at Lee Ferry pursuant to the Colorado River Compact.

III. OPERATION OF LAKE MEAD

(1) Water released from Lake Powell, plus the tributary inflows between Lake Powell and Lake Mead, shall be regulated in Lake Mead and either pumped from Lake Mead or released to the Colorado River to meet requirements as follows:

(a) Mexican Treaty obligations;
(b) Reasonable consumptive use requirements of mainstream users in the Lower Basin;
(c) Net river losses;
(d) Net reservoir losses;
(e) Regulatory wastes

(2) Until such time as mainstream water is delivered by means of the Central Arizona Project, the consumptive use requirements of Article III(1)(b) of these Operating Criteria will be met.

(3) After commencement of delivery of mainstream water by means of the Central Arizona Project, the consumptive use requirements of Article

III(1)(Reclamation) of these Operating Criteria will be met to the following extent:

(a) *Normal*: The annual pumping and release from Lake Mead will be sufficient to satisfy 7,500,000 acre-feet of annual consumptive use in accordance with the decree in Arizona v. California, 376 U.S. 340 (1964).

(b) *Surplus*: The Secretary shall determine from time to time when water in quantities greater than "Normal" is available for either pumping or release from Lake Mead pursuant to Article II(b)(2) of the decree in Arizona v. California after consideration of all relevant factors, including, but not limited to, the following:

   (i) the requirements stated in Article 111(1) of these Operating Criteria;
   (ii) requests for water by holders of water delivery contracts with the United States, and of other rights recognized in the decree in Arizona v. California;
   (iii) actual and forecast quantities of active storage in Lake Mead and the Upper Basin Storage Reservoirs; and
   (iv) estimated net inflow to Lake Mead.

(c) Shortage: The Secretary shall determine from time to time when . insufficient mainstream water is available to satisfy annual consumptive use requirements of 7,500,000 acre-feet after consideration of all relevant factors, including, but not limited to, the following:

   (i) the requirements stated in Article III(1) of these Operating Criteria;
   (ii) actual and forecast quantities of active storage in Lake Mead;
   (iii) estimate of net inflow to Lake Mead for the current year;
   (iv) historic streamflows, including the most critical period of record;
   (v) priorities set forth in Article II(A) of the decree in *Arizona v. California*; and
   (vi) the purposes stated in Article 1(2) of these Operating Criteria.

The shortage provisions of Article II(B)(3) of the decree in *Arizona v. California* shall thereupon become effective and consumptive uses from the mainstream shall be restricted to the extent determined by the Secretary to be required by Section 301(b) of Public Law 90-537.

IV. DEFINITIONS

(1) In addition to the definitions in Section 606 of P.L. 90-537, the following shall also apply:

(a) "Spills," as used in Article II(3)(c) herein, means water released from Lake Powell which cannot be utilized for project purposed, including, but not limited to, the generation of power and energy.

(b) "Surplus," as used in Article III(3)(b) herein, is water which can be used to meet consumptive use demands in the three Lower Division States in excess of 7,500,000 acre-feet annually. The term "surplus" as used in these Operating Criteria is not to be construed as applied to, being interpretive of, or in any manner having reference to the term "surplus" in the Colorado River Compact.

(c) "Net inflow to Lake Mead," as used in Article III(b)(iv) and (c)(iii) herein, represents the annual inflow to Lake Mead in excess of losses from Lake Mead.

(d) "Available capability," as used in Article II(4) herein, means that portion of the total capacity of the powerplant that is physically available for generation.

ATTACHMENT B

Environmental Guidelines for Transboundary Impacts

This attachment contains federal instruction and guidelines governing the analysis of the Transboundary Impacts in Section 3.16 of the FEIS. Two documents are included – Executive Order 12114, *Environmental Effects Abroad of Major Federal Actions,* and *Council on Environmental Quality Guidance on NEPA Analysis for Transboundary Impacts,* July 1, 1997.

Executive Order 12114 - Environmental Effects Abroad of Major Federal Actions

Exec. Order No. 12114
44 Federal Register 1957
1979 WL 25866 (Pres.)

Executive Order 12114

Environmental Effects Abroad of Major Federal Actions

January 4, 1979

By virtue of the authority vested in me by the Constitution and the laws of the United States, and as President of the United States, in order to further environmental objectives consistent with the foreign policy and national security policy of the United States, it is ordered as follows:

Section 1.

1-1. Purpose and Scope. The purpose of this Executive Order is to enable responsible officials of Federal Agencies having ultimate responsibility for authorizing and approving actions encompassed by this Order to be informed of pertinent environmental considerations and to take such considerations into account, with other pertinent considerations of national policy, in making decisions regarding such actions. While based on independent authority, this Order furthers the purpose of the National Environmental Policy Act and the Marine Protection Research and Sanctuaries Act and the Deepwater Port Act consistent with the foreign policy and national security policy of the United States, and represents the United States government's exclusive and complete determination of the procedural and other actions to be taken by Federal agencies to further the purpose of the National Environmental Policy Act, with respect to the environment outside the United States, its territories and possessions.

Sec. 2.

2-1. Agency Procedures. Every Federal agency taking major Federal actions encompassed hereby and not exempted herefrom having significant effects on the environment outside the geographical borders of the United States and its territories and possessions shall within eight months after the effective date of this Order have in effect procedures to implement this Order. Agencies shall consult with the Department of State and the Council on Environmental Quality concerning such procedures prior to placing them in effect.

2-2. Information Exchange. To assist in effectuating the foregoing purpose, the Department of State and the Council on Environmental Quality in collaboration with other interested Federal agencies and other nations shall conduct a program for exchange on a continuing basis of information concerning the environment. The objectives of this program shall be to provide information for use by decisionmakers, to heighten awareness of and interest in environmental concerns and, as appropriate, to facilitate environmental cooperation with foreign nations.

2-3. Actions Included. Agencies in their procedures under Section 2-1 shall establish procedures by which their officers having ultimate responsibility for authorizing and approving actions in one of the following categories encompassed by this Order, take into consideration in making decisions concerning such actions, a document described in Section 2-4(a):

(a) major Federal actions significantly affecting the environment of the global commons outside the jurisdiction of any nation (e.g., the oceans or Antarctica);

(b) major Federal actions significantly affecting the environment of a foreign nation not participating with the United States and not otherwise involved in the action;

(c) major Federal actions significantly affecting the environment of a foreign nation which provide to that nation:

(1) a product, or physical project producing a principal product or an emission or effluent, which is prohibited or strictly regulated by Federal law in the United States because its toxic effects on the environment create a serious public health risk; or

(2) a physical project which in the United States is prohibited or strictly regulated by Federal law to protect the environment against

radioactive substances.

(d) major Federal actions outside the United States, its territories and possessions which significantly affect natural or ecological resources of global importance designated for protection under this subsection by the President, or, in the case of such a resource protected by international agreement binding on the United States, by the Secretary of State. Recommendations to the President under this subsection shall be accompanied by the views of the Council on Environmental Quality and the Secretary of State.

2-4. Applicable Procedures. (a) There are the following types of documents to be used in connection with actions described in Section 2-3:

(i) environmental impact statements (including generic, program and specific statements);

(ii) bilateral or multilateral environmental studies, relevant or related to the proposed action, by the United States and one or more foreign nations, or by an international body or organization in which the United States is a member or participant; or

(iii) concise reviews of the environmental issues involved, including environmental assessments, summary environmental analyses or other appropriate documents.

(b) Agencies shall in their procedures provide for preparation of documents described in Section 2-4(a), with respect to actions described in Section 2-3, as follows:

(i) for effects described in Section 2-3(a), an environmental impact statement described in Section 2-4(a)(1);

(ii) for effects described in Section 2-3(b), a document described in Section 2-4(a)(ii) or (iii), as determined by the agency;

(iii) for effects described in Section 2-3(c), a document described in Section 2-4(a)(ii) or (iii), as determined by the agency;

(iv) for effects described in Section 2-3(d), a document described in Section 2-4(a)(i), (ii) or (iii), as determined by the agency.

Such procedures may provide that an agency need not prepare a new document when a document described in Section 2-4(a) already exists.

(c) Nothing in this Order shall serve to invalidate any existing regulations of any agency which have been adopted pursuant to court order or pursuant to judicial settlement of any case or to prevent any agency from providing in its procedures for measures in addition to those provided for herein to further the purpose of the National Environmental Policy Act and other environmental laws, including the Marine Protection Research and Sanctuaries Act and the Deepwater Port Act, consistent with the foreign and national security policies of the United States.

(d) Except as provided in Section 2-5(b), agencies taking action encompassed by this Order shall, as soon as feasible, inform other Federal agencies with relevant expertise of the availability of environmental documents prepared under this Order.

Agencies in their procedures under Section 2-1 shall make appropriate provision for determining when an affected nation shall be informed in accordance with Section 3-2 of this Order of the availability of environmental documents prepared pursuant to those procedures.

In order to avoid duplication of resources, agencies in their procedures shall provide for appropriate utilization of the resources of other Federal agencies with relevant environmental jurisdiction or expertise.

2-5. Exemption and Considerations. (a) Notwithstanding Section 2-3, the following actions are exempt from this Order:

(i) actions not having a significant effect on the environment outside the United States as determined by the agency;

(ii) actions taken by the President;

(iii) actions taken by or pursuant to the direction of the President or Cabinet officer when the national security or interest is involved or when the action occurs in the course of an armed conflict;

(iv) intelligence activities and arms transfers;

(v) export licenses or permits or export approvals, and actions relating to nuclear activities except actions providing to a foreign nation a nuclear production or utilization facility as defined in the Atomic Energy Act of 1954, as amended, or a nuclear waste management facility;

(vi) votes and other actions in international conferences and organizations;

(vii) disaster and emergency relief action.

(b) Agency procedures under Section 2-1 implementing Section 2-4 may provide for appropriate modifications in the contents, timing and availability of documents to other affected Federal agencies and affected nations, where necessary to:

(i) enable the agency to decide and act promptly as and when required;

(ii) avoid adverse impacts on foreign relations or infringement in fact or appearance of other nations' sovereign responsibilities, or

(iii) ensure appropriate reflection of:

(1) diplomatic factors;

(2) international commercial, competitive and export promotion factors;

(3) needs for governmental or commercial confidentiality;

(4) national security considerations;

(5) difficulties of obtaining information and agency ability to analyze meaningfully environmental effects of a proposed action; and

(6) the degree to which the agency is involved in or able to affect a decision to be made.

(c) Agency procedure under Section 2-1 may provide for categorical exclusions and for such exemptions in addition to those specified in subsection (a) of this Section as may be necessary to meet emergency circumstances, situations involving exceptional foreign policy and national security sensitivities and other such special circumstances. In utilizing such additional exemptions agencies shall, as soon as feasible, consult with the Department of State and the Council on Environmental Quality.

(d) The provisions of Section 2-5 do not apply to actions described in Section 2-3(a) unless permitted by law.

Sec. 3.

3-1. Rights of Action. This Order is solely for the purpose of establishing internal procedures for Federal agencies of consider the significant effects of their actions on the environment outside the United States, its territories and possessions, and nothing in this Order shall be construed to create a cause of action.

3-2. Foreign Relations. The Department of State shall coordinate all communications by agencies with foreign governments concerning environmental agreements and other arrangements in implementation of this Order.

3-3. Multi-Agency Actions. Where more than one Federal agency is involved in an action or program, a lead agency, as determined by the agencies involved, shall have responsibility for implementation of this Order.

3-4. Certain Terms. For purposes of this Order, 'environment' means the natural and physical environment and excludes social, economic and other environments; and an action significantly affects the environment if it does significant harm to the environment even though on balance the agency believes the action to be beneficial to the environment. The term 'export approvals' in Section 2-5(a)(v) does not mean or include direct loans to finance exports.

3-5. Multiple Impacts. If a major Federal action having effects on the environment of the United States or the global commons requires preparation of an environmental impact statement, and if the action also has effects on the environment of a foreign nation, an environmental impact statement need not be prepared with respect to the effects on the environment of the foreign nation.

JIMMY CARTER
THE WHITE HOUSE,
January 4, 1979.

Exec. Order No. 12114
44 Federal Register 1957
1979 WL 25866 (Pres.)
END OF DOCUMENT

CEQ Guidance on NEPA Analyses for Transboundary Impacts
July 1, 1997

EXECUTIVE OFFICE OF THE PRESIDENT
COUNCIL ON ENVIRONMENTAL QUALITY
WASHINGTON, D.C. 20503

MEMORANDUM TO HEADS OF AGENCIES ON THE APPLICATION OF THE NATIONAL ENVIRONMENTAL POLICY ACT TO PROPOSED FEDERAL ACTIONS IN THE UNITED STATES WITH TRANSBOUNDARY EFFECTS

FROM: KATHLEEN A. MCGINTY
CHAIR

DATE: JULY 1, 1997

In recent months, the Council has been involved in discussions with several agencies concerning the applicability of the National Environmental Policy Act (NEPA) to transboundary impacts that may occur as the result of proposed federal actions in the United States. To set forth a consistent interpretation of NEPA, CEQ is today issuing the attached guidance on NEPA analysis for transboundary impacts. In it, we advise that NEPA requires analysis and disclosure of transboundary impacts of proposed federal actions taking place in the United States.

We recommend that agencies which take actions with potential transboundary impacts consult as necessary with CEQ concerning specific procedures, proposals or programs which may be affected.

COUNCIL ON ENVIRONMENTAL QUALITY GUIDANCE ON NEPA ANALYSES FOR TRANSBOUNDARY IMPACTS
JULY 1, 1997

The purpose of this guidance is to clarify the applicability of the National Environmental Policy Act (NEPA) to proposed federal actions in the United States, including its territories and possessions, that may have transboundary effects extending across the border and affecting another country's environment. While the guidance arises in the context of negotiations undertaken with the governments of Mexico and Canada to develop an agreement on transboundary environmental impact assessment in North America,[1] the guidance pertains to all federal agency actions that are normally subject to NEPA, whether covered by an international agreement or not.

It is important to state at the outset the matters to which this guidance is addressed and those to which it is not. This guidance does not expand the range of actions to which NEPA currently applies. An action that does not otherwise fall under NEPA would not now fall under NEPA by virtue of this guidance. Nor does this guidance apply NEPA to so-called "extraterritorial actions"; that is, U.S. actions that take place in another country or otherwise outside the jurisdiction of the United States[2]. The guidance pertains only to those proposed actions currently covered by NEPA that take place within the United States and its territories, and it does not change the applicability of NEPA law, regulations or case law to those actions. Finally, the guidance is consistent with long-standing principles of international law.

NEPA LAW AND POLICY

NEPA declares a national policy that encourages productive and enjoyable harmony

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[1] The negotiations were authorized in Section 10.7 of the North American Agreement on Environmental Cooperation, which is a side agreement to the North American Free Trade Agreement. The guidance is also relevant to the ECE Convention on Environmental Impact Assessment in a Transboundary Context, signed in Espoo, Finland in February, 1991, but not yet in force.

[2] For example, NEPA does apply to actions undertaken by the National Science Foundation in the Antarctica. Environmental Defense Fund v. Massey, 986 F.2d 528 (D.C. Cir. 1993).

between human beings and their environment, promotes efforts which will prevent or eliminate damage to the environment and biosphere, stimulates the health and welfare of human beings, and enriches the understanding of ecological systems.[3] Section 102(1) of NEPA "authorizes and directs that, to the fullest extent possible . . . . the policies, regulations and public laws of the United States shall be interpreted and administered in accordance with the policies set forth in [the] Act."[4] NEPA's explicit statement of policies calls for the federal government "to use all practical means and measures . . . . to create and maintain conditions under which man and nature can exist in productive harmony . . . ."[5] In addition, Congress directed federal agencies to "use all practical means . . . . to improve and coordinate Federal plans, functions, programs, and resources to the end that the Nation may . . . . attain the widest range of beneficial uses of the environment without degradation, risk to health or safety, or other undesirable and unintended consequences."[6] Section 102(2)(C) requires federal agencies to assess the environmental impacts of and alternatives to proposed major federal actions significantly affecting the quality of the human environment.[7] Congress also recognized the "worldwide and long-range character of environmental problems" in NEPA and directed agencies to assist other countries in anticipating and preventing a decline in the quality of the world environment.[8]

Neither NEPA nor the Council on Environmental Quality's (CEQ) regulations implementing the procedural provisions of NEPA define agencies' obligations to analyze effects of actions by administrative boundaries. Rather, the entire body of NEPA law directs federal agencies to analyze the effects of proposed actions to the extent they are reasonably foreseeable consequences of the proposed action, regardless of where those impacts might occur. Agencies

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[3] 42 USC 4321.

[4] 42 USC 4332(1).

[5] 42 USC 4331(a).

[6] 42 USC 4331(b)(3).

[7] 42 USC 4332(2)(C).

[8] 42 USC 4332(2)(F).

must analyze indirect effects, which are caused by the action, are later in time or farther removed in distance, but are still reasonably foreseeable, including growth-inducing effects and related effects on the ecosystem,[9] as well as cumulative effects.[10] Case law interpreting NEPA has reinforced the need to analyze impacts regardless of geographic boundaries within the United States,[11] and has also assumed that NEPA requires analysis of major federal actions that take place entirely outside of the United States but could have environmental effects within the United States.[12]

Courts that have addressed impacts across the United States' borders have assumed that the same rule of law applies in a transboundary context. In Swinomish Tribal Community v. Federal Energy Regulatory Commission,[13] Canadian intervenors were allowed to challenge the adequacy of an environmental impact statement (EIS) prepared by FERC in connection with its approval of an amendment to the City of Seattle's license that permitted raising the height of the Ross Dam on the Skagit River in Washington State. Assuming that NEPA required consideration of Canadian impacts, the court concluded that the report had taken the requisite "hard look" at Canadian impacts. Similarly, in Wilderness Society v. Morton,[14] the court granted intervenor status to Canadian environmental organizations that were challenging the adequacy of the trans-Alaska pipeline EIS. The court granted intervenor status because it found that there was a reasonable possibility that oil spill damage could significantly affect Canadian resources,

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[9] 40 CFR 1508.8(b).

[10] 40 CFR 1508.7.

[11] *See, for example,* Sierra Club v. U.S.Forest Service, 46 F.3d 835 (8th Cir. 1995); Resources Ltd., Inc. v. Robertson, 35 F.3d 1300 and 8 F.3d 1394 (9th Cir. 1993); Natural Resources Defense Council v. Hodel, 865 F.2d 288 (D.C. Cir. 1988); County of Josephine v. Watt, 539 F.Supp. 696 (N.D. Cal. 1982).

[12] See Sierra Club v. Adams, 578 F.2d 389 (D.C. Cir. 1978); NORML v. Dept. of State, 452 F.Supp. 1226 (D.D.C. 1978).

[13] 627 F.2d 499 (D.C. Cir. 1980).

[14] 463 F.2d 1261 (D.C. Cir. 1972).

and that Canadian interests were not adequately represented by other parties in the case.

In sum, based on legal and policy considerations, CEQ has determined that agencies must include analysis of reasonably foreseeable transboundary effects of proposed actions in their analysis of proposed actions in the United States.

PRACTICAL CONSIDERATIONS

CEQ notes that many proposed federal actions will not have transboundary effects, and cautions agencies against creating boilerplate sections in NEPA analyses to address this issue. Rather, federal agencies should use the scoping process[15] to identify those actions that may have transboundary environmental effects and determine at that point their information needs, if any, for such analyses. Agencies should be particularly alert to actions that may affect migratory species, air quality, watersheds, and other components of the natural ecosystem that cross borders, as well as to interrelated social and economic effects.[16] Should such potential impacts be identified, agencies may rely on available professional sources of information and should contact agencies in the affected country with relevant expertise.

Agencies have expressed concern about the availability of information that would be adequate to comply with NEPA standards that have been developed through the CEQ regulations and through judicial decisions. Agencies do have a responsibility to undertake a reasonable search for relevant, current information associated with an identified potential effect. However, the courts have adopted a "rule of reason" to judge an agency's actions in this respect, and do not require agencies to discuss "remote and highly speculative consequences".[17] Furthermore,

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[15] 40 CFR 1501.7. Scoping is a process for determining the scope of the issues to be addressed and the parties that need to be involved in that process prior to writing the environmental analyses.

[16] It is a well accepted rule that under NEPA, social and economic impacts by themselves do not require preparation of an EIS. 40 CFR 1508.14.

[17] Trout Unlimited v. Morton, 509 F.2d 1276, 1283 (9th Cir. 1974). See also, Northern Alaska Environmental Center v. Lujan, 961 F.2d 886, 890 (9th Cir. 1992); Idaho Conservation League v. Mumma, 956 F.2d 1508, 1519 (9th Cir. 1992); San Luis Obispo Mothers for Peace v. N.R.C., 751 F.2d 1287, 1300 (D.C. Cir. 1984); Scientists Institute for Public Information, Inc. v. Atomic Energy Commission, 481 F.2d 1079, 1092 (D.C. Cir. 1973).

CEQ's regulation at 40 CFR 1502.22 dealing with incomplete or unavailable information sets forth clear steps to evaluating effects in the context of an EIS when information is unobtainable.[18] Additionally, in the context of international agreements, the parties may set forth a specific process for obtaining information from the affected country which could then be relied upon in most circumstances to satisfy agencies' responsibility to undertake a reasonable search for information.

Agencies have also pointed out that certain federal actions that may cause transboundary effects do not, under U.S. law, require compliance with Sections 102(2)(C) and 102(2)(E) of NEPA. Such actions include actions that are statutorily exempted from NEPA, Presidential actions, and individual actions for which procedural compliance with NEPA is excused or modified by virtue of the CEQ regulations[19] and various judicial doctrines interpreting NEPA[20]. Nothing in this guidance changes the agencies' ability to rely on those rules and doctrines.

INTERNATIONAL LAW

It has been customary law since the 1905 Trail Smelter Arbitration that no nation may undertake acts on its territory that will harm the territory of another state[21]. This rule of

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[18] See Preamble to Amendment of 40 CFR 1502.22, deleting prior requirement for "worst case analysis" at 51 Federal Register 15625, April 25, 1986, for a detailed explanation of this regulation.

[19] For example, agencies may contact CEQ for approval of alternative arrangements for compliance with NEPA in the case of emergencies. 40 CFR 1506.11.

[20] For example, courts have recognized that NEPA does not require an agency to make public information that is otherwise properly classified information for national security reasons, Weinberger v. Cathollic Action of Hawaii, 454 U.S. 139 (1981).

[21] *Trail Smelter Arbitration*, U.S. v. Canada, 3 UN Rep. Int'l Arbit. Awards 1911 (1941). The case involved a smelter in British Columbia that was causing environmental harm in the state of Washington. The decision held that "under principles of International Law, as well as the law of the United States, no State has the right to use or permit the use of its territory in such a manner as to cause injury by fumes in or to the territory of another or the properties or persons therein, when the case is of serious consequence and the injury is described by clear and convincing injury." *Id*. at 1965). Also see the American Law Institute's Restatement of the Foreign Relations Law of the United States 3d, Section 601, ("State obligations with respect to environment of other States and the common environment").

customary law has been recognized as binding in Principle 21 of the Stockholm Declaration on the Human Environment and Principle 2 of the 1992 Rio Declaration on Environment and Development. This concept, along with the duty to give notice to others to avoid or avert such harm, is incorporated into numerous treaty obligations undertaken by the United States. Analysis of transboundary impacts of federal agency actions that occur in the United States is an appropriate step towards implementing those principles.

CONCLUSION

NEPA requires agencies to include analysis of reasonably foreseeable transboundary effects of proposed actions in their analysis of proposed actions in the United States. Such effects are best identified during the scoping stage, and should be analyzed to the best of the agency's ability using reasonably available information. Such analysis should be included in the EA or EIS prepared for the proposed action.

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1-1. Purpose and Scope. The purpose of this Executive Order is to enable responsible officials of Federal Agencies having ultimate responsibility for authorizing and approving actions encompassed by this Order to be informed of pertinent environmental considerations and to take such considerations into account, with other pertinent considerations of national policy, in making decisions regarding such actions. While based on independent authority, this Order furthers the purpose of the National Environmental Policy Act and the Marine Protection Research and Sanctuaries Act and the Deepwater Port Act consistent with the foreign policy and national security policy of the United States, and represents the United States government's exclusive and complete determination of the procedural and other actions to be taken by Federal agencies to further the purpose of the National Environmental Policy Act, with respect to the environment outside the United States, its territories and possessions.

Sec. 2.

2-1. Agency Procedures. Every Federal agency taking major Federal actions encompassed hereby and not exempted herefrom having significant effects on the environment outside the geographical borders of the United States and its territories and possessions shall within eight months after the effective date of this Order have in effect procedures to implement this Order. Agencies shall consult with the Department of State and the Council on Environmental Quality concerning such procedures prior to placing them in effect.

2-2. Information Exchange. To assist in effectuating the foregoing purpose, the Department of State and the Council on Environmental Quality in collaboration with other interested Federal agencies and other nations shall conduct a program for exchange on a continuing basis of information concerning the environment. The objectives of this program shall be to provide information for use by decisionmakers, to heighten awareness of and interest in environmental concerns and, as appropriate, to facilitate environmental cooperation with foreign nations.

2-3. Actions Included. Agencies in their procedures under Section 2-1 shall establish procedures by which their officers having ultimate responsibility for authorizing and approving actions in one of the following categories encompassed by this Order, take into consideration in making decisions concerning such actions, a document described in Section 2-4(a):

(a) major Federal actions significantly affecting the environment of the global commons outside the jurisdiction of any nation (e.g., the oceans or Antarctica);

(b) major Federal actions significantly affecting the environment of a foreign nation not participating with the United States and not otherwise involved in the action;

(c) major Federal actions significantly affecting the environment of a foreign nation which provide to that nation:

(1) a product, or physical project producing a principal product or an emission or effluent, which is prohibited or strictly regulated by Federal law in the United States because its toxic effects on the environment create a serious public health risk; or

(2) a physical project which in the United States is prohibited or strictly regulated by Federal law to protect the environment against

radioactive substances.

(d) major Federal actions outside the United States, its territories and possessions which significantly affect natural or ecological resources of global importance designated for protection under this subsection by the President, or, in the case of such a resource protected by international agreement binding on the United States, by the Secretary of State. Recommendations to the President under this subsection shall be accompanied by the views of the Council on Environmental Quality and the Secretary of State.

2-4. Applicable Procedures. (a) There are the following types of documents to be used in connection with actions described in Section 2-3:

(i) environmental impact statements (including generic, program and specific statements);

(ii) bilateral or multilateral environmental studies, relevant or related to the proposed action, by the United States and one or more foreign nations, or by an international body or organization in which the United States is a member or participant; or

(iii) concise reviews of the environmental issues involved, including environmental assessments, summary environmental analyses or other appropriate documents.

(b) Agencies shall in their procedures provide for preparation of documents described in Section 2-4(a), with respect to actions described in Section 2-3, as follows:

(i) for effects described in Section 2-3(a), an environmental impact statement described in Section 2-4(a)(1);

(ii) for effects described in Section 2-3(b), a document described in Section 2-4(a)(ii) or (iii), as determined by the agency;

(iii) for effects described in Section 2-3(c), a document described in Section 2-4(a)(ii) or (iii), as determined by the agency;

(iv) for effects described in Section 2-3(d), a document described in Section 2-4(a)(i), (ii) or (iii), as determined by the agency.

Such procedures may provide that an agency need not prepare a new document when a document described in Section 2-4(a) already exists.

(c) Nothing in this Order shall serve to invalidate any existing regulations of any agency which have been adopted pursuant to court order or pursuant to judicial settlement of any case or to prevent any agency from providing in its procedures for measures in addition to those provided for herein to further the purpose of the National Environmental Policy Act and other environmental laws, including the Marine Protection Research and Sanctuaries Act and the Deepwater Port Act, consistent with the foreign and national security policies of the United States.

(d) Except as provided in Section 2-5(b), agencies taking action encompassed by this Order shall, as soon as feasible, inform other Federal agencies with relevant expertise of the availability of environmental documents prepared under this Order.

Agencies in their procedures under Section 2-1 shall make appropriate provision for determining when an affected nation shall be informed in accordance with Section 3-2 of this Order of the availability of environmental documents prepared pursuant to those procedures.

In order to avoid duplication of resources, agencies in their procedures shall provide for appropriate utilization of the resources of other Federal agencies with relevant environmental jurisdiction or expertise.

2-5. Exemption and Considerations. (a) Notwithstanding Section 2-3, the following actions are exempt from this Order:

(i) actions not having a significant effect on the environment outside the United States as determined by the agency;

(ii) actions taken by the President;

(iii) actions taken by or pursuant to the direction of the President or Cabinet officer when the national security or interest is involved or when the action occurs in the course of an armed conflict;

(iv) intelligence activities and arms transfers;

(v) export licenses or permits or export approvals, and actions relating to nuclear activities except actions providing to a foreign nation a nuclear production or utilization facility as defined in the Atomic Energy Act of 1954, as amended, or a nuclear waste management facility;

(vi) votes and other actions in international conferences and organizations;

(vii) disaster and emergency relief action.

(b) Agency procedures under Section 2-1 implementing Section 2-4 may provide for appropriate modifications in the contents, timing and availability of documents to other affected Federal agencies and affected nations, where necessary to:

(i) enable the agency to decide and act promptly as and when required;

(ii) avoid adverse impacts on foreign relations or infringement in fact or appearance of other nations' sovereign responsibilities, or

(iii) ensure appropriate reflection of:

(1) diplomatic factors;

(2) international commercial, competitive and export promotion factors;

(3) needs for governmental or commercial confidentiality;

(4) national security considerations;

(5) difficulties of obtaining information and agency ability to analyze meaningfully environmental effects of a proposed action; and

(6) the degree to which the agency is involved in or able to affect a decision to be made.

(c) Agency procedure under Section 2-1 may provide for categorical exclusions and for such exemptions in addition to those specified in subsection (a) of this Section as may be necessary to meet emergency circumstances, situations involving exceptional foreign policy and national security sensitivities and other such special circumstances. In utilizing such additional exemptions agencies shall, as soon as feasible, consult with the Department of State and the Council on Environmental Quality.

(d) The provisions of Section 2-5 do not apply to actions described in Section 2-3(a) unless permitted by law.

Sec. 3.

3-1. Rights of Action. This Order is solely for the purpose of establishing internal procedures for Federal agencies of consider the significant effects of their actions on the environment outside the United States, its territories and possessions, and nothing in this Order shall be construed to create a cause of action.

3-2. Foreign Relations. The Department of State shall coordinate all communications by agencies with foreign governments concerning environmental agreements and other arrangements in implementation of this Order.

3-3. Multi-Agency Actions. Where more than one Federal agency is involved in an action or program, a lead agency, as determined by the agencies involved, shall have responsibility for implementation of this Order.

3-4. Certain Terms. For purposes of this Order, 'environment' means the natural and physical environment and excludes social, economic and other environments; and an action significantly affects the environment if it does significant harm to the environment even though on balance the agency believes the action to be beneficial to the environment. The term 'export approvals' in Section 2-5(a)(v) does not mean or include direct loans to finance exports.

3-5. Multiple Impacts. If a major Federal action having effects on the environment of the United States or the global commons requires preparation of an environmental impact statement, and if the action also has effects on the environment of a foreign nation, an environmental impact statement need not be prepared with respect to the effects on the environment of the foreign nation.

JIMMY CARTER
THE WHITE HOUSE,
January 4, 1979.

Exec. Order No. 12114
44 Federal Register 1957
1979 WL 25866 (Pres.)
END OF DOCUMENT

CEQ Guidance on NEPA Analyses for Transboundary Impacts

July 1, 1997

EXECUTIVE OFFICE OF THE PRESIDENT
COUNCIL ON ENVIRONMENTAL QUALITY
WASHINGTON, D.C. 20503

MEMORANDUM TO HEADS OF AGENCIES ON THE APPLICATION OF THE NATIONAL ENVIRONMENTAL POLICY ACT TO PROPOSED FEDERAL ACTIONS IN THE UNITED STATES WITH TRANSBOUNDARY EFFECTS

FROM: KATHLEEN A. MCGINTY
CHAIR

DATE: JULY 1, 1997

In recent months, the Council has been involved in discussions with several agencies concerning the applicability of the National Environmental Policy Act (NEPA) to transboundary impacts that may occur as the result of proposed federal actions in the United States. To set forth a consistent interpretation of NEPA, CEQ is today issuing the attached guidance on NEPA analysis for transboundary impacts. In it, we advise that NEPA requires analysis and disclosure of transboundary impacts of proposed federal actions taking place in the United States.

We recommend that agencies which take actions with potential transboundary impacts consult as necessary with CEQ concerning specific procedures, proposals or programs which may be affected.

COUNCIL ON ENVIRONMENTAL QUALITY GUIDANCE ON NEPA ANALYSES FOR TRANSBOUNDARY IMPACTS
JULY 1, 1997

The purpose of this guidance is to clarify the applicability of the National Environmental Policy Act (NEPA) to proposed federal actions in the United States, including its territories and possessions, that may have transboundary effects extending across the border and affecting another country's environment. While the guidance arises in the context of negotiations undertaken with the governments of Mexico and Canada to develop an agreement on transboundary environmental impact assessment in North America,[1] the guidance pertains to all federal agency actions that are normally subject to NEPA, whether covered by an international agreement or not.

It is important to state at the outset the matters to which this guidance is addressed and those to which it is not. This guidance does not expand the range of actions to which NEPA currently applies. An action that does not otherwise fall under NEPA would not now fall under NEPA by virtue of this guidance. Nor does this guidance apply NEPA to so-called "extraterritorial actions"; that is, U.S. actions that take place in another country or otherwise outside the jurisdiction of the United States[2]. The guidance pertains only to those proposed actions currently covered by NEPA that take place within the United States and its territories, and it does not change the applicability of NEPA law, regulations or case law to those actions. Finally, the guidance is consistent with long-standing principles of international law.

NEPA LAW AND POLICY

NEPA declares a national policy that encourages productive and enjoyable harmony

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[1] The negotiations were authorized in Section 10.7 of the North American Agreement on Environmental Cooperation, which is a side agreement to the North American Free Trade Agreement. The guidance is also relevant to the ECE Convention on Environmental Impact Assessment in a Transboundary Context, signed in Espoo, Finland in February, 1991, but not yet in force.

[2] For example, NEPA does apply to actions undertaken by the National Science Foundation in the Antarctica. Environmental Defense Fund v. Massey, 986 F.2d 528 (D.C. Cir. 1993).

between human beings and their environment, promotes efforts which will prevent or eliminate damage to the environment and biosphere, stimulates the health and welfare of human beings, and enriches the understanding of ecological systems.[3] Section 102(1) of NEPA "authorizes and directs that, to the fullest extent possible . . . . the policies, regulations and public laws of the United States shall be interpreted and administered in accordance with the policies set forth in [the] Act."[4] NEPA's explicit statement of policies calls for the federal government "to use all practical means and measures . . . . to create and maintain conditions under which man and nature can exist in productive harmony . . . ."[5] In addition, Congress directed federal agencies to "use all practical means . . . . to improve and coordinate Federal plans, functions, programs, and resources to the end that the Nation may . . . . attain the widest range of beneficial uses of the environment without degradation, risk to health or safety, or other undesirable and unintended consequences."[6] Section 102(2)(C) requires federal agencies to assess the environmental impacts of and alternatives to proposed major federal actions significantly affecting the quality of the human environment.[7] Congress also recognized the "worldwide and long-range character of environmental problems" in NEPA and directed agencies to assist other countries in anticipating and preventing a decline in the quality of the world environment.[8]

Neither NEPA nor the Council on Environmental Quality's (CEQ) regulations implementing the procedural provisions of NEPA define agencies' obligations to analyze effects of actions by administrative boundaries. Rather, the entire body of NEPA law directs federal agencies to analyze the effects of proposed actions to the extent they are reasonably foreseeable consequences of the proposed action, regardless of where those impacts might occur. Agencies

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[3] 42 USC 4321.

[4] 42 USC 4332(1).

[5] 42 USC 4331(a).

[6] 42 USC 4331(b)(3).

[7] 42 USC 4332(2)(C).

[8] 42 USC 4332(2)(F).

must analyze indirect effects, which are caused by the action, are later in time or farther removed in distance, but are still reasonably foreseeable, including growth-inducing effects and related effects on the ecosystem,[9] as well as cumulative effects.[10] Case law interpreting NEPA has reinforced the need to analyze impacts regardless of geographic boundaries within the United States,[11] and has also assumed that NEPA requires analysis of major federal actions that take place entirely outside of the United States but could have environmental effects within the United States.[12]

Courts that have addressed impacts across the United States' borders have assumed that the same rule of law applies in a transboundary context. In Swinomish Tribal Community v. Federal Energy Regulatory Commission,[13] Canadian intervenors were allowed to challenge the adequacy of an environmental impact statement (EIS) prepared by FERC in connection with its approval of an amendment to the City of Seattle's license that permitted raising the height of the Ross Dam on the Skagit River in Washington State. Assuming that NEPA required consideration of Canadian impacts, the court concluded that the report had taken the requisite "hard look" at Canadian impacts. Similarly, in Wilderness Society v. Morton,[14] the court granted intervenor status to Canadian environmental organizations that were challenging the adequacy of the trans-Alaska pipeline EIS. The court granted intervenor status because it found that there was a reasonable possibility that oil spill damage could significantly affect Canadian resources,

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[9] 40 CFR 1508.8(b).

[10] 40 CFR 1508.7.

[11] *See, for example,* Sierra Club v. U.S.Forest Service, 46 F.3d 835 (8th Cir. 1995); Resources Ltd., Inc. v. Robertson, 35 F.3d 1300 and 8 F.3d 1394 (9th Cir. 1993); Natural Resources Defense Council v. Hodel, 865 F.2d 288 (D.C. Cir. 1988); County of Josephine v. Watt, 539 F.Supp. 696 (N.D. Cal. 1982).

[12] See Sierra Club v. Adams, 578 F.2d 389 (D.C. Cir. 1978); NORML v. Dept. of State, 452 F.Supp. 1226 (D.D.C. 1978).

[13] 627 F.2d 499 (D.C. Cir. 1980).

[14] 463 F.2d 1261 (D.C. Cir. 1972).

and that Canadian interests were not adequately represented by other parties in the case.

In sum, based on legal and policy considerations, CEQ has determined that agencies must include analysis of reasonably foreseeable transboundary effects of proposed actions in their analysis of proposed actions in the United States.

PRACTICAL CONSIDERATIONS

CEQ notes that many proposed federal actions will not have transboundary effects, and cautions agencies against creating boilerplate sections in NEPA analyses to address this issue. Rather, federal agencies should use the scoping process[15] to identify those actions that may have transboundary environmental effects and determine at that point their information needs, if any, for such analyses. Agencies should be particularly alert to actions that may affect migratory species, air quality, watersheds, and other components of the natural ecosystem that cross borders, as well as to interrelated social and economic effects.[16] Should such potential impacts be identified, agencies may rely on available professional sources of information and should contact agencies in the affected country with relevant expertise.

Agencies have expressed concern about the availability of information that would be adequate to comply with NEPA standards that have been developed through the CEQ regulations and through judicial decisions. Agencies do have a responsibility to undertake a reasonable search for relevant, current information associated with an identified potential effect. However, the courts have adopted a "rule of reason" to judge an agency's actions in this respect, and do not require agencies to discuss "remote and highly speculative consequences".[17] Furthermore,

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[15] 40 CFR 1501.7. Scoping is a process for determining the scope of the issues to be addressed and the parties that need to be involved in that process prior to writing the environmental analyses.

[16] It is a well accepted rule that under NEPA, social and economic impacts by themselves do not require preparation of an EIS. 40 CFR 1508.14.

[17] Trout Unlimited v. Morton, 509 F.2d 1276, 1283 (9th Cir. 1974). See also, Northern Alaska Environmental Center v. Lujan, 961 F.2d 886, 890 (9th Cir. 1992); Idaho Conservation League v. Mumma, 956 F.2d 1508, 1519 (9th Cir. 1992); San Luis Obispo Mothers for Peace v. N.R.C., 751 F.2d 1287, 1300 (D.C. Cir. 1984); Scientists Institute for Public Information, Inc. v. Atomic Energy Commission, 481 F.2d 1079, 1092 (D.C. Cir. 1973).

CEQ's regulation at 40 CFR 1502.22 dealing with incomplete or unavailable information sets forth clear steps to evaluating effects in the context of an EIS when information is unobtainable.[18] Additionally, in the context of international agreements, the parties may set forth a specific process for obtaining information from the affected country which could then be relied upon in most circumstances to satisfy agencies' responsibility to undertake a reasonable search for information.

Agencies have also pointed out that certain federal actions that may cause transboundary effects do not, under U.S. law, require compliance with Sections 102(2)(C) and 102(2)(E) of NEPA. Such actions include actions that are statutorily exempted from NEPA, Presidential actions, and individual actions for which procedural compliance with NEPA is excused or modified by virtue of the CEQ regulations[19] and various judicial doctrines interpreting NEPA[20]. Nothing in this guidance changes the agencies' ability to rely on those rules and doctrines.

INTERNATIONAL LAW

It has been customary law since the 1905 Trail Smelter Arbitration that no nation may undertake acts on its territory that will harm the territory of another state[21]. This rule of

[18] See Preamble to Amendment of 40 CFR 1502.22, deleting prior requirement for "worst case analysis" at 51 Federal Register 15625, April 25, 1986, for a detailed explanation of this regulation.

[19] For example, agencies may contact CEQ for approval of alternative arrangements for compliance with NEPA in the case of emergencies. 40 CFR 1506.11.

[20] For example, courts have recognized that NEPA does not require an agency to make public information that is otherwise properly classified information for national security reasons, Weinberger v. Cathollic Action of Hawaii, 454 U.S. 139 (1981).

[21] *Trail Smelter Arbitration*, U.S. v. Canada, 3 UN Rep. Int'l Arbit. Awards 1911 (1941). The case involved a smelter in British Columbia that was causing environmental harm in the state of Washington. The decision held that "under principles of International Law, as well as the law of the United States, no State has the right to use or permit the use of its territory in such a manner as to cause injury by fumes in or to the territory of another or the properties or persons therein, when the case is of serious consequence and the injury is described by clear and convincing injury." *Id*. at 1965). Also see the American Law Institute's Restatement of the Foreign Relations Law of the United States 3d. Section 601, ("State obligations with respect to environment of other States and the common environment").

customary law has been recognized as binding in Principle 21 of the Stockholm Declaration on the Human Environment and Principle 2 of the 1992 Rio Declaration on Environment and Development. This concept, along with the duty to give notice to others to avoid or avert such harm, is incorporated into numerous treaty obligations undertaken by the United States. Analysis of transboundary impacts of federal agency actions that occur in the United States is an appropriate step towards implementing those principles.

CONCLUSION

NEPA requires agencies to include analysis of reasonably foreseeable transboundary effects of proposed actions in their analysis of proposed actions in the United States. Such effects are best identified during the scoping stage, and should be analyzed to the best of the agency's ability using reasonably available information. Such analysis should be included in the EA or EIS prepared for the proposed action.

ATTACHMENT C

Dams and Reservoirs Along the Lower Colorado River

This attachment describes the dams and reservoirs on the mainstem of the Colorado River from Glen Canyon Dam in Arizona to Morelos Dam along the international boundary with Mexico. The role that each plays in the operation of the Colorado River system is also explained.

ATTACHMENT C

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COLORADO RIVER DAMS AND RESERVOIRS
Lake Powell to the Southerly International Boundary

The following discussion summarizes the dams and reservoirs along the Colorado River from Lake Powell to the Southerly International Boundary (SIB) with Mexico and their specific roles in the operation of the Colorado River. Individual dams serve one or more specific purposes as designated in their federal construction authorizations. Such purposes are, water storage, flood control, river regulation, power generation, and water diversion to Arizona, California, Nevada and delivery to Mexico. The All-American Canal is included in this summary because it conveys some of the water delivered to Mexico and thereby contributes to the river system operation. The dams and reservoirs are listed in the order of their location along the river proceeding downstream from Lake Powell.

Glen Canyon Dam – Glen Canyon Dam, which formed Lake Powell, is a principal part of the Colorado River Storage Project. It is a concrete arch dam 710 feet high and 1,560 feet wide. The maximum generating discharge capacity is 33,200 cfs which may be augmented by an additional 15,000 cfs through the river outlet works. The active capacity of Lake Powell is 24,300,000 af. Lake Powell has no legislated flood control space. The required system flood control space is allocated among selected project reservoirs including Lake Powell, to augment the 1.5 maf required to be available in Lake Mead.

Hoover Dam – Hoover Dam was constructed in the Black Canyon of the Colorado River about 36 miles from Las Vegas, Nevada. Hoover Dam was constructed to provide storage for river regulation and flood control, storage of water for irrigation and domestic uses and generation of hydropower. Recreation also constitutes a major use of Lake Mead. The dam is 726 feet high and the water depth is approximately 590 feet. Lake Mead can store water to a maximum elevation of 1,221.4 feet above msl (maximum water surface). Hoover Dam spillway gates in the raised position would equal elevation 1229 feet. At that elevation Lake Mead has a nominal "live capacity" of 27,377,000 af and an active capacity of 17,353,000 af above elevation 1083 feet msl, the minimum elevation for power generation. However, sediment accumulation in the upper end of the reservoir is gradually decreasing the water storage capacity. The dam backs water upstream approximately 115 miles creating a surface area of about 163,000 acres at its maximum design water surface elevation of 1229 feet msl. Flood storage of 1.5 maf is located between elevation 1,219.6 and 1,229 msl.

Hoover Powerplant is a major source of hydropower in the Southwest. The powerplant generating capacity is rated at approximately 2,062,000 Kw with maximum release capacity of approximately 49,000 cfs. The spillways have a maximum release capacity of about 400,000 cfs at 1,232 msl with the drum gates in a closed position. This provides a total release capacity of 449,000 cfs.

Davis Dam – Davis Dam and Powerplant are 67 miles downstream from Hoover Dam, and approximately 2 miles upstream from Laughlin, Nevada, and Bullhead City, Arizona. The dam's primary purpose is to re-regulate Hoover Dam releases and aid in delivery of Mexico's annual apportionment of 1.5 maf, and meet downstream demand. Located on the Arizona side of the river, the Davis Dam Powerplant has five generating units, each rated at 50,000

Kw, whose combined hydraulic capacity is 31,000 cfs.

Lake Mohave lies behind Davis Dam and is bounded for most of its 67-mile length by the steep walls of Pyramid, Eldorado, and Black Canyons. The lake is relatively narrow, not more than 4 miles across at its widest point, but provides significant recreation opportunities and habitat for fish and wildlife. The lake also captures and delays flash flood discharge from the side washes below Hoover Dam. Typical flow time from Hoover Dam to Lake Mohave is 4 to 6 hours. The lake has a storage capacity of 1,818,000 af.

Parker Dam – Parker Dam spans the Colorado River between Arizona and California 17 miles northeast of the town of Parker, Arizona. Parker Dam's primary purpose is to provide reservoir storage from which water can be pumped into the Colorado River aqueduct and the CAP aqueduct. Lake Havasu, the reservoir behind Parker Dam, is about 45 miles long and covers 20,390 acres. It can store 648,000 af of water. Typical flow time from Davis Dam to Lake Havasu is 1 to 1.5 days.

Parker Powerplant is located on the California side of the Colorado River immediately below the dam. It houses four hydroelectric generating units, each of which can produce 30,000 Kw of hydroelectric power. Four 22-foot diameter penstocks carry up to 5,500 cfs each, to feed the generating units. Fifty percent of the plant's power output is reserved for MWD's use to pump water along the Colorado River aqueduct to the Pacific Coast. The remaining power is marketed by WAPA, a DOE agency. Under an agreement between Reclamation and MWD, the latter agency financed essentially the entire cost of constructing Parker Dam. MWD's Whitsett Pumping Plant, 2 miles upstream from the dam on Lake Havasu, lifts water from the reservoir into the Colorado River Aqueduct.

Headgate Rock Dam – Headgate Rock Dam is located on the river about 14 miles below Parker Dam about a mile northeast of the town of Parker. It was constructed as a diversion structure to provide irrigation water to the Colorado River Indian Reservation. A 3-unit, low-head powerplant is built into the dam structure. The water retained by the dam is named Lake Moovalya, which extends upstream approximately 10 miles and contributes a stable water surface to the recreational area referred to as the Parker strip. The dam raises the river water level approximately 15 feet but develops no useable storage. The water releases below Headgate Rock Dam mirror the releases from Parker Dam. The maximum powerplant discharge is 20,000 cfs. The maximum generating capacity of the powerplant is 19.5 MW. Typical flow time from Parker Dam to Headgate Rock Dam is 1 to 4 hours.

Palo Verde Diversion Dam – The Palo Verde Diversion Dam consists of a concrete, gated structure with an adjacent embankment, constructed as a permanent replacement for the old Palo Verde rock weir. The dam raises the water levels approximately 12 feet, which is sufficient for the gravity flow to provide the water supply to the Palo Verde Valley including the city of Blythe. The impoundment has no useable storage even though the backwater from the dam reflects approximately 15 miles upstream. The dam is operated and maintained by the PVID. Typical flow time from Headgate Rock Dam to Palo Verde Diversion Dam is about 1 day.

Senator Wash Pumping/Generating Plant and Regulating Reservoir – The Senator Wash facility is a pumped offstream storage facility located approximately 2 miles upstream from Imperial Dam. It was constructed to supplement limited storage behind Imperial Dam and Laguna Dam responding to sudden changes in water delivery requirements at Imperial Dam; the water travel time from Davis Dam to Imperial Dam is 3 days or more. When sufficient storage is not available at Imperial and Laguna Dams, Senator Wash is used to regulate excess flows arriving at Imperial Dam to prevent over deliveries to Mexico, and to ensure demands can be met when flows arriving at Imperial Dam are less than water user demand. The reservoir elevation fluctuates according to water user demand and flows arriving at Imperial Dam.

The reservoir has a capacity of 13,836 af at elevation 251 feet msl. However, current reservoir restrictions prevent raising the reservoir to elevation 251 feet due to concerns with seepage and high hydraulic pressure under the toe of Senator Wash Dam and along Squaw Lake Dike.

<u>Imperial Dam</u> – Imperial Dam, approximately 18 miles northeast of Yuma, Arizona, was constructed to provide a diversion of Colorado River water to the Imperial and Coachella Valleys, to the Reservation Division and the City of Yuma through the first reach of the All-American Canal on the west side of the dam; and to the Gila Project and the Yuma Auxiliary Project through the Gila Gravity Main Canal on the east side of the dam. Imperial Dam, which raised the water surface above the original river 23 feet to elevation 181 feet msl, was designed to provide a maximum diversion of 15,155 cfs for the All-American Canal; 2,200 cfs for the Gila Gravity Main Canal; and was designed to pass a maximum flood of 180,000 cfs. Typical flow time from Palo Verde Diversion Dam to Imperial Dam is about 2 days.

Imperial Dam created a reservoir that originally had a capacity of 85,000 af but, as was anticipated, the reservoir quickly filled with sediment. Intermittent dredging and sluicing operations are required to maintain a small reservoir pool of about 1,000 af in capacity to ensure diversions can be made to the All-American Canal and Gila Gravity Main Canal. Desilting works were provided for both the All-American Canal and Gila Gravity Main Canal. Sediment accumulations are sluiced downstream to the Laguna Desilting Basin where the sediment is removed by dredging and disposed of adjacent to the desilting basin.

<u>All-American Canal, Pilot Knob and Siphon Drop Powerplants</u> – The All-American Canal is approximately 80 miles long and provides irrigation water to over 500,000 acres of land in the Imperial Valley, over 78,000 acres in the Coachella Valley, approximately 15,000 acres in the Reservation Division of the Yuma Project, and over 40,000 acres in the Valley Division of the Yuma Project. Situated along the All-American Canal are two turnouts through which water is released for use in Mexico and in the Reservation Division, after passing through a powerplant at each turnout.

A wasteway was constructed on the All-American Canal at Pilot Knob, to which a power generation facility was added. Both facilities are located upstream of Morelos Dam. The wasteway was constructed to protect the All-American Canal and provide a place to discharge excess water back to the Colorado River, in particular those deriving from side wash inflows or sudden water user cutbacks in Imperial Valley. Pilot Knob Powerplant was constructed to allow generation of power from water deliveries made in satisfaction of the 1944 Treaty with

Mexico. Pilot Knob has 55 feet of hydraulic head and can produce up to 33,000 Kw of electricity.

Siphon Drop Powerplant operates to develop power from Yuma Project deliveries and deliveries made to Mexico. Currently, if Mexico's order at the NIB, less drainage return flows and sediment control flows below Imperial Dam, is greater than 800 cfs, the water is routed through the Pilot Knob Powerplant to generate power, which then takes away water that would otherwise have been delivered either below Laguna Dam or through Siphon Drop Powerplant and the California wasteway near Yuma, Arizona.

If Mexico's order at the NIB, less drainage return flows and sediment control flows below Imperial Dam, is less than 800 cfs, the water is normally routed through the Siphon Drop Powerplant to generate power. Siphon Drop Powerplant requires a minimum flow of 350 cfs to operate and, to the extent possible, this flow is maintained through delivery requirements to Mexico and water ordered for the Valley Division of the Yuma Project.

The Yuma Main Canal wasteway, more commonly referred to as the California wasteway, was constructed to protect the Yuma Main Canal if excess flows are diverted into the canal or sudden cutbacks in water use in the Yuma Valley occur. The wasteway allows those excess flows to be diverted back into the Colorado River. Now a portion of the water delivery to Mexico is routed down the All-American Canal through Siphon Drop Powerplant and the Yuma Main Canal wasteway.

Laguna Dam – Laguna Dam was originally constructed (1905 - 1909) to serve as a diversion structure and desilting works for the Yuma Main Canal on the California side of the Colorado River and for the North Gila Canal on the Arizona side of the Colorado River. The dam raised the water level above the original stream bed approximately 13 feet. However, now these canals receive their water from the All-American Canal, diverted at Imperial Dam. And Laguna Dam serves as a regulating structure for sluicing flows that control sediment below Laguna Dam, and to help store excess flows that arrive at Imperial Dam to prevent over deliveries to Mexico. Water stored behind Laguna Dam can be used to make up part of Mexico's water order when a shortage of water relative to water user demand arrives at Imperial Dam. Laguna Dam also protects the downstream toe of Imperial Dam. Typical flow time from Imperial Dam to Laguna Dam is about 2 hours.

Total storage behind Laguna Dam is currently estimated to be 700 af. Prior to the 1983 Colorado River flood the capacity was approximately 1,500 af. Dredging was carried out behind Laguna Dam in the 1950s to the early 1970s, in order to maintain its relatively small storage capacity. Sediment removed from above Laguna Dam was placed directly downstream of the rockfill weir in the flood plain.

Morelos Dam – Morelos Dam is located along the limitrophe section of the Colorado River, approximately 9 miles southwest of Yuma, Arizona. Morelos Dam was constructed by Mexico to provide a diversion for the delivery of Colorado River water to the Mexicali Valley. Mexico is responsible for the operation and maintenance of Morelos Dam and associated expenses.

Under Minute 242 (Minutes are defined as decisions of IBWC and signed by the Mexican and United States commissioners of IBWC) of the Mexican Water Treaty of 1944, up to 140,000 af annually of agricultural drainage water can be delivered to Mexico at the SIB. The remaining 1,360,000 af of water is to be delivered to Mexico at the NIB annually and diverted at Morelos Dam to the Mexicali Valley of Mexico

Flows below Morelos Dam occur only when water in excess of Mexico's diversion requirements arrives at the dam, in which case the excess is normally passed through Morelos Dam into the original Colorado River Channel downstream. Water in excess of Mexico's water order occurs when surplus or flood releases are made from either the Colorado River system or the Gila River system. Excess water arriving at Mexico may also result from side wash inflows that occur above or below Imperial Dam; from a sudden drop in water user demand; or when insufficient storage is available in Senator Wash, Imperial or Laguna reservoirs.

Flows arriving at Morelos Dam normally range from about 900 cfs to over 3,000 cfs during the year. During 1983, flows in excess of 40,000 cfs arrived at the NIB due to flood control releases on the Colorado River, and in 1993 flows in excess of 25,000 cfs arrived at the NIB due to flooding on the Gila River. Typical flow time from Laguna Dam to Morelos Dam is about 6 hours.

ATTACHMENT D

Glen Canyon Dam Operation Record of Decision

This attachment is the October 8, 1996 Record of Decision prepared for the Operation of Glen Canyon Dam Final Environmental Impact Statement, March 1995.

RECORD OF DECISION

OPERATION OF GLEN CANYON DAM

Final Environmental Impact Statement

October 1996

Approved

Commissioner, U.S. Bureau of Reclamation Date OCT 08 1996

Secretary of the Interior Date OCT 09 1996

RECORD OF DECISION

OPERATION OF GLEN CANYON DAM
FINAL ENVIRONMENTAL IMPACT STATEMENT

I. INTRODUCTION

This record of decision (ROD) of the Department of the Interior, Bureau of Reclamation (Reclamation), documents the selection of operating criteria for Glen Canyon Dam, as analyzed in the final Environmental Impact Statement (EIS), dated March 21, 1995 (FES 95-8). The EIS on the operation of Glen Canyon Dam was prepared with an unprecedented amount of scientific research, public involvement, and stakeholder cooperation.

Scientific evidence gathered during Phase I of the Glen Canyon Environmental Studies (GCES) indicated that significant impacts on downstream resources were occurring due to the operation of Glen Canyon Dam. These findings led to a July 1989 decision by the Secretary of the Interior for Reclamation to prepare an EIS to reevaluate dam operations. The purpose of the reevaluation was to determine specific options that could be implemented to minimize, consistent with law, adverse impacts on the downstream environment and cultural resources, as well as Native American interests in Glen and Grand Canyons. Analysis of an array of reasonable alternatives was needed to allow the Secretary to balance competing interests and to meet statutory responsibilities for protecting downstream resources and producing hydropower, and to protect affected Native American interests.

In addition, the Grand Canyon Protection Act of 1992 was enacted on October 30, 1992. Section 1802 (a) of the Act requires the Secretary to operate Glen Canyon Dam:

> "...in such a manner as to protect, mitigate adverse impacts to, and improve the values for which Grand Canyon National Park and Glen Canyon National Recreation Area were established, including, but not limited to natural and cultural resources and visitor use."

Alternatives considered include the No Action Alternative as well as eight operational alternatives that provide various degrees of protection for downstream resources and hydropower production.

II. DECISION

The Secretary's decision is to implement the Modified Low Fluctuating Flow Alternative (the preferred alternative) as described in the final EIS on the Operation of Glen Canyon Dam with a minor change in the timing of beach/habitat building flows (described below). This alternative was selected because it will reduce daily flow fluctuations well below the no action levels (historic pattern of releases) and will provide high steady releases of short duration which will protect or enhance downstream resources while allowing limited flexibility for power operations.

The Modified Low Fluctuating Flow Alternative incorporates beach/habitat-building flows which are scheduled high releases of short duration designed to rebuild high elevation sandbars, deposit nutrients, restore backwater channels, and provide some of the dynamics of a natural system. In the final EIS, it was assumed that these flows would occur in the spring when the reservoir is low, with a frequency of 1 in 5 years.

The Basin States expressed concern over the beach/habitat-building flows described in the final EIS because of the timing of power plant by-passes. We have accomodated their concerns, while maintaining the objectives of the beach/habitat-building flows. Instead of conducting these flows in years in which Lake Powell storage is low on January 1, they will be accomplished by utilizing reservoir releases in excess of power plant capacity required for dam safety purposes. Such releases are consistent with the 1956 Colorado River Storage Project Act, the 1968 Colorado River Basin Project Act, and the 1992 Grand Canyon Protection Act.

Both the Colorado River Management Work Group and the Transition Work Group, which participated in the development of the Annual Operating Plan and the EIS, respectively, support this change as it conforms unambiguously with each member's understanding of the Law of the River. These groups include representatives of virtually all stakeholders in this process.

The upramp rate and maximum flow criteria were also modified between the draft and final EIS. The upramp rate was increased from 2,500 cubic feet per second per hour to 4,000 cubic feet per second per hour, and the maximum allowable release was increased from 20,000 to 25,000 cubic feet per second. We made these modifications to enhance power production flexibility, as suggested by comments received. These modifications were controversial among certain interest groups because of concerns regarding potential impacts on resources in the Colorado River and the Grand Canyon. However, our analysis indicates that there would be no significant differences in impacts associated with these changes ("Assessment of Changes to the Glen Canyon Dam EIS Preferred Alternative from Draft to Final EIS", October 1995).

The 4,000 cubic feet per second per hour upramp rate limit will be implemented with the understanding that results from the monitoring program will be carefully considered. If impacts differing from those described in the final EIS are identified, a new ramp rate criterion will be considered by the Adaptive Management Work Group and a recommendation for action forwarded to the Secretary.

The maximum flow criterion of 25,000 cubic feet per second will be implemented with the understanding that actual maximum daily releases would only occasionally exceed 20,000 cubic feet per second during a minimum release year of 8.23 million acre-feet. This is because the maximum allowable daily change constraint overrides the maximum allowable release and because monthly release volumes are lower during minimum release years. If impacts differing from those described in the final EIS are identified through the Adaptive Management Program, the maximum flow restriction will be reviewed by the Adaptive Management Work Group and a recommendation for action will be forwarded to the Secretary.

III. DESCRIPTION OF ALTERNATIVES

Nine alternative methods of operating Glen Canyon Dam (including the No Action Alternative) were presented in the final EIS. The eight action alternatives were designed to provide a reasonable range of alternatives with respect to operation of the dam. One alternative would allow unrestricted fluctuations in flow (within the physical constraints of the power plant) to maximize power production, four would impose varying restrictions on fluctuations, and three others would provide steady flows on a monthly, seasonal, or annual basis. The names of the alternatives reflect the various operational regimes. In addition, the restricted fluctuating flow and steady flow alternatives each include seven elements which are common to all of them. These common elements are: 1) Adaptive Management, 2) Monitoring and Protecting Cultural Resources, 3) Flood Frequency Reduction Measures, 4) Beach/Habitat-Building Flows, 5) New Population of Humpback Chub, 6) Further Study of Selective Withdrawal, and 7) Emergency Exception Criteria. A detailed description of the alternatives and common elements can be found in Chapter 2 of the final EIS. A brief description of the alternatives is given below.

UNRESTRICTED FLUCTUATING FLOWS

No Action: Maintain the historic pattern of fluctuating releases up to 31,500 cubic feet per second and provide a baseline for impact comparison.

Maximum Power plant Capacity: Permit use of full power plant capacity up to 33,200 cubic feet per second.

RESTRICTED FLUCTUATING FLOWS

High: Slightly reduce daily fluctuations from historic levels.

Moderate: Moderately reduce daily fluctuations from historic levels; includes habitat maintenance flows.

Modified Low (Preferred Alternative): Substantially reduce daily fluctuations from historic levels; includes habitat maintenance flows.

Interim Low: Substantially reduce daily fluctuations from historic levels; same as interim operations except for addition of common elements.

STEADY FLOWS

Existing Monthly Volume: Provide steady flows that use historic monthly release strategies.

Seasonally Adjusted: Provide steady flows on a seasonal or monthly basis; includes habitat maintenance flows.

Year-Round: Provide steady flows throughout the year.

Table 1 shows the specific operational criteria for each of the alternatives.

IV. SIGNIFICANT ISSUES AND ALTERNATIVES

The Glen Canyon Dam EIS scoping process was initiated in early 1990 and the public was invited to comment on the appropriate scope of the EIS. More than 17,000 comments were received during the scoping period, reflecting the national attention and intense interest in the EIS.

As a result of the analysis of the oral and written scoping comments, the following were determined to be resources or issues of public concern: beaches, endangered species, ecosystem integrity, fish, power costs, power production, sediment, water conservation, rafting/boating, air quality, the Grand Canyon wilderness, and a category designated as "other" for remaining concerns. Comments regarding interests and values were categorized as: expressions about the Grand Canyon, economics, nonquantifiable values, nature versus human use, and the complexity of Glen Canyon Dam issues.

The EIS team consolidated and refined the public issues of concern, identifying the significant resources and associated issues to be analyzed in detail. These resources include: water, sediment, fish, vegetation, wildlife and habitat, endangered and other special status species, cultural resources, air quality, recreation, hydropower, and non-use value.

Further meetings were held with representatives from the cooperating agencies and public interest groups who provided comments on the criteria for development of reasonable alternatives for the EIS. The public also had an opportunity to comment on the preliminary selection of alternatives at public meetings and through mailings. The final selection of alternatives took into consideration the public's views.

V. COMMENTS RECEIVED ON THE FINAL EIS

Many comments and recommendations on the final EIS were received in the form of pre-printed postcards and letters that addressed essentially the same issues. The comments are summarized below along with Reclamation's responses.

COMMENT: Maintain Draft EIS flows. Modifying the upramp rate and maximum flows

Table 1.—Operating limits of alternatives identified for detailed analysis

	Unrestricted Fluctuating Flows		Restricted Fluctuating Flows				Steady Flows		
	No Action	Maximum Powerplant Capacity	High	Moderate	Modified Low	Interim Low	Existing Monthly Volume	Seasonally Adjusted	Year-Round
Minimum releases (cfs)[1]	1,000 Labor Day-Easter [2]3,000 Easter-Labor Day	1,000 Labor Day-Easter [2]3,000 Easter-Labor Day	3,000 5,000 8,000 depending on monthly volume, firm load, and market conditions	5,000	8,000 between 7 a.m. and 7 p.m. 5,000 at night	8,000 between 7 a.m. and 7 p.m. 5,000 at night	8,000	[3]8,000 Oct-Nov 8,500 Dec 11,000 Jan Mar 12,500 Apr 18,000 May-Jun 12,500 Jul 9,000 Aug Sep	Yearly volume prorated[4]
Maximum releases (cfs)[5]	31,500	33,200	31,500	31,500 (may be exceeded during habitat maintenance flows)	25,000 (exceeded during habitat maintenance flows)	20,000	Monthly volumes prorated	18,000 (exceeded during habitat maintenance flows)	Yearly volume prorated[4]
Allowable daily flow fluctuations (cfs/24 hours)	30,500 Labor Day-Easter 28,500 Easter-Labor Day	32,200 Labor Day-Easter 30,200 Easter-Labor Day	15,000 to 22,000	±45% of mean flow for the month not to exceed ±6,000	[6]5,000 6,000 or 8,000	[6]5,000 6,000 or 8,000	[7]±1,000	[7]±1,000	[7]±1,000
Ramp rates (cfs/hour)	Unrestricted	Unrestricted	Unrestricted up 5,000 or 4,000 down	4,000 up 2,500 down	4,000 up 1,500 down	2,500 up 1,500 down	2,000 cfs/day between months	2,000 cfs/day between months	2,000 cfs/day between months
Common elements	None	None	Adaptive management (including long-term monitoring and research) Monitoring and protecting cultural resources Flood frequency reduction measures Beach/habitat-building flows New population of humpback chub Further study of selective withdrawal Emergency exception criteria						

[1] In high volume release months, the allowable daily change would require higher minimum flows (cfs).
[2] Releases each weekday during recreation season (Easter to Labor Day) would average not less than 8,000 cfs for the period from 8 a.m. to midnight.
[3] Based on an 8.23-million-acre-foot (maf) year; in higher release years, additional water would be added equally to each month, subject to an 18,000-cfs maximum.
[4] For an 8.23-maf year, steady flow would be about 11,400 cfs.
[5] Maximums represent normal or routine limits and may necessarily be exceeded during high water years.
[6] Daily fluctuation limit of 5,000 cfs for monthly release volumes less than 600,000 acre-feet; 6,000 cfs for monthly release volumes of 600,000 to 800,000 acre-feet; and 8,000 cfs for monthly volumes over 800,000 acre-feet.
[7] Adjustments would allow for small power system load changes.

between the draft and final EIS has neither been open for public review nor subjected to serious scientific scrutiny. These changes should have been addressed in the draft EIS and made available for public comment at that time. Credible proof, based on the testing of a specific scientific hypothesis, that alterations in operating procedures at Glen Canyon Dam follow the spirit and intent of the Grand Canyon Protection Act needs to be provided. The burden of proof that there will be no impact on downstream resources rests with those proposing changes.

RESPONSE: The modification of the preferred alternative, which incorporated changes in the upramp rate and maximum flows, was made after extensive public discussion. The new preferred alternative was discussed as an agenda item during the May, June, August, and November 1994 public meetings of the Cooperating Agencies who assisted in the development of the EIS. A wide range of public interest groups received advance mailings and agendas and were represented at the public meetings. The environmental groups attending these meetings included: America Outdoors, American Rivers, Desert Flycasters, Environmental Defense Fund, Friends of the River, Grand Canyon River Guides, Grand Canyon Trust, Sierra Club, and Trout Unlimited. Meeting logs indicate that representatives from at least some of these groups attended all but the May meeting. In addition, approximately 16,000 citizens received periodic newsletters throughout the EIS process. This included a newsletter outlining the proposed changes issued several months prior to the final EIS. The environmental groups mentioned above were included on the newsletter mailing list.

Reclamation's research and analysis has been thorough with regards to changes in flows and ramping rates and potential impacts upon downstream resources. A complete range of research flows was conducted from June 1990 to July 1991. These included high and low fluctuating flows with fast and slow up and down ramp rates. Glen Canyon Environmental Studies Phase II identified cause and effect relationships between downramp rates and adverse impacts to canyon resources. However, no cause and effect relationships between upramp rates and adverse impacts to canyon resources were identified. The draft EIS, (a public document peer reviewed by GCES and the EIS Cooperating Agencies) states that upramp rates have not been linked to sandbar erosion (page 95) and that "Rapid increases in river stage would have little or no effect on sandbars." (page 190).

With respect to potential impacts occurring with the change in flows, it should be noted that sand in the Grand Canyon is transported almost exclusively by river flows. The amount of sand transported increases exponentially with increases in river flow. Maintaining sandbars over the long term depends on the amount of sand supplied by tributaries, monthly release volumes, range of flow fluctuations, and the frequency and distribution of flood flows. Conversely, occasional flows between 20,000 and 25,000 cubic feet per second may cause minor beach building, and may provide water to riparian vegetation.

As part of the EIS, the effects of each alternative on long-term sand storage in Marble Canyon (river miles 0 to 61) were analyzed. The Marble Canyon reach was chosen for analysis because it is more sensitive to impacts from dam operations than downstream reaches. For each fluctuating flow alternative, the analysis used 20 years of hourly flow modeled by Spreck Rosekrans of the Environmental Defense Fund and 85 different hydrologic scenarios (each representing 50 years of monthly flow data). This analysis was documented in the draft EIS on page 182, and Appendix D, pages 4-5. The analyses relating to the probability of net gain in riverbed sand for each alternative is documented in the draft EIS on pages 54-55, 184, 187, and 194.

Specific peer reviewed studies relating to the above analyses are listed in Attachment 1.

COMMENT: **Do not change the upramp rate and maximum flow criteria at the same time.** While acknowledging Reclamation's good efforts to identify and establish optimum operating criteria for all users of Glen Canyon Dam, changing two flow criteria (upramp rate and maximum flow criterion of preferred alternative) does not make prudent scientific sense. It will not result in reliable data. Not enough information is at hand to predict the outcome of these proposals.

RESPONSE: Viewed from the purely scientific viewpoint, it would be preferable to change variables one at a time in a controlled experiment. However, many uncontrolled variables already exist, and from a resource management standpoint the interest lies in measuring the possible resource impact, if any, which might result from jointly changing both criteria. The best available information suggests that the long-term impact of changing both criteria at once will be difficult, if not impossible to detect.

Even though both parameters would change, for 8 months of an 8.23 million acre foot year (minimum release year), only the upramp rate will be used. The ability to operationally exceed 20,000 cubic feet per second only exists in months in which releases are in excess of 900,000 acre feet. In a minimum release year, flows above 20,000 cubic feet per second will most likely occur in December, January, July, and August. Evaluation of the upramp rates can be initiated immediately with the evaluation of the increase in maximum flow relegated to the months with the highest volumes. New upramp and maximum flow criteria would be recommended through the Adaptive Management Program should monitoring results indicate that either of these criteria are resulting in adverse impacts to the natural, cultural, or recreational (human safety) resources of the Grand Canyon differing from those shown in the final EIS.

COMMENT: **"Habitat/Beach Building Floods" designed to redeposit sediment and reshape the river's topography much like the Canyon's historic floods should be conducted.** An experimental release based on this premise is critical to restore some of the river's historic dynamics; without it, any flow regime will result in continued loss of beach and backwater habitat. This "spike" should be assessed and implemented for the spring of 1996, subject to a critical evaluation of its flow size, timing, impact on fisheries, and completion of a comprehensive monitoring plan. Recent side-canyon floods underscore the need for restoring natural processes.

RESPONSE: Reclamation and the Cooperating Agencies continue to support this concept. The preferred alternative supports such a flow regime. A test flow was conducted this spring. The results of this flow are currently being analyzed. We expect to conduct more of these flows in the future.

COMMENT: **Endorse the Fish & Wildlife Service's Biological Opinion** and implement experimental steady flows to benefit native fishes, subject to the results of a risk/benefit analysis now in progress.

RESPONSE: The preferred alternative provides for experimental steady flows through the Adaptive Management Program for the reasons put forth in the Biological Opinion.

COMMENT: **Fund and implement immediately an Adaptive Management Program.** This is the appropriate forum to address important issues. It is imperative that resource management rely on good science to monitor, and respond to possible adverse effects resulting from changes in dam operations.

RESPONSE: The preferred alternative provides for implementation of an Adaptive Management Program.

COMMENT: **Interior Secretary Babbitt should issue a Record of Decision by December 31, 1995,** and conduct an efficient and timely audit by the General Accounting Office as mandated by the Grand Canyon Protection Act.

RESPONSE: In compliance with the Grand Canyon Protection Act, Interior Secretary Babbitt could not issue the Record of Decision until considering the findings of the General Accounting Office. Those findings were issued on October 2, 1996.

OTHER COMMENTS: Another set of comments were received from municipalities and other power user groups. These letters made up about 3 percent of the total received and were essentially identical in content. Although the authors were not totally in agreement with the preferred alternative because of the reduction in peaking power, they believe it is a workable compromise. These letters characterized the final EIS as ". . .a model for resolving complex environmental issues among divergent interests." They also urged the government to protect the integrity of the process, resist efforts to overturn the FEIS, and allow the scientists' assessment to stand, in as much as the Adaptive Management Process will give Reclamation an opportunity to evaluate the effects of operational changes over time and make modifications according to scientific findings.

RESPONSE: While the preferred alternative may not satisfy all interests, Reclamation believes it is a workable compromise and meets the two criteria set out in the EIS for the reoperation of the dam, namely restoring downstream resources and maintaining hydropower capability and flexibility.

A letter of comment from the Environmental Protection Agency (EPA) indicates that EPA's comments on the draft EIS were adequately addressed in the final EIS. It also expresses their support for the preferred alternative.

Samples of the comment letters and cards, and a copy of EPA's comment letter are included as Attachment 2.

VI. ENVIRONMENTAL COMMITMENTS AND MONITORING

The following environmental and monitoring commitments will be carried out under the preferred alternative or any of the other restricted fluctuating or steady flow alternatives described in the final EIS. A detailed description of these commitments can be found on pages 33 - 43 of that document. All practicable means to avoid or minimize environmental harm from the preferred alternative have been adopted.

1. **Adaptive Management:** This commitment includes the establishment of an Adaptive Management Workgroup, chartered in accordance with the Federal Advisory Committee Act; and development of a long-term monitoring, research, and experimental program which could result in some additional operational changes. However, any operational changes will be carried out in compliance with NEPA.

2. **Monitoring and Protection of Cultural Resources:** Cultural sites in Glen and Grand Canyons include prehistoric and historic sites and Native American traditional use and sacred sites. Some of these sites may erode in the future under any EIS alternative, including the no action alternative. Reclamation and the National Park Service, in consultation with Native American Tribes, will develop and implement a long-term monitoring program for these sites. Any necessary mitigation will be carried out according to a programmatic agreement written in compliance with the National Historic Preservation Act. This agreement is included as Attachment 5 in the final EIS.

3. **Flood Frequency Reduction Measures:** Under this commitment, the frequency of unanticipated floods in excess of 45,000 cubic feet per second will be reduced to an average of once in 100 years. This will be accomplished initially through the Annual Operating Plan process and eventually by raising the height of the spillway gates at Glen Canyon Dam 4.5 feet.

4. **Beach/Habitat-Building Flows:** Under certain conditions, steady flows in excess of a given alternative's maximum will be scheduled in the spring for periods ranging from 1 to 2 weeks. Scheduling, duration, and flow magnitude will be recommended by the Adaptive Management Work Group and scheduled through the Annual Operating Plan process. The objectives of these flows are to deposit sediment at high elevations, re-form backwater channels, deposit nutrients, restore some of the natural system dynamics along the river corridor, and help the National Park Service manage riparian habitats.

5. **New Population of Humpback Chub:** In consultation with the U.S. Fish and Wildlife Service (FWS), National Park Service, and Arizona Game and Fish Department (AGFD), Reclamation will make every effort (through funding, facilitating, and technical support) to ensure that a new population of humpback chub is established in the mainstem or one or more of the tributaries within Grand Canyon.

6. **Further Study of Selective Withdrawal:** Reclamation will aggressively pursue and support research on the effects of multilevel intake structures at Glen Canyon Dam and use the results of this research to decide whether or not to pursue construction. FWS, in consultation with AGFD,

will be responsible for recommending to Reclamation whether or not selective withdrawal should be implemented at Glen Canyon Dam. Reclamation will be responsible for design, NEPA compliance, permits, construction, operation, and maintenance.

7. **Emergency Exception Criteria:** Operating criteria have been established to allow the Western Area Power Administration to respond to various emergency situations in accordance with their obligations to the North American Electric Reliability Council. This commitment also provides for exceptions to a given alternative's operating criteria during search and rescue situations, special studies and monitoring, dam and power plant maintenance, and spinning reserves.

VII. BASIS FOR DECISION

The goal of selecting a preferred alternative was not to maximize benefits for the most resources, but rather to find an alternative dam operating plan that would permit recovery and long-term sustainability of downstream resources while limiting hydropower capability and flexibility only to the extent necessary to achieve recovery and long-term sustainability.

Based on the impact analysis described in the final EIS, three of the alternatives are considered to be environmentally preferable. They are: the Moderate Fluctuating Flow Alternative, the Modified Low Fluctuating Flow Alternative, and the Seasonally Adjusted Steady-Flow Alternative. Modified Low Fluctuating Flow is selected for implementation because it satisfies the critical needs for sediment resources and some of the habitat needs of native fish, benefits the remaining resources, and allows for future hydropower flexibility, although there would be moderate to potentially major adverse impacts on power operations and possible decreases in long-term firm power marketing. Nearly all downstream resources are dependent to some extent on the sediment resource. This alternative meets the critical requirements of the sediment resource by restoring some of the pre-dam variability through floods and by providing a long-term balance between the supply of sand from Grand Canyon tributaries and the sand-transport capacity of the river. This, in turn, benefits the maintenance of habitat. The critical requirements for native fish are met by pursuing a strategy of warming releases from Glen Canyon Dam, enhancing the sediment resource, and substantially limiting the daily flow fluctuations.

The decision process for selecting the preferred alternative for the EIS followed a repetitive sequence of comparisons of effects on downstream resources resulting from each alternative. Alternatives resulting in unacceptable adverse effects on resources (such as long-term loss of sandbars leading to the destruction of cultural resource sites and wildlife habitat) were eliminated from further comparisons. Comparisons continued until existing data were no longer available to support assumed benefits.

All resources were evaluated in terms of both positive and adverse effects from proposed alternatives. Once it was determined that all alternatives would deliver at least 8.23 million acre feet of water annually, water supply played a minor role in subsequent resource evaluations. (One of the objectives of the "Criteria for Coordinated Long-Range Operation of Colorado River Reservoirs" is a minimum annual release of 8.23 million acre feet of water from Glen Canyon

Dam.) The alternatives covered a range of possible dam operations from maximum utilization of peaking power capabilities with large daily changes in downstream river levels (Maximum Powerplant Capacity Alternative) to the Year-Round Steady Flow Alternative that would have eliminated all river fluctuations and peaking power capabilities. Within this range, the Maximum Powerplant Capacity, No Action, and High Fluctuating Flow alternatives were eliminated from consideration as the preferred alternative because they would not meet the first criterion of resource recovery and long-term sustainability. Data indicated that while beneficial to hydropower production, these alternatives would either increase or maintain conditions that resulted in adverse impacts to downstream resources under no action. For example, under these alternatives, the sediment resource would not likely be maintained over the long-term.

At the other end of the range, the Year-Round Steady Flow Alternative was also eliminated from consideration as the preferred alternative. This alternative would result in the greatest storage of sand within the river channel, the lowest elevation sandbars, the largest potential expansion of riparian vegetation, and the highest white-water boating safety benefits. However, it would not provide the variability on which the natural processes of the Grand Canyon are dependent (e.g. beach building, unvegetated sandbars, and backwater habitats). A completely stable flow regime would encourage the growth of vegetation thereby reducing bare-sand openings and patches of emergent marsh vegetation. This would limit beach camping and reduce the habitat value of these sites. With respect to other resources, this alternative did not provide any benefits beyond those already provided by other alternatives. Steady flows could also increase the interactions between native and non-native fish by intensifying competition and predation by non-natives on native fish. Such interactions would reach a level of concern under steady flows. Finally, this alternative would have major adverse impacts on hydropower (power operations and marketing).

The Existing Monthly Volume Steady Flow Alternative was eliminated from selection as the preferred alternative for reasons similar to those discussed above for the Year-Round Steady Flow Alternative.

Although the Interim Low Fluctuating Flow Alternative performed well over the interim period (August 1991 to the present), long-term implementation of this alternative would not restore some of the pre-dam variability in the natural system. The selected Modified Low Fluctuating Flow Alternative is an improved version of the Interim Low Fluctuating Flow Alternative because it would provide for some pre-dam variability through habitat maintenance flows.

The three remaining alternatives--the Moderate Fluctuating, Modified Low Fluctuating, and Seasonally Adjusted Steady Flow Alternatives-- provide similar benefits to most downstream resources (e.g.. vegetation, terrestrial wildlife, and cultural resources) with respect to increased protection or improvement of those resources (see Table II-7 in the EIS). The Moderate Fluctuating Flow Alternative provided only minor benefits to native fish over no action conditions because of the relative similarity in flow fluctuations; and the benefits from the Seasonally Adjusted Steady Flow Alternative were uncertain given the improvement in habitat conditions for non-native fish this alternative would provide. Seasonally adjusted steady flows also would create conditions significantly different from those under which the current aquatic ecosystem has developed in the last 30 years and would adversely affect hydropower to a greater extent than the other two alternatives. The Modified Low Fluctuating Flow could substantially improve the aquatic food base and benefit native and non-native fish. The potential exists for a minor increase in the native fish population.

Although the Moderate Fluctuating, Modified Low Fluctuating, and Seasonally Adjusted Steady Flow Alternatives provide similar benefits to most downstream resources, the Modified Low Fluctuating Flow Alternative was selected as the preferred alternative because it would provide the most benefits with respect to the original selection criteria, given existing information. This alternative would create conditions that promote the protection and improvement of downstream resources while maintaining some flexibility in hydropower production. Although there would be a significant loss of hydropower benefits due to the selection of the preferred alternative (between $15.1 and $44.2 million annually) a recently completed non-use value study conducted under the Glen Canyon Environmental Studies indicates that the American people are willing to pay much more than this loss to maintain a healthy ecosystem in the Grand Canyon. The results of this non-use value study are summarized in Attachment 3 of the ROD.

The results of a General Accounting Office (GAO) audit mandated by the Grand Canyon Protection Act are in Attachment 4 of the ROD. This audit generally concludes that Reclamation used appropriate methodologies and the best available information in determining the potential impact of various dam flow alternatives on important resources. However, GAO identified some shortcomings in the application of certain methodologies and data, particularly with respect to the hydropower analysis. Reclamation's assumptions do not explicitly include the mitigating effect of higher electricity prices on electricity demand (price elasticity). GAO also determined that Reclamation's assumptions about natural gas prices were relatively high and that two computational errors were made during the third phase of the power analysis. According to GAO, these limitations suggest that the estimated economic impacts for power are subject to uncertainty. GAO also found limitations with some of the data used for impact analysis. Certain data was incomplete or outdated, particularly data used in assessing the economic impact of alternative flows on recreational activities. Nevertheless, the National Research Council peer reviewed both the Glen Canyon Environmental Studies and the EIS, and generally found the analysis to be adequate. The GAO audit concluded that these shortcomings and limitations are not significant and would not likely alter the findings with respect to the preferred alternative and usefulness of the document in the decision-making process. The audit also determined that most of the key parties (83 percent of respondents) support Reclamation's preferred alternative for dam operations, although some concerns remain.

ATTACHMENT 1.

Specific peer reviewed sediment studies:

Beus, S. and C. Avery. 1993. The influence of variable discharge regimes on Colorado River sand bars below Glen Canyon Dam. Glen Canyon Environmental Studies, Report PHY0101, Chapters 1 through 7. Northern Arizona University, Flagstaff, AZ

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ATTACHMENT E

Surplus Criteria Proposal by Six States

This attachment is a December 4, 1998 document prepared by representatives of Arizona, Nevada, New Mexico, Colorado, Utah, and Wyoming presenting their joint recommendations on interim surplus criteria.

Proposal for Interim Lake Mead Reservoir Operation Criteria Related to Surplus, Normal, and Shortage Year Declarations

Prepared by Representatives of the States of Arizona, Colorado, Nevada, New Mexico, Utah, and Wyoming in Response to the Draft California 4.4 Plan

December 4, 1998

I. Introduction

The States of Arizona, Colorado, Nevada, New Mexico, Utah and Wyoming ("Six States") are encouraged by the progress presently being made by the Colorado River water users within the State of California, who are endeavoring to formulate a defined, enforceable program to reduce California's dependence on Colorado River water over its basic entitlement. If implemented as envisioned, California's plan to gradually step-down from its current use of over 5.2 million acre-feet ("maf") of Colorado River water to its basic apportionment amount of 4.4 maf over a ten-to-fifteen year period will be a significant accomplishment.

The California 4.4 Plan, however, is greatly dependent upon using Colorado River water made available from surplus declarations on the Colorado River as a way to ease the State's transition to living within its basic apportionment. The other Colorado River Basin States have been, up to now, unwilling to enter into discussions on operating criteria that would accommodate California's plan. The reason for this reticence is obvious--new reservoir operating criteria on the Colorado River must only be an interim measure while California steps down its Colorado River water use. The temporary criteria cannot be viewed as a means to continue California's utilization of Colorado River water above its basic entitlement. Therefore, the Six States have insisted that California demonstrate a tangible commitment to reduce its water use before entertaining discussions of transitory reservoir operating criteria that might facilitate that reduction.

The Six States now believe that a reasonable draft plan has been formulated by California and sufficient commitment to the plan's implementation has been demonstrated by water users in California to allow the initiation of discussions on special interim reservoir operating criteria. The purpose of this paper is to describe the parameters of the interim criteria that would be acceptable to the Six States. These parameters are consistent with and based upon the principles described in the paper issued by the Six States on October 20, 1998 titled Background and Principles for Negotiation – Special Interim Criteria for Releases of Water from Lake Mead During Implementation of the California 4.4 Plan.

II. Consistency with the Law of the River

It goes without saying that any interim operating criteria implemented to assist California in its program to eliminate its dependence on Colorado River water above its basic apportionment must be consistent with the Law of the River. Of particular importance in developing the interim criteria will be the apportionment system decreed by the United States Supreme Court under which water diverted into any of the three Lower Division States must fit within one of three categories:

1.) The water diverted is within that state's basic apportionment. Article II(B)(1) of the Decree, 374 U.S. 340 (1964).

2.) The water diverted is water that has been declared by the Secretary of the Interior as surplus water available above the 7.5 maf basic apportionment available to the Lower Division States. It must also be recognized that, of any amount declared to be available as surplus, only 50% of that amount is available to California, unless Arizona or Nevada choose not to divert and use the 46% and 4% of the surplus amount that is available to those states, respectively. Article II(B)(2).

3.) The water diverted is water that was available to one of the other Lower Division States in accordance with a) or b), above, but was unused by that state. Article II(B)(6).

III. Other Policy Considerations

In addition to the need for the interim reservoir operating criteria to be consistent with the existing Law of the River, the Six States assert that, as a matter of fairness to all Colorado River Basin States, the process of developing and promulgating interim criteria shall be consistent with the following principles:

1.) The federal government and California must affirmatively recognize that interim operating criteria are only temporary. The interim operating criteria will be in effect only during the transition period in which California reduces its dependence upon Colorado River water. Thus, the interim operating criteria must expire by their own terms no later than 2015. However, the interim criteria will also expire at an earlier date if it is established that California has achieved its goal of living within its basic 4.4 maf annual apportionment.

2.) California must commit to implementing its 4.4 Plan as quickly as possible. If, during the implementation phase of the Plan, it appears reasonable that the goal can be achieved more quickly than allowed for in the Plan, California must agree to take those steps reasonable to hasten achievement of the goal.

The Draft California 4.4 Plan proposed a two phased implementation process. The Six States accept the reasonableness of that approach, but disagree on the proposed time frame for implementation of the second phase. Rather than waiting for the completion of phase 1 core programs to begin phase 2, the Six States believe that phase 2 programs should be initiated by the year 2005. This policy is based on the desire for California to complete the entire reduction to 4.4 maf by the year 2015. This schedule provides six years for planning and environmental compliance, followed by ten years for implementation.

3.) For the reasons discussed above, the federal government and California must affirmatively recognize that there is a direct relationship between the continuation of the interim operating criteria and California's continued commitment and implementation of its plan to reduce its Colorado River water use to its legal entitlement of 4.4 maf/yr. At any point that there is demonstrated a diminishment or lack of commitment by California to achieve its goal as quickly as is practical, the interim operating criteria must be terminated.

4.) The interim criteria cannot be adopted without a parallel commitment among the Colorado River Basin States and the United States to determine how the River will be operated during periods of water shortage. The interim criteria providing surplus supplies will likely diminish the amount of Colorado River water in storage and thus increase the risk of water shortages on the river. While California will gain the greatest benefit under surplus criteria, it will place a greater risk of shortages on the other Lower Division States. Therefore, it is inherently unfair to Arizona and Nevada to adopt interim criteria without developing in parallel an understanding of how shortages on the river will be managed. The existence of water shortage management criteria is essential if those states are to adequately analyze the increased risks they would face from the interim surplus criteria.

5.) The United States and the Colorado River Basin States must commit to ongoing studies and analysis to examine whether the interim surplus operating criteria are causing an increased risk of water shortages to Arizona and Nevada. In this process, all parties must reach a mutual understanding of how increased risk will be measured.

6.) California must agree to mitigate any increased risk of shortage to Arizona and Nevada. That mitigation might be accomplished through several techniques including a waiver by California of the shortage protection it is afforded by 43 U.S.C. § 1521(b)or, by California agreeing to store in Arizona through the excess capacity available to the Arizona Water Banking Authority, water that could be used to compensate Arizona and Nevada for any increased water shortages they suffer due to the interim operating criteria. Impacts of this interim criteria on the Upper Basin States would be minimized by measures such as the establishment of interim 602 (a)storage criteria or through other mutually agreed-upon measures.

7.) Interim operating criteria provisions that would provide extra municipal and industrial water for California during that state's reduction in water use transition period must be designed to provide only that amount of water that is needed by California M&I users after other sources currently available to the state have been used.

The Metropolitan Water District of Southern California ("MWD") holds California priority 4 and 5 rights under the Seven Party Agreement to a total of 1.212 maf. The Six States believe that if this volume of water can be provided, the California 4.4 Plan's goal of keeping MWD's Colorado River Aqueduct "essentially full" will be satisfied.

The Six States believe that the volume of surplus water to be made available to MWD must first take into account water unused by higher priority users within California. The Draft 4.4 Plan sets forth a schedule which phases down California's overall demand for water as conservation measures are being implemented. What the Draft 4.4 Plan does not indicate is the amount of unused water that may be available from more senior water uses (present perfected rights and agricultural districts) which could keep the Colorado River Aqueduct full without requiring additional surplus deliveries. The Six States fully anticipate and expect that the water use of the more senior agricultural users will be carefully monitored by California and the Bureau of Reclamation and to the extent the irrigation districts do not use water within their contract entitlements, that water will be made available to MWD, thereby reducing the need for surplus releases from Lake Mead.

Likewise, to the extent that unused Arizona or Nevada basic apportionment can be made available to California users under the provisions of Article II(B)6 of the Decree, that water also must be counted against MWD's needs prior to determining the need for any surplus water derived under the interim criteria.

8.) To the extent that these interim criteria operate to provide extra water to municipal and industrial water users in Southern California, municipal and industrial water users in the other Lower Division States must be afforded the same opportunity, within the allocations defined by the Law of the River. For example, if the Secretary declares a surplus, it must be recognized that municipal and industrial water users in Nevada and Arizona would also be entitled to water above the states' basic apportionments to meet their needs.

9.) The Six States are well aware that the revised Draft 4.4 Plan calls for a considerable amount of groundwater banking within California at sites in the Cadiz Basin, Hayfield/Chuckwalla Basin, and Desert/Coachella Basin. These proposals will depend upon the availability of surplus Colorado River water. The Six States are concerned that under some circumstances these off stream banking proposals will lower reservoir levels to the point where the following year a "space building" type surplus will not be declared. The interim operating criteria proposed in the Draft 4.4 Plan insulates MWD from the effects of this condition by merely triggering a "Level 2 surplus" which still will keep the Colorado River Aqueduct full. The Six States believe that off stream banking of surplus water must be limited to only those years when a reservoir spill would otherwise be imminent.

IV. Proposed Lake Mead Reservoir Interim Operating Criteria

A. Introduction

The December 17,1997, Draft of the California 4.4 Plan outlined a proposal for Lake Mead reservoir operations. The Six States agree with many of the concepts set forth in that proposal. However, there are several areas in which those concepts deviate from the principles discussed above and thus are in need of further definition, discussion and clarification. This section briefly identifies those areas and proposed additional concepts.

The Draft California 4.4 Plan describes three levels of surplus criteria. Level 1 is a spill avoidance strategy based on anticipated runoff. Level 2 is a strategy that attempts to keep the Colorado River Aqueduct full during the transition period during which agricultural conservation measures are being implemented within California. Level 3 is similar to Level 2, except that the surplus supplies are more limited, and California is required to use additional alternate supplies including dry year land fallowing and groundwater basin pumping options if it wishes to keep the Aqueduct full.

The Six State proposal envisions a set of interim criteria for reservoir operation in which the various levels are less distinct. The Six State proposal seeks to achieve a balance between the need to release water to build storage space to avoid future flood control regulation dictated releases and the need to carry over as much water in storage as possible to sustain future water deliveries through droughts. Similar to the California proposal, the Six States are willing to provide California with additional water for a specified period of time while conservation measures are being implemented. The States believe that when California is successful in implementing programs for conservation transfers to M&I uses it will be able to meet its future needs within its basic 4.4 maf annual entitlement and, therefore, there will be no need to continue the proposed form of interim reservoir operating criteria in the future.

Underlying all levels of the Interim criteria is the commitment to attempt to meet the needs of southern California municipal and industrial water users which are causing the state to use more than its 4.4 maf basic apportionment. While this volume is expected to reduce continuously over time, it is still a significant amount of water , especially in the early years of the Plan's implementation. The Six State proposal also includes water for municipal uses in Southern

Nevada to meet Nevada's M&I needs above its basic apportionment of 0.3 maf after about the year 2005.

B. Tiered Surplus Strategy

The Six State proposal for Lake Mead operation, like the California 4.4 Plan proposal, envisions a tiered water management approach. In order to meet the objective of providing additional water to MWD and the Southern Nevada Water Authority ("SNWA"), Arizona must agree, under certain circumstances, to temporarily waive all or a portion of its legal entitlement to 46% of any surplus. The Six State tiered approach allows Lower Basin demands to be met incrementally based on designed surplus releases under certain reservoir conditions and anticipated runoff. The tiered approach steps are summarized as follows:

1.) Normal Year

During the period while the proposed interim criteria are in place, normal years will be declared only when available Lake Mead storage is at or below elevation 1125 (13.569 maf content). This represents about 3.8 maf of available storage capacity above the minimum power pool. This amount of storage will allow a minimum of five years of normal year deliveries through a drought cycle represented by the 33rd percentile lowest five year average of historic runoff. At the end of the five-year period, the reservoir elevation would be at 1083, which is the minimum power head (9.764 maf content). While this elevation is greater than the protection level proposed for declaration of shortages, the Six States feel that surplus declarations must be terminated 5 years before power production is impacted, rather than 5 years before the SNWA water intake structure is impacted.

In a normal year, California will be limited to 4.4 maf of consumptive use, and Nevada will be limited to 0.3 maf of consumptive use, unless unused apportionment is available from Arizona.

2.) Partial M&I Surplus

During the interim period, MWD and SNWA will be allowed to increase orders which would result in California's and Nevada's consumptive uses exceeding their basic apportionments. Under the partial surplus tier, the surplus volume would not be large enough to keep the Colorado River Aqueduct full nor to meet all of the potential needs of the SNWA. The volume of surplus will be dependent on the water demands in the given year, reduced by the conservation opportunities the entities have to provide additional supplies in dry years. The dry year options are expected to include land fallowing opportunities, groundwater importation, and recovery of water that had been previously banked within California or possibly in the Arizona Water Bank. The combination of these programs may yield as much as 250,000 acre feet per year in California. SNWA would probably rely on recovery of water from the Arizona Water Bank as its dry year option and would be required to reduce its surplus demand above 300,000 af by one-half.

The partial M&I surplus tier will be implemented when Lake Mead storage is between elevation 1125 and elevation 1145 (15.585 maf). The volume of the partial M&I surplus will vary yearly and will decline over time as California proceeds toward its 4.4 maf legal entitlement. It will be equal to the volume needed to deliver 1.212 maf through the MWD Colorado River Aqueduct, considering the amount of core transfer programs already in place, less 250,000 af. When California has reduced its demand to 4.65 maf or lower, the extra water made available through the partial M&I surplus tier will be zero.

3.) Full M&I Surplus

During periods when Lake Mead content is above elevation 1145, but less than the amount which would initiate a surplus under the space building or flood control criteria described below, limited surpluses would be declared that would meet the goal of keeping the Colorado River Aqueduct full and meeting the needs of the SNWA. The volume of this surplus, as it relates to the Colorado River Aqueduct, would be the difference between the amount of water necessary to keep the aqueduct full (1.212 maf) and the amount that MWD already has available to it from sources within California's 4.4 maf basic apportionment. MWD's available supply includes its own priority 4 and 5 entitlements under the Seven Party Agreement, the amount conserved through core conservation programs that have been implemented, and any unused apportionment from more senior California contractors. The overall Lower Basin surplus, i.e. the amount of delivery above 7.5 maf, would also be reduced to the extent there is Arizona or Nevada unused basic apportionment. The volume of water available to SNWA would be that amount needed for M&I purposes within SNWA's service area above Nevada's basic apportionment of 0.3 maf. Current projections indicate that SNWA may not need additional surpluses until about the year

2005. Surpluses made available under the full M&I surplus tier would only be used for delivery to meet direct use needs in that calendar year and may not be used to refill carryover storage in off-mainstream reservoirs or for groundwater banking programs.

4.) Additional Surpluses Based on Space Building to Contain Above-Average Runoff

This tier refers to interim reservoir operating criteria that will allow additional surplus amounts to be made available to create reservoir storage space in anticipation of above normal runoff. A surplus strategy based on enhanced space building criteria was proposed by the Bureau of Reclamation based on studies performed following the 1983 flood events on the Colorado River. In January, 1986, the Bureau issued a special report titled Colorado River - Alterative Operating Strategies for Distributing Surplus Water and Avoiding Spills. This report suggested operating strategies for avoiding Lake Mead spills that went beyond the Corps of Engineers flood control criteria, but were, in essence, based on similar principles. Under these criteria, limited surpluses would be determined based on the need to provide adequate storage capacity for an assumed runoff rather than the actual yearly forecast. The Six States propose that the assumed runoff be the value of the 70th percentile of exceedance based on the historic record which is equivalent to about 17.331 maf runoff above Lake Powell. Technical studies have named this strategy "70R."

In recent years, the Bureau of Reclamation has investigated a number of surplus strategies including "spill avoidance," "flood control avoidance," and "shortage avoidance." All of these methods have positives and negatives associated with them. The Six States believe that the "70R" strategy is the best for use during this interim period because any surplus water provided is incremental to the previous tier of a full M&I surplus. In other words, the surplus strategy is not necessary to provide additional water for high value M&I uses since those needs will have already been met. The increment of use that could be available above M&I would likely be for additional groundwater banking and perhaps additional agricultural water in California, Arizona, or Mexico. The Six States do not believe it is prudent to apply surplus strategies that make additional water available based on statistical spill avoidance analysis which will present a higher risk, if the incremental water benefits are limited to groundwater banking and agricultural purposes. The Six State proposal will make water available for such purposes in years when the "70R" strategy indicates that additional water should be released for beneficial use in lieu of potential release through the flood control criteria. If incremental surplus volumes are limited under this tier, priority must be given to groundwater banking for future M&I needs within California over agricultural uses. Agricultural uses in California should be limited to those years when the "70R" criteria results in large surplus volumes and there is a high degree of certainty that water would otherwise be subject to spill.

5.) Flood Control criteria

This tier refers to the current Corps of Engineers criteria for space building in Lake Mead that is necessary to avoid damaging levels of downstream flood releases. The flood control criteria is not, per se, a surplus strategy. Rather it is a strategy to use reservoir space to be able to reduce peak inflows so that outflow rates can be reduced to non-damaging levels. The surplus strategy relationship develops when the Corps criteria call for reservoir releases to be made at levels above downstream delivery requirements. Rather than let that volume be spilled to the Gulf of California, this tier of surpluses are designed to allow increased beneficial use in the Lower Division States and Mexico.

The Corps has defined specific volumes of storage space that must be left vacant during certain months of the year depending on forecast volumes to accommodate spring runoff or other unanticipated weather events. They have also mandated specific release rates by month to achieve these vacant storage spaces. In order to avoid the "dumping" of water in order to build storage space, provisions will be made which would allow the Lower Division States to schedule additional water for delivery. The volume of extra water available for delivery is equal to the amount that must be evacuated from storage, above regularly scheduled downstream demands, to meet the space requirements. Under some conditions, such as when the reservoirs are starting the year very full and when the forecast runoff is above average, the amount of flood control release could be several million acre feet. Under other circumstances, the space building formula may be such that only small volumes of water would need to be evacuated. However, since flood control related releases are generally associated with very full reservoir conditions, the Six State proposal would allow any and all beneficial uses to be met, including unlimited off stream groundwater banking and additional water for Mexico.

V. Shortage Determination Criteria

The Six States believe that considering current reservoir conditions and with prudent system management, the Secretary of the Interior should not have to declare a shortage condition for many years. Even with this recognition, the Six States believe that the establishment of shortage criteria that work in conjunction with the interim criteria is valuable for two primary reasons. First, the Arizona Water Bank has been created within Arizona primarily to store water underground over the next twenty years to mitigate the effects of future shortages to Arizona municipal water users. Shortage criteria are critical for Water Bank planning. The volumes of water that Arizona will withdraw as either basic apportionment or surplus apportionment over the next ten to twenty years is highly dependent on the need for water banking that will be used as shortage protection. Secondly, shortage criteria are needed to be able to identify any negative impacts created by the implementation of the temporary surplus criteria. All Six States, and especially Arizona and Nevada, want to be able to identify when the release of water to California from either the partial or full M&I surplus tiers, causes an increased risk of shortage. This analysis can only be performed if the shortage criteria are known.

The Bureau of Reclamation has been studying options for shortage criteria for a number of years. The framework for most of these strategies is to declare limited cutbacks well in advance of the point where those levels are critical. The most junior Lower Division water user, the Central Arizona Project, bears the burden of most of the delivery reduction. The timing of the reduction is based on the use of computer models to simulate reservoir operations. The model study focuses on the statistical probability of reservoir levels dropping below a critical "protect" level. The Six States endorse this framework and propose to adopt the protect level in Lake Mead of elevation 1050 (7.471 maf content) which is the elevation of the intake structure for the Southern Nevada Water Project. The Bureau of Reclamation has named this shortage strategy "80P1050." In accordance with the Bureau's studies, this level would not be guaranteed but the risk of drawing down to below that level would be limited to 20%. When the model studies indicate that the reservoir level is in jeopardy, a first tier shortage would be declared which would reduce Arizona's consumptive use by the CAP and other similar priority users to no more than 1,000,000 acre feet (about a 500,000 af reduction). Nevada would also share in shortages, but to a much more limited extent. If reservoir conditions continue to deteriorate, additional cuts in use by CAP will be required.

VI. <u>Overrun Accounting</u>

The Draft California 4.4 Plan includes a provision that allows individual entitlement holders to exceed their yearly apportionment. The proposed overrun would be constrained by a maximum allowable accrual and would be subject to repayment in subsequent years. The overrun accounting provision is tied to the administration of agricultural entitlements.

The Six States are concerned with the overrun provisions. First, as the Colorado River enters into an era of limits, the States expect the Bureau of Reclamation to strictly enforce its contracts and the entitlements. In essence, within the Lower Basin, the Bureau must play the role of the State Engineer and enforce current limits on diversions by water users. Secondly, the Six States are leery of proposals that would allow significant diversions above the amount of water allowed to a state in shortage, normal, or limited surplus years according to the proposal described in this paper. It would be extremely inequitable to allow California agricultural districts to overrun their diversions by 10%, which is over 300,000 acre feet, while at the same time calling for the Central Arizona Project to reduce diversions by 500,000 acre feet because a shortage had been declared.

In spite of these significant concerns, the Six States do recognize that there may be limited occasions when <u>inadvertent</u> overruns will occur. Due to the fact that the annual entitlement of a junior priority district is dependent on the actual use by a senior priority user, there may be occasions when a district will order water only to find out later that it had exceeded its contract entitlement. This matter is further compounded in the Lower Basin because a state's apportionment is for consumptive use rather than diversions. Until the books are reconciled to calculate diversions less measured and unmeasured return flows, it may not be possible to know whether or not an overrun has occurred until the after-the-fact accounting is completed.

The Six States propose that a limited form of overrun accounting be instituted. It must be based on the following principles:

1.) Overruns must be inadvertent.

2.) Overruns may not exceed 7% of annual entitlement.

3.) Overruns must be repaid the following year by the entity that benefitted from the extra water unless the following year's operation is controlled by the flood control regulation and water must be released beyond downstream demands.

VII. Control of Illegal Diversions and Uses

The implementation of interim reservoir operating criteria cannot stand alone in the water management of the Lower Colorado River. The Six States' concern about California's continuing use of Colorado River water above its basic apportionment is an indicator that they believe that the era of limits in the Lower Basin has begun. In order to implement and enforce these limits so that other states or individual water entitlement holders are not adversely impacted, the Bureau of Reclamation must move forward with its identification of Lower Basin water users who are either exceeding contract entitlements or are diverting water without a contract. The Bureau must take steps necessary to require more accurate measurement and reporting of diversions. It must also develop accurate techniques for determining both measured and unmeasured return flows to the river. The issues of withdrawal of Colorado River water from wells must be dealt with either by adopting a modified version of the "bright line" approach currently being considered by the Bureau or by some other scientifically and legally valid approach. The Bureau must consult with the affected states and water users before proposing any final regulation, but it should establish a schedule and process to undertake this necessary step.

VIII. Conclusion

The Governor's representatives of the States of Arizona, Colorado, Nevada, New Mexico, Utah and Wyoming have stated on numerous occasions their desire to work with representatives of California to develop and implement a plan that will, over time, eliminate California's dependence on Colorado River water above its 4.4 maf basic apportionment. One critical component of that plan is the implementation of interim Lake Mead reservoir operating criteria that will provide California M&I entities greater security of supply through the Colorado

River Aqueduct than currently exists. The Six State Representatives conditioned their willingness to work on mutually agreeable interim operating criteria on California's commitment to enter into a defined, enforceable program to reduce its dependence on Colorado River water over its basic entitlement in a way that avoids undue risk of shortage to other Basin States. While California has not yet completed the 4.4 Plan that will create the framework for the defined, enforceable program that the Six States require, it has made meaningful progress. In recognition of that progress and in order to move the discussions forward, last October the Six States set forth their principles for defining the interim operating criteria. They have now added additional explanation and detail to those principles.

The Six State proposal is based on a number of legal and policy considerations. Critical to these considerations is that the interim operating criteria must be accomplished within the existing "Law of the River." Also, any risk of future shortages resulting from the interim operating criteria be must be borne by those who benefitted. The proposal for surplus determination is similar in approach to that proposed in the December 1997 Draft California 4.4 Plan, but contains differences in several of the specific provisions. The Six States also believe that issues of shortage criteria, overrun accounting, and control of illegal diversions and uses must be addressed and have suggested how those issues should be resolved.

The representatives of the Six States believe that this proposal should be viewed as a positive step toward the successful completion and implementation of the California 4.4 Plan. They believe the time has come to expedite discussions with California's representatives on these critical Colorado River issues.

ATTACHMENT F

Surplus Criteria Proposal by California

This attachment contains a document prepared by agencies in California presenting their recommendations on interim surplus criteria. This document was published as Exhibit A of an October 15, 1999 document entitled *Key Terms for Quantification of Settlement Among the State of California, IID, CVWD and MWD.*

EXHIBIT A:

SURPLUS CRITERIA FOR MANAGEMENT OF THE COLORADO RIVER

Need For Development of Revised Interim Surplus Criteria

The Criteria for Coordinated Long-Range Operation of the Colorado River Reservoirs (LROC) reflect the multiple purposes for which the reservoir system is operated. Resource management requires the optimization of the operation of the Colorado River System reservoirs to satisfy the growing needs of these purposes. The Colorado River has been widely developed through great investments by the federal government and many water and power agencies to provide system storage of more than 60 million acre-feet. The reservoir system and its extensive storage allows the operation of the Colorado River to be efficiently managed so as to optimize the beneficial use of this resource which supports more than 20 million people and multi-billion dollar farm and business economies.

The governing view of river operations during the development of the LROC anticipated that the level and growth of water needs for this period and beyond would be such that little or no surplus water would occur, and did not contemplate a prolonged interim period of surplus water. Most efforts relating to reservoir operations in the development of the LROC focused on shortage criteria. Consequently, Colorado River management has the consequence of maximizing the amount of water held in storage in the near term. This strategy tends to force more flood control releases in wet years, in excess of downstream needs and the ability to divert and store such water for subsequent use. In dry years, this strategy leans towards not releasing water to users even though there is a high probability for the next fifteen years of surplus water releases in excess of needs and the ability to store and divert such water. Overall, this strategy does not optimize the beneficial use of this valuable resource because it does not take full advantage of the high volume of storage created by the extensive infrastructure on the river. It was also envisioned in the 1968 Colorado River Basin Project Act that there would be a federal augmentation of the flow of Colorado River. In the absence of augmentation, the ability to optimize the use of available surplus water and to store water off-stream is essential.

Revised interim surplus criteria are needed to guide reservoir operations to increase the reasonable and beneficial use of surplus water while keeping risk of shortages minimal. Specific criteria would provide for more effective and efficient use of Colorado River water by providing for steadier releases over longer periods of time. This would reduce the need for flood control releases in excess of the downstream needs, and increase the ability to divert and store such water for subsequent use.

Surplus criteria based on these principles would promote water use efficiency, and provide increased reliability and predictability to Colorado River water users. Predictability would allow water agencies to more effectively plan for the future, and more efficiently allocate limited resources as appropriate. More predictable releases could also benefit the planning required for developing the Lower Colorado River Multi-Species Conservation Program.

A. Implementation of Surplus Criteria

Revised interim surplus criteria should preferably be developed pursuant to Article III(3) of the LROC. These surplus criteria would be used in conjunction with the LROC to develop the annual operating plan (AOP). In this way, the surplus criteria will provide a high degree of certainty by adoption through a formal process with public comment and input, and publication in the Federal Register. Certainty is enhanced through the five-year review process already present in the LROC which requires consultation with the Basin states and water users, before changes to the surplus criteria can be implemented. By keeping reviews of the surplus criteria on a five-year time frame, agencies can develop data and gain experience on how the surplus criteria are operating without reacting to annual fluctuations.

By the same token, the five-year review process in the LROC provides flexibility through a process in which the surplus criteria can be adjusted without requiring a lengthy administrative process. The AOP consultation process will serve to put parties on notice of any concerns regarding the operation of the surplus criteria, which can then be addressed through the five-year review. This orderly process will prevent sudden or unilateral changes to the surplus criteria while providing flexibility to adapt the surplus criteria to changed conditions as circumstances warrant.

The current schedule for development of surplus criteria by the Department of the Interior calls for circulation of final NEPA documentation in December 2000, with a Record of Decision by January 2001. This schedule allows the surplus criteria to provide the sought for benefits and certainty within a reasonable timeframe.

B. Revised Surplus Criteria

Revised interim surplus criteria, also referred to as "River Re-operations", are based on a strategy of optimizing use of existing storage to make available the maximum amount of surplus water while keeping risk of shortages to a minimum during at least the first fifteen-year period of the California Quantification Settlement, and possibly beyond. This allows for an efficient use of the existing supply of Colorado River water by utilizing storage to reduce flood control releases. The use of revised surplus criteria during this period also allows California to achieve a "soft landing", avoiding severe supply impacts and lengthy legal disputes over water rights, in implementing the California Plan to reduce annual Colorado River water usage to 4.4 million acre-feet when required.

The proposed surplus criteria specifically use elevations at Lake Mead as a trigger, instead of the previous concept, which used avoidance of flood control releases as the trigger. This management strategy uses three levels of surplus water releases with elevation triggers that are adjusted periodically to reflect real world conditions in the Colorado River Basin.

The proposed surplus criteria provide significant surplus water benefits to California, Arizona, and Nevada--allowing for beneficial use of water that would otherwise likely be lost. River modeling indicates that the risk of shortage to Arizona and Nevada is quite slight, and even these small risks can be mitigated. For instance, with regard to shortage risk for the Central Arizona Project caused by revised surplus criteria, there would be a zero percent likelihood of shortage through 2010, and a 1 to 6 percent likelihood from 2011 through 2015. Withdrawing prior surplus water from groundwater storage could completely offset the likelihood of shortage through 2015. Such surplus criteria would provide for more effective use of surplus water, and provide greater benefits to California, Arizona, and Nevada than under previous proposals.

The proposed three levels of surplus criteria are as follows:

Level 1 Surplus Release – Level 1 surplus releases will be based on a Lake Mead elevation at or above 1,160 feet (17.6 million acre-feet (MAF) in storage at Lake Mead) starting in 2001 and rising to 1,166 feet (18.4 MAF in storage) by 2015. The trigger elevations will be adjusted based on demands within the Upper Basin. Actual trigger levels will be based on reality and have the ability to be adjusted depending on the real usage of Colorado River water. If the Upper Basin demand for a given calendar year differs from the current assumed projection of demand, the elevation levels will be adjusted upward or downward by 1-foot for every 1.7 percent change in the Upper Basin demands. Level 1 surplus releases will be available to Arizona, California and Nevada for all direct uses or off-stream storage based on the current surplus allocation (46%-50%-4%, respectively). Storage water is essential for increasing water supply reliability during inevitable shortage or normal years. Any water apportioned to but unused in any state will be available for use in the other states.

Level 2 Surplus Release – Level 2 surplus releases will be based on a Lake Mead elevation at or above 1,116 feet (13.0 MAF in storage) in 2001 (but below the Level 1 surplus of 1,160 feet in that year) and rising to 1,125 feet (13.9 MAF in storage) in 2015 (but below the Level 1 surplus of 1,166 feet in that year). Here again, the trigger elevation will be subject to adjustment over time. If the Upper Basin demand for a given calendar year differs from the current assumed projection of demand, the elevation levels will be adjusted upward or downward by 1-foot for every 1.1 percent change in the Upper Basin demands. Under a Level 2 surplus declaration, surplus water will be made available for the following uses: Metropolitan will keep the Colorado River Aqueduct full, the Southern Nevada Water Authority will meet water needs in its service area, and the Central Arizona Project will meet water needs in its service area. In keeping the Colorado River Aqueduct full, Metropolitan will divert water conserved and available to Metropolitan under the IID/MWD Water Conservation Program, the IID-SDCWA Transfer, and the All American and Coachella Canal lining projects before diverting Level 2 surplus water. Surplus water will not be made available for any other agricultural uses. Surplus water may be stored for municipal and industrial uses only. Any water apportioned to but unused in any state will be available for use in the other states.

Level 3 Surplus Releases -- Level 3 surplus releases will be based on a Lake Mead elevation at or above 1,088 feet (10.5 MAF in storage) in 2001 (but below the Level 2 surplus of 1,116 feet in that year) and rising to 1,098 feet (11.3 MAF in storage) in 2015 (but below the Level 2 surplus of 1,125 feet in that year). Here again, the trigger elevation will be subject to adjustment over time. If the Upper Basin demand for a given calendar year differs from the current assumed projection of demand, the elevation levels will be adjusted upward or downward by 1 foot for every 1 percent change in the Upper Basin demands. Under a Level 3 surplus declaration, surplus water will be made available to satisfy Indian and urban demands; Metropolitan will keep the Colorado River Aqueduct full, the Southern Nevada Water Authority will meet water needs in its service area, and the Central Arizona Project will meet urban and Indian water needs in its service area. In keeping the Colorado River Aqueduct full, Metropolitan will divert water conserved and available to Metropolitan under the IID/MWD Water Conservation Program, the IID-SDCWA Transfer, the All American and Coachella Canal lining projects, and an additional 100,000 acre-feet from other sources annually, before diverting Level 3 surplus water. The additional 100,000 acre-feet will come either from already banked off-stream storage or an option type program similar to the MWD-PVID Test Land Fallowing

Program. Surplus water will not be made available for agricultural uses or for off-stream storage. Any water apportioned to but unused in any state will be available for use in the other states.

ATTACHMENT G

Surplus Criteria Proposal by Pacific Institute

This attachment contains correspondence from the Pacific Institute for Studies in Development, Environment, and Security. Included are a February 15, 2000 letter report presenting their proposed alternative for interim surplus criteria and an excerpt from their September 8, 2000 letter of comment on the DEIS, in which they propose certain modifications of the alternative proposed in February. The entire text of their September 8, 2000 letter is reproduced in Volume III.

American Rivers · Defenders of Wildlife · Environmental Defense · Friends of Arizona Rivers
Glen Canyon Institute · Grand Canyon Trust · Land and Water Fund of the Rockies
Pacific Institute for Studies in Development, Environment, and Security
Sierra Club · Sonoran Institute

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1849 C Street, NW
Washington, DC 20240

Robert Johnson
Regional Director
Lower Colorado River Region
Bureau of Reclamation
PO Box 61470
Boulder City, NV 89006

RE: Colorado River Interim Surplus Criteria

February 15, 2000

Dear Mr. Hayes and Mr. Johnson:

On behalf of American Rivers, Defenders of Wildlife, Environmental Defense, Friends of Arizona Rivers, Glen Canyon Institute, Grand Canyon Trust, Land and Water Fund of the Rockies, the Pacific Institute for Studies in Development, Environment, and Security, Sierra Club, and the Sonoran Institute, we submit the following set of interim surplus criteria. We support the development of interim surplus criteria that would facilitate California's reduction in demands on the Colorado River to 4.4 million acre-feet (maf) per year by the year 2015. Yet, absent explicit environmental safeguards, interim surplus criteria for the Colorado River could have long-term negative impacts on the Colorado River Delta. We write to ensure that the needs of the Delta are recognized and satisfied as California implements its 4.4 Plan. We submit the following general set of interim surplus criteria as an alternative that would balance the municipal and industrial (M&I) water needs of Southern California and Southern Nevada with the instream flow requirements of the lower Colorado River and its Delta. We urge you to consider these interim criteria in the upcoming draft Environmental Impact Statement.

In his speech before the Colorado River Water Users Association in Las Vegas last December, the Secretary of the Interior described an important environmental baseline that should inform the development of interim surplus criteria. The Secretary stated that surpluses must be determined and allocated with *no net loss* of environmental benefits. "No net loss" sets an important minimum standard and is a welcome commitment by the Secretary.

Background

Historically, prior to the construction of dams, diversions, and other reclamation projects, millions of acre-feet of Colorado River water flowed every year through the Colorado River Delta and into the Upper Gulf of California, supporting tremendous levels of biological productivity and diversity. The Delta has been degraded as human demands have dramatically reduced the amount of water reaching the Delta. Except for years with unusually high run-off, virtually the entire flow of the Colorado is now captured and used before reaching the river's mouth. However, even without the historic flows, the remnants of the Delta and Upper Gulf still comprise the largest and most critical desert wetland in North America, as well as one of the world's most diverse and productive marine ecosystems. In recent years, flood release flows from upstream dams have prompted the re-emergence of ecologically valuable riparian habitat and have been strongly correlated with a rise in the shrimp catch in the Upper Gulf, an indication of the renewed viability of an important estuary. In 1993, Mexico affirmed the importance of the region and designated it a Biosphere Reserve, which has since received international recognition.

At its upper reaches, the Delta is dominated by vegetation such as cottonwoods and willows, offering more than twice the amount of native riparian habitat found in the entire reach of the river in the United States from Hoover Dam to Morelos Dam. The native riparian vegetation of the lower Colorado River and the Delta evolved in response to occasional flood events; such flows must be replicated to ensure the continued viability of these species. The middle extent of the Delta contains extensive backwaters filled by occasional floods, providing valuable wetland habitat for migratory birds as well as a myriad of local species. The Delta supports several species listed by the U.S. Fish & Wildlife Service, including southwestern willow flycatchers (*Empidonax traillii extimus*), Yuma clapper rails (*Rallus longirostris yumanensis*), totoaba (*Totoaba macdonaldi*) and desert pupfish (*Cyprinodon macularius*), while the river's estuary is home to the vaquita porpoise (*Phocoena sinus*), the world's most endangered marine mammal.

Interest in the Delta of the Colorado River has grown markedly in the past decade. Scientists from Mexico and the United States are studying the physical and biological characteristics of the region, increasing our understanding of its value not only as a desert wetland and stopover on the Pacific Flyway, but also as a species reservoir for the lower Colorado River as a whole. Historically, plant and animal species moved upstream to re-colonize the riparian corridor of the lower Colorado after periodic large-magnitude floods devastated that reach of the river. Recent, preliminary research indicates that the quantity of Colorado River baseline flows necessary to sustain the upper reaches of the Delta on an annual basis is at least 32,000 acre-feet, with periodic flood flows of at least 260,000 acre-feet every four years, on average, to promote seedling recruitment.[1] These instream flows thus represent the minimum quantities necessary to prevent a net loss of environmental

[1] See Glenn, Edward P., Valdes-Casillas, Carlos, "Importance of United States' Water Flows to the Colorado River Delta and the Northern Gulf of California, Mexico," unpub. October 13, 1998, at 14; and Luecke et al., *A Delta Once More*, Washington, DC: EDF Publications, June 1999.

benefits in the upper reaches of the Delta. (Such flood flows would also have a demonstrable salutary effect on the lower reach of the Colorado River within the United States, freshening backwaters and promoting germination of native vegetation.) Ongoing research will further improve our understanding of the ecosystems of the Delta and Upper Gulf. This research will also describe the instream flow requirements of other elements of the system. When they become available, these refined assessments of instream flow requirements should be incorporated into the interim surplus criteria described in the following.

No Net Loss

The Secretary's "no net loss" standard should be applied to the losses to the Delta from allocating "surplus" water to California and to any other potential losses in the United States or Mexico. No water shall be considered surplus until the Secretary has been assured, through a plan for releases of sufficient instream flows, mitigation, reservoir management, and other measures, that additional consumptive use would cause no net loss of the environmental benefits that would result if the potential "surplus" were left in the river. Water is surplus only if those benefits are maintained by flows or through mitigation. Managing water available in the river after satisfying the lower basin and Mexican apportionments could benefit riparian areas or wetlands or fish and wildlife or endangered species or water quality, in the United States and/or in Mexico. If there is scientific evidence that these benefits would be lost by consuming the water, no determination of surplus shall be made until the loss of those benefits can be mitigated.

An assessment of the environmental benefits that could accrue if the erstwhile surplus water were not consumed is therefore a prerequisite to allocating surpluses. Conducting such an assessment will require a well-funded adaptive management program for the Delta that includes monitoring and research. Such a program should be an integral component of the interim surplus criteria. Such an adaptive management program is necessary to understanding the environmental baseline and satisfying the Secretary's no net loss standard.

Discretion

Allocation of surplus water, over and above the basic lower basin apportionment, is a discretionary function of the Secretary that can and should be exercised consistent with other responsibilities incumbent upon him for allocating the benefits of the river, planning its use, and protecting its resources. Past decisions on development, basic allocations, and operations were made before most of those other responsibilities had been articulated under laws and policies of the United States. This has resulted in serious environmental harm. Given this situation, the Secretary can and should use his discretion in this more enlightened era to the maximum extent possible to ensure that his decisions result in no further harm and, wherever possible, in an improvement of environmental quality.

Environmental needs must be met before any quantity of discretionary water is dedicated to consumptive uses. Until then it is not truly "surplus." Environmental losses were perhaps unfortunate consequences of the basic allocations embedded in the law of the river and related development; but they need not be perpetuated when the Secretary has discretion over whether and when to allocate additional water. The Secretary recognized as much when he insisted that the surpluses must be determined and allocated with no net loss of environmental benefits.

Surplus Criteria

We support the development of interim surplus criteria to guide the Secretary of the Interior's decision to determine a surplus condition for the Colorado River. We agree that interim surplus criteria should facilitate California's reduction in consumptive use of Colorado River water down to California's entitlement of 4.4 maf/year. Since the objective is California's successful and timely implementation of a 4.4 Plan, surplus criteria should be interim and should be explicitly linked to California's diligent and timely reduction of demand on Colorado River water. We are in general agreement with the principle offered by the Six States' proposal that interim surplus criteria should be directed towards providing greater security of supply through the Colorado River Aqueduct (CRA), after all other potential sources of Colorado River water are exhausted. We further agree that the declaration of surplus under the interim criteria should be explicitly linked to California's diligent implementation of water conservation strategies as specified in the 4.4 Plan, and that surplus allocations should be suspended in the absence of such implementation. In any case, these interim criteria should expire in 2015.

Absent a prolonged above-average cycle of precipitation in the Upper Basin and explicit environmental safeguards, the interim surplus criteria would reduce Colorado River reservoir storage, in turn decreasing the likelihood of the flood release and space-building flows that sustain the Colorado River Delta, undermining efforts to restore and preserve the Delta and violating the Secretary's no net loss standard.

Prior to the implementation of interim surplus criteria, there must be a guaranteed delivery of water to the Delta. Surplus conditions should not be declared until sufficient water is identified and scheduled to be delivered to meet the water needs of the Delta, as described above. Article II(A) of the Supreme Court Decree (1964) states that "river regulation" and flood control are the Secretary's first priority in managing the Colorado River, precedent over deliveries for consumptive uses. "River regulation" has yet to be satisfactorily defined; today it necessarily encompasses the full range of the Secretary's authority and missions under current law including but not limited to fish and wildlife, recreation, water quality, and conservation of endangered species. As a first priority under the Decree, "river regulation" would therefore permit the delivery of water to the Delta as described below.

We recommend an interim tiered strategy to meeting the needs of both the Delta and the municipal and industrial needs of California's coastal plain and of southern Nevada. This tiered strategy is a modified version of that proposed by the Six States in December 1998. In this modified approach, guarantees of delivery to satisfy the baseline needs of the Delta would be made before any surplus flows for M&I could be allocated in the United States or Mexico. In the tiered interim surplus strategy outlined in the following, surplus agricultural deliveries could only be scheduled after the Secretary makes his no net loss determination as described above, including scheduling the necessary delta flood flows. Diversions for off-stream storage and groundwater banking would be permitted from flood release flows.

Proposed Interim Surplus Criteria

We recommend that the Interim Surplus Criteria contain the following provisions:

No water shall be considered surplus until the Secretary has been assured, through a plan for releases of sufficient instream flows, mitigation, reservoir management, and other measures, that additional consumptive use would cause no net loss of the environmental benefits that would result if the potential "surplus" were left in the river. If there is scientific evidence that these benefits would be lost by consuming the water, no determination of surplus shall be made until the loss of those benefits can be mitigated. The Secretary shall make a no net loss determination before releases at any of the three surplus tiers — partial M&I, full M&I, or full surplus.

The Secretary's no net loss determination shall be based on an assessment of the lower Colorado River as a whole, including the Colorado River Delta. Conducting such an assessment will require a well-funded adaptive management program for the Delta that includes monitoring and research. Current research, based on empirical evidence from the past decade, suggests that the baseline and Delta flood flow releases described below may serve as interim mitigation measures. The Delta flow requirements and other conditions necessary to achieve no net loss shall be adjusted from time to time as the Secretary deems appropriate based on scientific and technical information.

The surplus criteria described below are interim and are intended to expire in 2015.

1) **Normal Year**
Normal years will be declared when available Lake Mead storage is at or below elevation 1120.4 (13.40 maf storage). This level will allow a minimum of five years of normal year deliveries through a drought cycle represented by the 34th percentile lowest five year average of historic runoff. At the end of the five-year period, the reservoir elevation would be at 1083, which is the minimum power head (9.764 maf content).

2) **Baseline Delta Flows**
When Lake Mead storage is above elevation 1120.4, the Bureau of Reclamation will deliver at least 32,000 af to the Delta.[2] These waters shall be released on a consistent, regular basis, to provide a perennial flow for the upper reaches of the Delta.

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[2] Quantities of water determined sufficient to provide baseline and flood flows for the Colorado River Delta shall be adjusted periodically through adaptive management based on ongoing research and data

3) **Partial M&I Surplus**
Equivalent to the Six States' 1998 proposal, that releases will be dependent on the water demands in the given year, reduced by the conservation opportunities available in dry years. This tier yields a maximum surplus of about 412,000 af for California and half of Nevada's demonstrated surplus demand. Total volume of this tier is equivalent to that needed to deliver 1.212 maf through the CRA, considering the amount of core transfer programs already in place, less 250,000 af. This tier is implemented between Lake Mead elevation 1125 and elevation 1145, upon a "no net loss" determination by the Secretary, as described above, and based on such conditions and operational changes as the Secretary may require.

4) **Full M&I Surplus**
Equivalent to the Six States' 1998 proposal. This would effectively make available an additional 250,000 af for MWD, after other sources had been exhausted, and would satisfy southern Nevada's full M&I needs. In this tier, surpluses could not be used for offstream storage, groundwater banking, or agricultural uses. This tier is triggered at Lake Mead elevation 1145, upon a "no net loss" determination by the Secretary, as described above, and based on such conditions and operational changes as the Secretary may require.

5) **Delta Flood Flows**
This tier is triggered by the Bureau of Reclamation's 70 percent flood control avoidance (70A1) elevation, which is the elevation required on January 1 to avoid flood control releases with a 70% assurance over the next sixty years. This is a slightly more liberal definition of surplus than the Bureau's "70R" criteria. When the surface of Lake Mead exceeds this elevation at the beginning of the year, the Bureau will deliver at least 260,000 af to the Delta.[2] These waters shall be released as late in the Spring as possible without violating Army Corps of Engineers flood control release guidelines.

6) **Full Surplus**
Upon a "no net loss" determination by the Secretary, as described above, and based on such conditions and operational changes as the Secretary may require, this tier is triggered when an assumed runoff, set at the 70th percentile of exceedance (roughly 17.3 maf), less uses and losses and delta flood flows, would cause Lake Mead elevation on January 1 to exceed the required system space capacity of 5.35 maf. In this tier, agricultural uses would be permitted, in addition to the M&I permitted in previous tiers.

Shortage Criteria

The implementation of surplus criteria based upon demand rather than supply, as is the case with the California 4.4 Plan and current efforts to develop security of supply through the CRA, will increase the likelihood of shortage conditions on the river in future years. The Department of the Interior should define shortage criteria so that stakeholders

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collection.

will be better able to project future supply and plan accordingly. The Record of Decision should commit the Department of the Interior to commencing rulemaking and appropriate environmental reviews at once, leading to setting shortage criteria that will based on principles consistent with those that guide the surplus criteria, including protection against net loss of environmental benefits.

Mexico and the Delta

If at any time surplus flows intended to benefit the Delta are intercepted and consumed by users within Mexico, further deliveries of surplus waters for such purposes shall cease unless and until Mexico enters into a commitment to prevent future releases from being diverted and consumed and to guarantee their delivery to the Delta.

Mexico and Surplus

Article 10 of the 1944 Treaty with Mexico grants the International Boundary and Water Commission (IBWC) the discretion to determine surplus flows to Mexico. It is therefore beyond the scope of the current process to set surplus criteria for Mexico.

Thank you for the opportunity to participate in this important process.

Sincerely,

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Southwest Regional Office
American Rivers

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Patricia Mulroy, Southern Nevada Water Authority
Rita Pearson, Arizona Department of Water Resources
Thomas Turney, New Mexico State Engineer
Greg Walcher, Colorado Water Conservation Board
Gerald Zimmerman, Colorado River Board of California
John Bernal, IBWC
Arturo Herrera Solis, CILA
Julia Carabias Lillo, SEMARNAP
Francisco Oyarzabal Tamargo, Comision Nacional del Agua
Lic. José Samaniegos, SEMARNAP

Excerpts from

Pacific Institute Comments

on the

Colorado River
Interim Surplus Criteria
Draft Environmental Impact Statement

A report of the

PACIFIC INSTITUTE FOR STUDIES IN
DEVELOPMENT, ENVIRONMENT AND SECURITY

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The following information is excerpted from an attachment to the Pacific Institute's letter of September 8, 2000 commenting on the Colorado River Interim Surplus Criteria Draft EIS.

PACIFIC INSTITUTE PROPOSAL

The "Environmental Interim Surplus Criteria," submitted by ten NGOs and subsequently endorsed by the Center for Biological Diversity and The Wilderness Society, should be analyzed in a supplemental DEIS. These criteria would satisfy the objective of facilitating California's reduction in its use of Colorado River water, without forcing the environment to bear the costs of such actions. Although similar in many respects to the Six States Plan, the Environmental Criteria differ sufficiently to merit appraisal in a supplemental DEIS.

In the following, and per previous conversations and correspondence with Reclamation staff, we offer suggestions as to how best to model the Environmental Interim Surplus Criteria, and suggest several specific projections that should be included in the supplemental DEIS.

Clarifications:

- Reclamation should model the monthly release schedule under "2) baseline delta flows" so that these delta flows are relatively constant throughout the year
- Reclamation should model the monthly release schedule under "5) delta flood flows" so that 100% of such releases are made from May through July, peaking in June at a ratio of 35%: 45%: 20% (flows in other months would be released by the baseline flow trigger, above)
- Due to difficulties in modeling a Secretarial determination of "No Net Loss," for the purposes of modeling Reclamation should assume that such a determination is made

Differences between the Environmental Criteria ("NGO") and the 7 States' Plan ("States"):

- **Normal elevation trigger**: ≤ 1120.4 for NGO, ≤ 1125 for States
- **Baseline delta flows** 0.032 MAF above elevation 1120.4 for NGO; none for States
- **Partial M&I/Domestic surplus elevation** triggered between 1125 & 1145 for both; for purposes of these modeling runs, the quantities of water released under the two plans are equivalent
- **Full M&I/Domestic Surplus** triggered above elevation 1145. NGO plan equivalent to States' plan with the following exceptions: Total deliveries through the Colorado River Aqueduct would be limited to 1.212 million acre-feet under the NGO plan instead of 1.250 under the States' plan
- **Delta Flood Flows** triggered by Reclamation 70 percent flood control avoidance elevation (70A1) under the NGO plan; no such release under the States'

- **Full Surplus/Quantified Surplus** 70R trigger for both plans, although for the purposes of determining the trigger elevation the NGO plan considers the above delta baseline and flood flows as "uses" and the States plan does not (so the trigger elevation will be higher under the NGO plan). Unlike the States' plan, under the NGO plan, no water would be made available to California or Nevada for off-stream storage, including groundwater banking, under this tier, and no surplus water would be made available to Arizona for such purposes under this tier.
- **Flood Control Surplus** equivalent for the two plans
- **Shortage Criteria** the NGO plan does not establish shortage criteria

ATTACHMENT H

Lower Division Depletion Schedules

This attachment contains schedules of projected depletions (consumptive use) of Colorado River system water by the Lower Division States. These schedules were used in the Colorado River Simulation System to model the river system operation under baseline conditions and the alternatives.

Attachment H

Lower Division Depletion Schedules

Overview

This attachment to the Colorado River Interim Surplus Criteria FEIS consists of the depletion schedules for the Lower Division states (17 tables) that were used to simulate the Colorado River water demands under the modeled baseline conditions and each of the surplus alternatives. These schedules contain the states' projections of future water needs. Separate schedules were used for normal, surplus, and shortage conditions. Schedules used for more than one alternative and/or baseline conditions are hereafter noted accordingly. It should be noted that the data presented in this attachment is model input data and should not be confused with the model output data discussed in Section 3.3.4 and 3.4 of the main document.

Normal Depletion Schedules With and Without California Transfers

The surplus alternatives (Basin States, California, Flood Control, Six States, and Shortage Protection alternatives) and the baseline conditions used normal schedules that included proposed California intrastate water transfers.

A breakdown of the depletions for the major diverters in each state is included in the appropriate schedule. Smaller diversions are aggregated into a single amount that is referred to as "Other Users" (i.e. Other AZ Users). Table H-1 presents a summary of the Lower Basin depletion schedule that shows depletions for the major diverters and other users by state as well as a total for the lower basin. The "other user's" depletion schedules (from Table H-1) for the states of Arizona, California and Nevada are shown in more detail on Tables H-3, H-4 and H-5, respectively.

The baseline conditions were also modeled without California intrastate water transfers and the results were evaluated in a sensitivity analysis (see Attachment L). The California intrastate water transfers affect the schedules of MWD, CVWD and IID only. The depletion schedule for these entities under the baseline without transfers modeled conditions are also presented in Table H-2. It should be noted that the transfers were based on Reclamation's interpretation of the original California 4.4 Plan (December 1997) and subsequent discussions with the State of California with respect to data changes. It should also be noted that IID's depletion schedule under these modeled conditions reflects IID's most recent 10-year average depletion.

The California Alternative normal schedule is shown in Table H-11. This schedule is not to be confused with the depletion schedules that were used to model the four other surplus alternatives (Basin States, Flood Control, Six States, and Shortage Protection alternatives). Under the California Alternative, PVID is assumed to transfer 100,000 acre-feet to the MWD under normal conditions. This modeling assumption is indicative of the type of intrastate water transfer that might occur under the California Plan and is not intended to imply that the transfer will occur. The depletion schedules of the rest of the California users, as well as for the states of Arizona and Nevada remained unchanged from the normal schedules used to model the other alternatives.

For all normal schedules, Arizona depletions for the first four years (2002 through 2005) are below its 2.8 million acre-feet (maf). Arizona's unused apportionment is distributed as follows:

- Metropolitan Water District of Southern California (73 percent of unused apportionment), and
- Southern Nevada Water Authority (27 percent of unused apportionment)

Shortage Depletion Schedules

Under shortage conditions, the model used operating rules to determine the shortage condition deliveries, instead of using specific shortage schedules, as discussed in Section 3.3.3.

Under a Level 1 shortage condition, the CAP deliveries are reduced to one mafy and the SNWA receives a delivery reduction equal to four percent of the total shortage amount. The model computes and allocates these Level 1 shortage condition deliveries in years when the modeled conditions render a Level 1 shortage condition. Table H-6 presents a summary of the Lower Division depletion schedule with the reduced CAP and SNWA depletions under a Level 1 shortage condition. The California normal depletion amount is included to show a total for the lower basin after a Level 1 shortage is computed.

A Level 2 shortage condition occurs if the Lake Mead water surface elevation drops below 1000 feet msl. Under a Level 2 shortage condition, the deliveries to the CAP and SNWA are further reduced, as needed, to maintain the Lake Mead water level at 1000 feet msl. If the Lake Mead water level continues to drop and if the CAP deliveries are reduced to zero, then at that time, the deliveries to MWD and Mexico would also be reduced, as needed, to maintain the Lake Mead water surface level at 1000 feet msl. CAP deliveries of zero were not observed in the simulations conducted as part of this FEIS.

Surplus Depletion Schedules

For the baseline conditions and Shortage Protection Alternative, the full surplus depletion schedule was used to model deliveries under surplus water supply conditions. Under a full surplus condition, the full amount of surplus water requested by each agency with a surplus water contract is delivered.

Furthermore, a full surplus delivery would be available under baseline conditions and all surplus alternatives when water is released from Lake Mead in excess of lower basin demands due to flood control regulations. Under these conditions, the model will assume delivery of up to the annual full surplus schedules, depending upon which month the flood control begins. Once a flood control surplus is determined, it remains in effect for the remainder of that calendar year. The full surplus schedules are shown in Table H-7. It should be noted that this schedule includes the California intrastate water transfers. The only difference between the full surplus schedules of the with transfers and without transfers conditions is the IID depletion. IID's full surplus amount without transfers is equal to a constant 3,240,000 afy, while the full surplus amount with transfers is equal to 250,000 afy plus IID's normal schedule from Table H-1. The full surplus schedules for the baseline without transfers condition are shown in Table H-8.

The Six States Alternative used a "tiered" surplus strategy, making different amounts of water available under each tier (or level) as specified for the Lake Mead elevation triggers. The first level is identical to the baseline (70R), and therefore uses the full surplus schedules with transfers. The second and third level surplus schedules for the Six State alternative are shown in Tables H-9 and H-10, respectively.

The California Alternative also used a "tiered" surplus strategy, making different amounts of water available under each tier (or level) as specified for the Lake Mead elevation triggers. The first and second level surplus schedules for the California Alternative are shown in Tables H-12 and H-13 and do not include the transfer of 100,000 acre-feet to MWD from PVID's schedule. The third level surplus schedules are shown in Table H-14 and again would transfer 100,000 acre-feet to MWD. Surplus water deliveries to Arizona and Nevada occur only in the first level of surplus and are full surplus deliveries. No surplus deliveries to Arizona and Nevada would take place in the second or third levels.

The Basin States Alternative also used a "tiered" surplus strategy (similar to that of the Six States Alternative) making different amounts of water available under each tier (or level) as specified for the Lake Mead elevation triggers. The first level of surplus is shown in Table H-15. The second and third level surplus schedules are shown in Table H-16 and Table H-17, respectively.

The contents of Tables H-1 through H-17 are listed on the following tabulation.

LISTING OF TABLES	
H-1	Normal Schedules with California Intrastate Transfers (kaf)
H-2	Normal Schedules without California Intrastate Transfers (kaf)
H-3	State of Arizona - Other Users (kaf)
H-4	State of California - Other Users (kaf)
H-5	State of Nevada - Others Users (kaf)
H-6	Lower Division Level 1 Shortage Schedules (kaf)
H-7	Full Surplus Schedule with California Transfers (kaf)
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Table H-1
Normal Schedules with California Intrastate Transfers (kaf)

Year	CALIFORNIA					ARIZONA			NEVADA			TOTAL
	CA Others	MWD	IID	CVWD	CA TOTAL	AZ Other	CAP	AZ Total	NV Other	SNWP	NV Total	L.B.
2002	444	645	2959	360	4407	1332	1458	2790	26	277	303	7500
2003	445	674	2939	354	4412	1337	1447	2784	26	278	304	7500
2004	446	758	2902	350	4455	1342	1382	2724	27	294	321	7500
2005	447	743	2882	356	4427	1348	1415	2763	28	282	310	7500
2006	449	784	2811	356	4400	1353	1447	2800	28	272	300	7500
2007	451	802	2786	361	4400	1359	1441	2800	28	272	300	7500
2008	454	819	2761	366	4400	1364	1436	2800	29	271	300	7500
2009	456	837	2736	371	4400	1369	1431	2800	29	271	300	7500
2010	459	855	2711	376	4400	1375	1425	2800	29	271	300	7500
2011	463	870	2686	381	4400	1375	1425	2800	29	271	300	7500
2012	468	865	2681	386	4400	1376	1424	2800	29	271	300	7500
2013	472	861	2676	391	4400	1376	1424	2800	29	271	300	7500
2014	477	856	2671	396	4400	1377	1423	2800	29	271	300	7500
2015	482	852	2666	401	4400	1378	1422	2800	29	271	300	7500
2016	482	852	2661	406	4400	1378	1422	2800	29	271	300	7500
2017	482	852	2656	411	4400	1379	1421	2800	29	271	300	7500
2018	482	852	2651	416	4400	1380	1420	2800	29	271	300	7500
2019	482	852	2646	421	4400	1380	1420	2800	29	271	300	7500
2020	482	852	2641	426	4400	1381	1419	2800	29	271	300	7500
2021	482	852	2636	431	4400	1382	1418	2800	29	271	300	7500
2022	482	852	2631	436	4400	1383	1417	2800	29	271	300	7500
2023	482	852	2626	441	4400	1385	1415	2800	29	271	300	7500
2024	482	852	2621	446	4400	1386	1414	2800	29	271	300	7500
2025	482	852	2616	451	4400	1388	1412	2800	29	271	300	7500
2026	482	852	2611	456	4400	1389	1411	2800	21	279	300	7500
2027	482	852	2611	456	4400	1390	1410	2800	13	287	300	7500
2028	482	852	2611	456	4400	1392	1408	2800	13	287	300	7500
2029	482	852	2611	456	4400	1393	1407	2800	13	287	300	7500
2030	482	852	2611	456	4400	1394	1406	2800	13	287	300	7500
2031	482	852	2611	456	4400	1395	1405	2800	13	287	300	7500
2032	482	852	2611	456	4400	1396	1404	2800	13	287	300	7500
2033	482	852	2611	456	4400	1397	1403	2800	13	287	300	7500
2034	482	852	2611	456	4400	1398	1402	2800	13	287	300	7500
2035	482	852	2611	456	4400	1398	1402	2800	13	287	300	7500
2036	482	852	2611	456	4400	1399	1401	2800	13	287	300	7500
2037	482	852	2611	456	4400	1400	1400	2800	13	287	300	7500
2038	482	852	2611	456	4400	1401	1399	2800	13	287	300	7500
2039	482	852	2611	456	4400	1402	1398	2800	13	287	300	7500
2040	482	852	2611	456	4400	1402	1398	2800	13	287	300	7500
2041	482	852	2611	456	4400	1403	1397	2800	13	287	300	7500
2042	482	852	2611	456	4400	1403	1397	2800	13	287	300	7500
2043	482	852	2611	456	4400	1403	1397	2800	13	287	300	7500
2044	482	852	2611	456	4400	1404	1396	2800	13	287	300	7500
2045	482	852	2611	456	4400	1404	1396	2800	13	287	300	7500
2046	482	802	2661	456	4400	1404	1396	2800	13	287	300	7500
2047	482	802	2661	456	4400	1404	1396	2800	13	287	300	7500
2048	482	802	2661	456	4400	1405	1395	2800	13	287	300	7500
2049	482	802	2661	456	4400	1405	1395	2800	13	287	300	7500
2050	482	802	2661	456	4400	1405	1395	2800	13	287	300	7500

Table H-2
Normal Schedules without California Intrastate Transfers (kaf)

Date	CA Other	MWD	IID	CVWD	CA Total
2002	444	644	2990	330	4407
2003	445	647	2990	330	4412
2004	446	690	2990	330	4455
2005	447	660	2990	330	4427
2006	449	631	2990	330	4400
2007	451	629	2990	330	4400
2008	454	626	2990	330	4400
2009	456	624	2990	330	4400
2010	459	621	2990	330	4400
2011	463	617	2990	330	4400
2012	468	612	2990	330	4400
2013	472	608	2990	330	4400
2014	477	603	2990	330	4400
2015	482	598	2990	330	4400
2016	482	598	2990	330	4400
2017	482	598	2990	330	4400
2018	482	598	2990	330	4400
2019	482	598	2990	330	4400
2020	482	598	2990	330	4400
2021	482	598	2990	330	4400
2022	482	598	2990	330	4400
2023	482	598	2990	330	4400
2024	482	598	2990	330	4400
2025	482	598	2990	330	4400
2026	482	598	2990	330	4400
2027	482	598	2990	330	4400
2028	482	598	2990	330	4400
2029	482	598	2990	330	4400
2030	482	598	2990	330	4400
2031	482	598	2990	330	4400
2032	482	598	2990	330	4400
2033	482	598	2990	330	4400
2034	482	598	2990	330	4400
2035	482	598	2990	330	4400
2036	482	598	2990	330	4400
2037	482	598	2990	330	4400
2038	482	598	2990	330	4400
2039	482	598	2990	330	4400
2040	482	598	2990	330	4400
2041	482	598	2990	330	4400
2042	482	598	2990	330	4400
2043	482	598	2990	330	4400
2044	482	598	2990	330	4400
2045	482	598	2990	330	4400
2046	482	598	2990	330	4400
2047	482	598	2990	330	4400
2048	482	598	2990	330	4400
2049	482	598	2990	330	4400
2050	482	598	2990	330	4400

Table H-3
State of Arizona - Other Users (kaf)

Date	Lake Mead NRA	Kingman	Ft. Mohave Ind. Res.	Mohave Valley I&DD	Mohave Valley M&I	Havasu NWR	Parker Ag.	Unused Depletion	Town of Parker & Other Users	Imperial NWR	Cibola NWR	CRIR	CRIR Pumped	Gila Gravity Main Canal	Cocopah Ind. Res.	City of Yuma	Yuma Co. WUA	Arizona Pumpers	Total Arizona Other
2002	0	0	46	25	4	5	14	0	18	9	6	343	0	549	25	25	267	10	1332
2003	0	0	50	25	4	5	13	0	19	9	6	351	0	543	13	25	264	10	1337
2004	0	0	55	24	4	5	13	0	19	9	6	359	0	537	13	25	262	10	1342
2005	0	0	60	24	4	5	13	0	20	9	7	367	0	531	13	25	259	10	1348
2006	0	0	63	24	4	5	13	0	21	10	7	376	0	526	13	26	257	10	1353
2007	0	0	65	24	4	5	13	0	22	10	7	386	0	521	13	26	255	10	1359
2008	0	0	68	23	4	5	13	0	22	10	8	395	0	516	12	26	252	10	1364
2009	0	0	70	23	4	5	13	0	23	10	8	405	0	510	12	26	250	10	1369
2010	0	0	73	23	4	5	13	0	24	10	8	414	0	505	12	27	248	10	1375
2011	0	0	73	22	4	5	12	0	24	10	8	424	0	499	12	27	245	10	1375
2012	0	0	73	22	4	5	12	0	24	10	8	434	0	494	12	27	242	10	1376
2013	0	0	73	21	4	5	12	0	24	10	8	443	0	487	12	27	239	10	1376
2014	0	0	73	20	4	5	12	0	24	10	8	453	0	482	12	27	237	10	1377
2015	0	0	73	20	5	5	12	0	24	9	8	463	0	477	12	27	234	10	1378
2016	0	0	73	19	5	5	12	0	25	9	8	463	0	476	12	28	234	10	1378
2017	0	0	73	19	5	5	12	0	25	9	8	463	0	477	12	28	234	10	1379
2018	0	0	73	18	5	5	12	0	26	9	8	463	0	477	12	29	234	10	1380
2019	0	0	73	18	5	5	12	0	26	9	8	463	0	476	12	29	234	10	1380
2020	0	0	73	17	5	5	12	0	27	9	8	463	0	477	12	30	234	10	1381
2021	0	0	73	17	5	5	12	0	27	9	9	463	0	477	12	30	233	10	1382
2022	0	0	73	17	5	5	12	0	27	9	10	463	0	476	12	31	233	10	1383
2023	0	0	73	17	5	5	12	0	28	10	10	463	0	477	12	32	233	10	1385
2024	0	0	73	17	5	5	12	0	28	10	11	463	0	477	12	32	232	10	1386
2025	0	0	73	17	5	5	12	0	28	10	12	463	0	477	12	33	232	10	1388
2026	0	0	73	17	5	5	12	0	29	10	13	463	0	477	12	33	232	10	1389
2027	0	0	73	17	5	5	12	0	29	10	14	463	0	476	12	34	231	10	1390
2028	0	0	73	17	5	5	12	0	29	10	14	463	0	477	12	34	231	10	1392
2029	0	0	73	17	6	5	12	0	30	10	15	463	0	477	12	35	230	10	1393
2030	0	0	73	17	6	5	12	0	30	10	16	463	0	476	12	35	229	11	1394
2031	0	0	73	17	6	5	12	0	30	10	16	463	0	476	12	36	229	11	1395
2032	0	0	73	17	6	5	12	0	30	10	16	463	0	476	12	36	230	11	1396
2033	0	0	73	17	6	5	12	0	30	10	16	463	0	476	12	37	230	11	1397
2034	0	0	73	17	6	5	12	0	31	10	16	463	0	477	12	38	230	11	1398
2035	0	0	73	17	6	5	12	0	31	10	16	463	0	476	12	38	229	11	1398
2036	0	0	73	17	6	5	12	0	31	10	16	463	0	476	12	39	229	11	1399
2037	0	0	73	17	6	5	12	0	31	10	16	463	0	476	12	39	230	11	1400
2038	0	0	73	17	6	5	12	0	31	10	16	463	0	477	12	40	230	11	1401
2039	0	0	73	17	6	5	12	0	32	10	16	463	0	477	12	40	230	11	1402
2040	0	0	73	17	6	5	12	0	32	10	16	463	0	476	12	41	229	11	1402
2041	0	0	73	17	6	5	12	0	32	10	16	463	0	477	12	41	230	11	1403
2042	0	0	73	17	6	5	12	0	32	10	16	463	0	477	12	41	230	11	1403
2043	0	0	73	17	6	5	12	0	32	10	16	463	0	476	12	41	230	11	1403
2044	0	0	73	17	6	5	12	0	33	10	16	463	0	477	12	41	230	11	1404
2045	0	0	73	17	6	5	12	0	33	10	16	463	0	477	12	41	230	11	1404
2046	0	0	73	17	6	5	12	0	33	10	16	463	0	477	12	41	230	11	1404
2047	0	0	73	17	6	5	12	0	33	10	16	463	0	476	12	41	230	11	1404
2048	0	0	73	17	6	5	12	0	34	10	16	463	0	477	12	41	230	11	1405
2049	0	0	73	17	6	5	12	0	34	10	16	463	0	477	12	41	230	11	1405
2050	0	0	73	17	6	5	12	0	34	10	16	463	0	476	12	41	230	11	1405

Table H-4
State of California - Other Users (kaf)

Year	Ft. Mohave Ind. Res.	City of Needles	Havasu NWR	Chemehuevi Ind. Res.	Others & Misc. PPRs	Imperial NWR	CRIR Ind. Res.	PVID	Unused Depletion	AAC Yuma Project Bard Unit	AAC Yuma Project Res. Unit Quechan	California Pumpers	Other Pumpers Below NIB	Total California Other
2002	14	1	0	2	2	0	5	383	0	18	19	0	0	444
2003	13	1	0	2	2	0	7	381	0	18	21	0	0	445
2004	13	1	0	3	2	0	8	380	0	18	22	0	0	446
2005	12	1	0	3	2	0	9	379	0	18	23	0	0	447
2006	12	1	0	3	2	0	11	378	0	18	24	0	0	449
2007	12	1	0	4	2	0	13	377	0	18	25	0	0	451
2008	12	1	0	4	2	0	15	375	0	18	27	0	0	454
2009	12	1	0	5	2	0	17	374	0	18	28	0	0	456
2010	12	1	0	5	2	0	19	373	0	18	29	0	0	459
2011	12	1	0	6	2	0	23	372	0	18	30	0	0	463
2012	12	1	0	6	2	0	27	370	0	18	32	0	0	468
2013	12	1	0	7	2	0	31	369	0	18	33	0	0	472
2014	12	1	0	7	2	0	35	367	0	18	35	0	0	477
2015	12	1	0	8	2	0	39	366	0	18	36	0	0	482
2016	12	1	0	8	2	0	39	366	0	18	36	0	0	482
2017	12	1	0	8	2	0	39	366	0	18	36	0	0	482
2018	12	1	0	8	2	0	39	366	0	18	36	0	0	482
2019	12	1	0	8	2	0	39	366	0	18	36	0	0	482
2020	12	1	0	8	2	0	39	366	0	18	36	0	0	482
2021	12	1	0	8	2	0	39	366	0	18	36	0	0	482
2022	12	1	0	8	2	0	39	366	0	18	36	0	0	482
2023	12	1	0	8	2	0	39	366	0	18	36	0	0	482
2024	12	1	0	8	2	0	39	366	0	18	36	0	0	482
2025	12	1	0	8	2	0	39	366	0	18	36	0	0	482
2026	12	1	0	8	2	0	39	366	0	18	36	0	0	482
2027	12	1	0	8	2	0	39	366	0	18	36	0	0	482

Table H-4
State of California - Other Users (kaf)

Year	Ft. Mohave Ind. Res.	City of Needles	Havasu NWR	Chemehuevi Ind. Res.	Others & Misc. PPRs	Imperial NWR	CRIR Ind. Res.	PVID	Unused Depletion	AAC Yuma Project Bard Unit	AAC Yuma Project Res. Unit Quechan	California Pumpers	Other Pumpers Below NIB	Total California Other
2028	12	1	0	8	2	0	39	366	0	18	36	0	0	482
2029	12	1	0	8	2	0	39	366	0	18	36	0	0	482
2030	12	1	0	8	2	0	39	366	0	18	36	0	0	482
2031	12	1	0	8	2	0	39	366	0	18	36	0	0	482
2032	12	1	0	8	2	0	39	366	0	18	36	0	0	482
2033	12	1	0	8	2	0	39	366	0	18	36	0	0	482
2034	12	1	0	8	2	0	39	366	0	18	36	0	0	482
2035	12	1	0	8	2	0	39	366	0	18	36	0	0	482
2036	12	1	0	8	2	0	39	366	0	18	36	0	0	482
2037	12	1	0	8	2	0	39	366	0	18	36	0	0	482
2038	12	1	0	8	2	0	39	366	0	18	36	0	0	482
2039	12	1	0	8	2	0	39	366	0	18	36	0	0	482
2040	12	1	0	8	2	0	39	366	0	18	36	0	0	482
2041	12	1	0	8	2	0	39	366	0	18	36	0	0	482
2042	12	1	0	8	2	0	39	366	0	18	36	0	0	482
2043	12	1	0	8	2	0	39	366	0	18	36	0	0	482
2044	12	1	0	8	2	0	39	366	0	18	36	0	0	482
2045	12	1	0	8	2	0	39	366	0	18	36	0	0	482
2046	12	1	0	8	2	0	39	366	0	18	36	0	0	482
2047	12	1	0	8	2	0	39	366	0	18	36	0	0	482
2048	12	1	0	8	2	0	39	366	0	18	36	0	0	482
2049	12	1	0	8	2	0	39	366	0	18	36	0	0	482
2050	12	1	0	8	2	0	39	366	0	18	36	0	0	482

Table H-5
State of Nevada - Other Users (kaf)

Year	Laughlin M&I	Mohave Steam Plant	Ft. Mohave Ind. Res.	Total NV Other
2002	4	16	6	26
2003	4	16	6	26
2004	4	16	7	27
2005	4	16	8	28
2006	4	16	8	28
2007	4	16	8	28
2008	4	16	9	29
2009	4	16	9	29
2010	4	16	9	29
2011	4	16	9	29
2012	4	16	9	29
2013	4	16	9	29
2014	4	16	9	29
2015	4	16	9	29
2016	4	16	9	29
2017	4	16	9	29
2018	4	16	9	29
2019	4	16	9	29
2020	4	16	9	29
2021	4	16	9	29
2022	4	16	9	29
2023	4	16	9	29
2024	4	16	9	29
2025	4	16	9	29
2026	4	8	9	21
2027	4	0	9	13
2028	4	0	9	13
2029	4	0	9	13
2030	4	0	9	13
2031	4	0	9	13
2032	4	0	9	13
2033	4	0	9	13
2034	4	0	9	13
2035	4	0	9	13
2036	4	0	9	13
2037	4	0	9	13
2038	4	0	9	13
2039	4	0	9	13
2040	4	0	9	13
2041	4	0	9	13
2042	4	0	9	13
2043	4	0	9	13
2044	4	0	9	13
2045	4	0	9	13
2046	4	0	9	13
2047	4	0	9	13
2048	4	0	9	13
2049	4	0	9	13
2050	4	0	9	13

Table H-6
Lower Division Level 1 Shortage Schedule (kaf)

Year	CA Total	AZ Other	CAP	AZ Total	NV Other	SNWP	NV Total	Total LB
2002	4407	1332	1000	2332	26	258	284	7023
2003	4412	1337	1000	2337	26	260	286	7034
2004	4455	1342	1000	2342	27	278	305	7102
2005	4427	1348	1000	2348	28	265	293	7068
2006	4400	1353	1000	2353	28	253	281	7034
2007	4400	1359	1000	2359	28	254	282	7041
2008	4400	1364	1000	2364	29	253	282	7046
2009	4400	1369	1000	2369	29	253	282	7051
2010	4400	1375	1000	2375	29	253	282	7057
2011	4400	1375	1000	2375	29	253	282	7057
2012	4400	1376	1000	2376	29	253	282	7058
2013	4400	1376	1000	2376	29	253	282	7058
2014	4400	1377	1000	2377	29	253	282	7059
2015	4400	1378	1000	2378	29	253	282	7060
2016	4400	1378	1000	2378	29	253	282	7060
2017	4400	1379	1000	2379	29	253	282	7061
2018	4400	1380	1000	2380	29	254	283	7063
2019	4400	1380	1000	2380	29	254	283	7063
2020	4400	1381	1000	2381	29	254	283	7064
2021	4400	1382	1000	2382	29	254	283	7065
2022	4400	1383	1000	2383	29	254	283	7066
2023	4400	1385	1000	2385	29	254	283	7068
2024	4400	1386	1000	2386	29	254	283	7069
2025	4400	1388	1000	2388	29	254	283	7071
2026	4400	1389	1000	2389	21	262	283	7072
2027	4400	1390	1000	2390	13	270	283	7073
2028	4400	1392	1000	2392	13	270	283	7075
2029	4400	1393	1000	2393	13	270	283	7076
2030	4400	1394	1000	2394	13	270	283	7077
2031	4400	1395	1000	2395	13	270	283	7078
2032	4400	1396	1000	2396	13	270	283	7079
2033	4400	1397	1000	2397	13	270	283	7080
2034	4400	1398	1000	2398	13	270	283	7081
2035	4400	1398	1000	2398	13	270	283	7081
2036	4400	1399	1000	2399	13	270	283	7082
2037	4400	1400	1000	2400	13	270	283	7083
2038	4400	1401	1000	2401	13	270	283	7084
2039	4400	1402	1000	2402	13	270	283	7085
2040	4400	1402	1000	2402	13	270	283	7085
2041	4400	1403	1000	2403	13	270	283	7086
2042	4400	1403	1000	2403	13	270	283	7086
2043	4400	1403	1000	2403	13	270	283	7086
2044	4400	1404	1000	2404	13	271	284	7088
2045	4400	1404	1000	2404	13	271	284	7088
2046	4400	1404	1000	2404	13	271	284	7088
2047	4400	1404	1000	2404	13	271	284	7088
2048	4400	1405	1000	2405	13	271	284	7089
2049	4400	1405	1000	2405	13	271	284	7089
2050	4400	1405	1000	2405	13	271	284	7089

Table H-7
Full Surplus Schedule With California Intrastate Water Transfers (kaf)

Date	CA Other	MWD	IID	CVWD	CA Total	AZ Other	CAP	AZ Total	NV Other	SNWP	NV Total	Total LB
2002	444	1250	3209	585	5487	1332	1658	2990	26	312	338	8815
2003	445	1250	3189	585	5468	1337	1647	2984	26	314	340	8792
2004	446	1250	3152	585	5432	1342	1582	2924	27	316	343	8699
2005	447	1250	3132	585	5413	1348	1615	2963	28	316	344	8720
2006	449	1250	3061	585	5344	1353	1652	3005	28	321	349	8698
2007	451	1250	3036	585	5322	1359	1680	3039	28	326	354	8715
2008	454	1250	3011	585	5299	1364	1715	3079	29	330	359	8737
2009	456	1250	2986	585	5276	1369	1750	3119	29	334	363	8758
2010	459	1250	2961	585	5254	1375	1787	3162	29	338	367	8783
2011	463	1250	2936	585	5233	1375	1812	3187	29	342	371	8791
2012	468	1250	2931	585	5233	1376	1835	3211	29	345	374	8818
2013	472	1250	2926	585	5233	1376	1835	3211	29	349	378	8822
2014	477	1250	2921	585	5232	1377	1835	3212	29	353	382	8826
2015	482	1250	2916	585	5232	1378	1835	3213	29	357	386	8831
2016	482	1250	2911	585	5227	1378	1835	3213	29	361	390	8830
2017	482	1250	2906	585	5222	1379	1835	3214	29	365	394	8830
2018	482	1250	2901	585	5217	1380	1835	3215	29	369	398	8830
2019	482	1250	2896	585	5212	1380	1835	3215	29	373	402	8829
2020	482	1250	2891	585	5207	1381	1835	3216	29	378	407	8830
2021	482	1250	2886	585	5202	1382	1835	3217	29	382	411	8830
2022	482	1250	2881	585	5197	1383	1835	3218	29	387	416	8831
2023	482	1250	2876	585	5192	1385	1835	3220	29	391	420	8832
2024	482	1250	2871	585	5187	1386	1835	3221	29	395	424	8832
2025	482	1250	2866	585	5182	1388	1835	3223	29	400	429	8834
2026	482	1250	2861	585	5177	1389	1835	3224	21	404	425	8826
2027	482	1250	2861	585	5177	1390	1835	3225	13	408	421	8823
2028	482	1250	2861	585	5177	1392	1835	3227	13	412	425	8829
2029	482	1250	2861	585	5177	1393	1835	3228	13	415	428	8833
2030	482	1250	2861	585	5177	1394	1835	3229	13	418	431	8837
2031	482	1250	2861	585	5177	1395	1835	3230	13	423	436	8843
2032	482	1250	2861	585	5177	1396	1835	3231	13	427	440	8848
2033	482	1250	2861	585	5177	1397	1835	3232	13	431	444	8853
2034	482	1250	2861	585	5177	1398	1835	3233	13	435	448	8858
2035	482	1250	2861	585	5177	1398	1835	3233	13	439	452	8862
2036	482	1250	2861	585	5177	1399	1835	3234	13	443	456	8867
2037	482	1250	2861	585	5177	1400	1835	3235	13	448	461	8873
2038	482	1250	2861	585	5177	1401	1835	3236	13	452	465	8878
2039	482	1250	2861	585	5177	1402	1835	3237	13	456	469	8883
2040	482	1250	2861	585	5177	1402	1835	3237	13	460	473	8887
2041	482	1250	2861	585	5177	1403	1835	3238	13	464	477	8892
2042	482	1250	2861	585	5177	1403	1835	3238	13	468	481	8896
2043	482	1250	2861	585	5177	1403	1835	3238	13	472	485	8900
2044	482	1250	2861	585	5177	1404	1835	3239	13	476	489	8905
2045	482	1250	2861	585	5177	1404	1835	3239	13	480	493	8909
2046	482	1250	2911	585	5227	1404	1835	3239	13	485	498	8964
2047	482	1250	2911	585	5227	1404	1835	3239	13	489	502	8968
2048	482	1250	2911	585	5227	1405	1835	3240	13	493	506	8973
2049	482	1250	2911	585	5227	1405	1835	3240	13	497	510	8977
2050	482	1250	2911	585	5227	1405	1835	3240	13	501	514	8981

Table H-8
Full Surplus without California Intrastate Transfers (kaf)

Date	CA Other	MWD	IID	CVWD	CA TOTAL
2002	444	1250	3240	585	5518
2003	445	1250	3240	585	5519
2004	446	1250	3240	585	5520
2005	447	1250	3240	585	5521
2006	449	1250	3240	585	5523
2007	451	1250	3240	585	5526
2008	454	1250	3240	585	5528
2009	456	1250	3240	585	5531
2010	459	1250	3240	585	5533
2011	463	1250	3240	585	5538
2012	468	1250	3240	585	5542
2013	472	1250	3240	585	5547
2014	477	1250	3240	585	5551
2015	482	1250	3240	585	5556
2016	482	1250	3240	585	5556
2017	482	1250	3240	585	5556
2018	482	1250	3240	585	5556
2019	482	1250	3240	585	5556
2020	482	1250	3240	585	5556
2021	482	1250	3240	585	5556
2022	482	1250	3240	585	5556
2023	482	1250	3240	585	5556
2024	482	1250	3240	585	5556
2025	482	1250	3240	585	5556
2026	482	1250	3240	585	5556
2027	482	1250	3240	585	5556
2028	482	1250	3240	585	5556
2029	482	1250	3240	585	5556
2030	482	1250	3240	585	5556
2031	482	1250	3240	585	5556
2032	482	1250	3240	585	5556
2033	482	1250	3240	585	5556
2034	482	1250	3240	585	5556
2035	482	1250	3240	585	5556
2036	482	1250	3240	585	5556
2037	482	1250	3240	585	5556
2038	482	1250	3240	585	5556
2039	482	1250	3240	585	5556
2040	482	1250	3240	585	5556
2041	482	1250	3240	585	5556
2042	482	1250	3240	585	5556
2043	482	1250	3240	585	5556
2044	482	1250	3240	585	5556
2045	482	1250	3240	585	5556
2046	482	1250	3240	585	5556
2047	482	1250	3240	585	5556
2048	482	1250	3240	585	5556
2049	482	1250	3240	585	5556
2050	482	1250	3240	585	5556

Table H-9
Six State Alternative Level 2 Surplus Schedules (kaf)

Date	CA Other	MWD	IID	CVWD	CA Total	AZ Other	CAP	AZ Total	NV Other	SNWP	NV Total	Total LB
2002	444	1212	2959	360	4974	1332	1458	2790	26	278	304	8068
2003	444	1212	2939	354	4949	1337	1447	2784	26	278	304	8038
2004	445	1212	2902	350	4909	1342	1382	2724	27	295	322	7955
2005	447	1212	2882	356	4896	1348	1415	2763	28	283	311	7970
2006	449	1212	2811	356	4828	1353	1447	2800	28	273	301	7929
2007	452	1212	2786	361	4810	1359	1441	2800	28	275	303	7913
2008	453	1212	2761	366	4793	1364	1436	2800	29	279	308	7901
2009	456	1212	2736	371	4775	1369	1431	2800	29	283	312	7887
2010	459	1212	2711	376	4757	1375	1425	2800	29	287	316	7873
2011	464	1212	2686	381	4742	1375	1425	2800	29	291	320	7862
2012	468	1212	2681	386	4747	1376	1424	2800	29	295	324	7871
2013	473	1212	2676	391	4751	1376	1424	2800	29	299	328	7879
2014	477	1212	2671	396	4756	1377	1423	2800	29	302	331	7887
2015	482	1212	2666	401	4760	1378	1422	2800	29	303	332	7892
2016	482	1212	2661	406	4760	1378	1422	2800	29	307	336	7896

Table H-10
Six State Alternative Level 3 Surplus Schedules (kaf)

Date	CA Other	MWD	IID	CVWD	CA Total	AZ Other	CAP	AZ Total	NV Other	SNWP	NV Total	Total LB
2002	444	962	2959	360	4724	1332	1458	2790	26	278	304	7818
2003	444	962	2939	354	4699	1337	1447	2784	26	278	304	7788
2004	445	962	2902	350	4659	1342	1382	2724	27	295	322	7705
2005	447	962	2882	356	4646	1348	1415	2763	28	283	311	7720
2006	449	962	2811	356	4578	1353	1447	2800	28	273	301	7679
2007	452	962	2786	361	4560	1359	1441	2800	28	274	302	7662
2008	453	962	2761	366	4543	1364	1436	2800	29	275	304	7647
2009	456	962	2736	371	4525	1369	1431	2800	29	277	306	7631
2010	459	962	2711	376	4507	1375	1425	2800	29	279	308	7615
2011	464	962	2686	381	4492	1375	1425	2800	29	281	310	7602
2012	468	962	2681	386	4497	1376	1424	2800	29	283	312	7609
2013	473	962	2676	391	4501	1376	1424	2800	29	285	314	7615
2014	477	962	2671	396	4506	1377	1423	2800	29	287	316	7622
2015	482	962	2666	401	4510	1378	1422	2800	29	287	316	7626
2016	482	962	2661	406	4510	1378	1422	2800	29	289	318	7628

Table H-11
California Plan Normal Schedules (kaf)

Year	CA Other	PVID	MWD	IID	CVWD	CA TOTAL	AZ Other	CAP	AZ Total	NV Other	SNWP	NV Total	Total LB
2002	61	283	745	2959	360	4407	1332	1458	2790	26	277	303	7500
2003	63	281	774	2939	354	4412	1337	1447	2784	26	278	304	7500
2004	65	280	858	2902	350	4455	1342	1382	2724	27	294	321	7500
2005	68	279	843	2882	356	4427	1348	1415	2763	28	282	310	7500
2006	71	278	884	2811	356	4400	1353	1447	2800	28	272	300	7500
2007	75	277	902	2786	361	4400	1359	1441	2800	28	272	300	7500
2008	78	275	919	2761	366	4400	1364	1436	2800	29	271	300	7500
2009	82	274	937	2736	371	4400	1369	1431	2800	29	271	300	7500
2010	86	273	955	2711	376	4400	1375	1425	2800	29	271	300	7500
2011	92	272	970	2686	381	4400	1375	1425	2800	29	271	300	7500
2012	98	270	965	2681	386	4400	1376	1424	2800	29	271	300	7500
2013	104	269	961	2676	391	4400	1376	1424	2800	29	271	300	7500
2014	110	267	956	2671	396	4400	1377	1423	2800	29	271	300	7500
2015	116	266	952	2666	401	4400	1378	1422	2800	29	271	300	7500
2016	116	266	952	2661	406	4400	1378	1422	2800	29	271	300	7500
2017	116	266	952	2656	411	4400	1379	1421	2800	29	271	300	7500
2018	116	266	952	2651	416	4400	1380	1420	2800	29	271	300	7500
2019	116	266	952	2646	421	4400	1380	1420	2800	29	271	300	7500
2020	116	266	952	2641	426	4400	1381	1419	2800	29	271	300	7500
2021	116	266	952	2636	431	4400	1382	1418	2800	29	271	300	7500
2022	116	266	952	2631	436	4400	1383	1417	2800	29	271	300	7500
2023	116	266	952	2626	441	4400	1385	1415	2800	29	271	300	7500
2024	116	266	952	2621	446	4400	1386	1414	2800	29	271	300	7500
2025	116	266	952	2616	451	4400	1388	1412	2800	29	271	300	7500
2026	116	266	952	2611	456	4400	1389	1411	2800	21	279	300	7500
2027	116	266	952	2611	456	4400	1390	1410	2800	13	287	300	7500
2028	116	266	952	2611	456	4400	1392	1408	2800	13	287	300	7500
2029	116	266	952	2611	456	4400	1393	1407	2800	13	287	300	7500
2030	116	266	952	2611	456	4400	1394	1406	2800	13	287	300	7500
2031	116	266	952	2611	456	4400	1395	1405	2800	13	287	300	7500
2032	116	266	952	2611	456	4400	1396	1404	2800	13	287	300	7500
2033	116	266	952	2611	456	4400	1397	1403	2800	13	287	300	7500
2034	116	266	952	2611	456	4400	1398	1402	2800	13	287	300	7500
2035	116	266	952	2611	456	4400	1398	1402	2800	13	287	300	7500
2036	116	266	952	2611	456	4400	1399	1401	2800	13	287	300	7500
2037	116	266	952	2611	456	4400	1400	1400	2800	13	287	300	7500
2038	116	266	952	2611	456	4400	1401	1399	2800	13	287	300	7500
2039	116	266	952	2611	456	4400	1402	1398	2800	13	287	300	7500
2040	116	266	952	2611	456	4400	1402	1398	2800	13	287	300	7500
2041	116	266	952	2611	456	4400	1403	1397	2800	13	287	300	7500
2042	116	266	952	2611	456	4400	1403	1397	2800	13	287	300	7500
2043	116	266	952	2611	456	4400	1403	1397	2800	13	287	300	7500
2044	116	266	952	2611	456	4400	1404	1396	2800	13	287	300	7500
2045	116	266	952	2611	456	4400	1404	1396	2800	13	287	300	7500
2046	116	266	902	2661	456	4400	1404	1396	2800	13	287	300	7500
2047	116	266	902	2661	456	4400	1404	1396	2800	13	287	300	7500
2048	116	266	902	2661	456	4400	1405	1395	2800	13	287	300	7500
2049	116	266	902	2661	456	4400	1405	1395	2800	13	287	300	7500
2050	116	266	902	2661	456	4400	1405	1395	2800	13	287	300	7500

Table H-12
California Plan Surplus Schedules Level 1 (kaf)

Date	CA Other	PVID	MWD	IID	CVWD	CA Total	AZ Other	CAP	AZ Total	NV Other	SNWP	NV Total	Total LB
2002	61	383	1250	3209	585	5487	1332	1658	2990	26	312	338	8815
2003	63	381	1250	3189	585	5468	1337	1647	2984	26	314	340	8792
2004	65	380	1250	3152	585	5432	1342	1582	2924	27	316	343	8699
2005	68	379	1250	3132	585	5413	1348	1615	2963	28	316	344	8720
2006	71	378	1250	3061	585	5344	1353	1652	3005	28	321	349	8698
2007	75	377	1250	3036	585	5322	1359	1680	3039	28	326	354	8715
2008	78	375	1250	3011	585	5299	1364	1715	3079	29	330	359	8737
2009	82	374	1250	2986	585	5276	1369	1750	3119	29	334	363	8758
2010	86	373	1250	2961	585	5254	1375	1787	3162	29	338	367	8783
2011	92	372	1250	2936	585	5233	1375	1812	3187	29	342	371	8791
2012	98	370	1250	2931	585	5233	1376	1835	3211	29	345	374	8818
2013	104	369	1250	2926	585	5233	1376	1835	3211	29	349	378	8822
2014	110	367	1250	2921	585	5232	1377	1835	3212	29	353	382	8826
2015	116	366	1250	2916	585	5232	1378	1835	3213	29	357	386	8831
2016	116	366	1250	2911	585	5227	1378	1835	3213	29	361	390	8830

Table H-13
California Plan Surplus Schedules Level 2 (kaf)

Date	CA Other	PVID	MWD	IID	CVWD	CA Total	AZ Other	CAP	AZ Total	NV Other	SNWP	NV Total	Total LB
2002	61	383	1250	2959	360	5012	1332	1458	2790	26	277	303	8105
2003	63	381	1250	2939	354	4987	1337	1447	2784	26	278	304	8076
2004	65	380	1250	2902	350	4947	1342	1382	2724	27	294	321	7992
2005	68	379	1250	2882	356	4934	1348	1415	2763	28	282	310	8007
2006	71	378	1250	2811	356	4866	1353	1447	2800	28	272	300	7966
2007	75	377	1250	2786	361	4848	1359	1441	2800	28	272	300	7948
2008	78	375	1250	2761	366	4831	1364	1436	2800	29	271	300	7931
2009	82	374	1250	2736	371	4813	1369	1431	2800	29	271	300	7913
2010	86	373	1250	2711	376	4795	1375	1425	2800	29	271	300	7895
2011	92	372	1250	2686	381	4780	1375	1425	2800	29	271	300	7880
2012	98	370	1250	2681	386	4785	1376	1424	2800	29	271	300	7885
2013	104	369	1250	2676	391	4789	1376	1424	2800	29	271	300	7889
2014	110	367	1250	2671	396	4794	1377	1423	2800	29	271	300	7894
2015	116	366	1250	2666	401	4798	1378	1422	2800	29	271	300	7898
2016	116	366	1250	2661	406	4798	1378	1422	2800	29	271	300	7898

Table H-14
California Plan Surplus Schedules Level 3 (kaf)

Date	CA Other	PVID	MWD	IID	CVWD	CA Total	AZ Other	CAP	AZ Total	NV Other	SNWP	NV Total	Total LB
2002	61	283	1250	2959	360	4912	1332	1458	2790	26	277	303	8005
2003	63	281	1250	2939	354	4887	1337	1447	2784	26	278	304	7976
2004	65	280	1250	2902	350	4847	1342	1382	2724	27	294	321	7892
2005	68	279	1250	2882	356	4834	1348	1415	2763	28	282	310	7907
2006	71	278	1250	2811	356	4766	1353	1447	2800	28	272	300	7866
2007	75	277	1250	2786	361	4748	1359	1441	2800	28	272	300	7848
2008	78	275	1250	2761	366	4731	1364	1436	2800	29	271	300	7831
2009	82	274	1250	2736	371	4713	1369	1431	2800	29	271	300	7813
2010	86	273	1250	2711	376	4695	1375	1425	2800	29	271	300	7795
2011	92	272	1250	2686	381	4680	1375	1425	2800	29	271	300	7780
2012	98	270	1250	2681	386	4685	1376	1424	2800	29	271	300	7785
2013	104	269	1250	2676	391	4689	1376	1424	2800	29	271	300	7789
2014	110	267	1250	2671	396	4694	1377	1423	2800	29	271	300	7794
2015	116	266	1250	2666	401	4698	1378	1422	2800	29	271	300	7798
2016	116	266	1250	2661	406	4698	1378	1422	2800	29	271	300	7798

Table H-15
Basin States Plan Surplus Schedules Level 1 (kaf)

Date	CA Other	MWD	IID	CVWD	CA Total	AZ Other	CAP	AZ Total	NV Other	SNWP	NV Total	Total LB
2002	444	1250	2959	489	5141	1332	1658	2990	26	312	338	8469
2003	445	1250	2939	483	5116	1337	1647	2984	26	314	340	8440
2004	446	1250	2902	478	5076	1342	1582	2924	27	316	343	8343
2005	447	1250	2882	485	5063	1348	1615	2963	28	316	344	8370
2006	449	1250	2811	485	4994	1353	1652	3005	28	321	349	8348
2007	451	1250	2786	490	4977	1359	1680	3039	28	326	354	8370
2008	454	1250	2761	495	4959	1364	1715	3079	29	330	359	8397
2009	456	1250	2736	500	4941	1369	1750	3119	29	334	363	8423
2010	459	1250	2711	505	4924	1375	1787	3162	29	338	367	8453
2011	463	1250	2686	510	4908	1375	1812	3187	29	342	371	8466
2012	468	1250	2681	515	4913	1376	1835	3211	29	345	374	8498
2013	472	1250	2676	520	4918	1376	1835	3211	29	349	378	8507
2014	477	1250	2671	525	4922	1377	1835	3212	29	353	382	8516
2015	482	1250	2666	530	4927	1378	1835	3213	29	357	386	8526
2016	482	1250	2661	535	4927	1378	1835	3213	29	361	390	8530

Table H-16
Basin States Plan Surplus Schedules Level 2 (kaf)

Date	CA Other	MWD	IID	CVWD	CA Total	AZ Other	CAP	AZ Total	NV Other	SNWP	NV Total	Total LB
2002	444	1250	2959	360	5012	1332	1458	2790	26	278	304	8106
2003	444	1250	2939	354	4987	1337	1447	2784	26	278	304	8076
2004	445	1250	2902	350	4947	1342	1382	2724	27	295	322	7993
2005	447	1250	2882	356	4934	1348	1415	2763	28	283	311	8008
2006	449	1250	2811	356	4866	1353	1447	2800	28	273	301	7967
2007	452	1250	2786	361	4848	1359	1441	2800	28	275	303	7951
2008	453	1250	2761	366	4831	1364	1436	2800	29	279	308	7939
2009	456	1250	2736	371	4813	1369	1431	2800	29	283	312	7925
2010	459	1250	2711	376	4795	1375	1425	2800	29	287	316	7911
2011	464	1250	2686	381	4780	1375	1425	2800	29	291	320	7900
2012	468	1250	2681	386	4785	1376	1424	2800	29	295	324	7909
2013	473	1250	2676	391	4789	1376	1424	2800	29	299	328	7917
2014	477	1250	2671	396	4794	1377	1423	2800	29	302	331	7925
2015	482	1250	2666	401	4798	1378	1422	2800	29	303	332	7930
2016	482	1250	2661	406	4798	1378	1422	2800	29	307	336	7934

Table H-17
Basin States Plan Surplus Schedules Level 3 (kaf)

Date	CA Other	MWD	IID	CVWD	CA Total	AZ Other	CAP	AZ Total	NV Other	SNWP	NV Total	Total LB
2002	444	832	2959	360	4594	1332	1458	2790	26	278	304	7688
2003	444	852	2939	354	4589	1337	1447	2784	26	278	304	7678
2004	445	872	2902	350	4569	1342	1382	2724	27	295	322	7615
2005	447	892	2882	356	4576	1348	1415	2763	28	283	311	7650
2006	449	912	2811	356	4528	1353	1447	2800	28	273	301	7629
2007	452	932	2786	361	4530	1359	1441	2800	28	274	302	7632
2008	453	952	2761	366	4533	1364	1436	2800	29	275	304	7637
2009	456	972	2736	371	4535	1369	1431	2800	29	277	306	7641
2010	459	992	2711	376	4537	1375	1425	2800	29	279	308	7645
2011	464	1012	2686	381	4542	1375	1425	2800	29	281	310	7652
2012	468	1032	2681	386	4567	1376	1424	2800	29	283	312	7679
2013	473	1052	2676	391	4591	1376	1424	2800	29	285	314	7705
2014	477	1072	2671	396	4616	1377	1423	2800	29	287	316	7732
2015	482	1092	2666	401	4640	1378	1422	2800	29	287	316	7756
2016	482	962	2661	406	4510	1378	1422	2800	29	289	318	7628

ATTACHMENT I

Draft Interim Surplus Guidelines

This attachment contains draft guidelines to provide reviewers with an understanding of the proposed format and content of the proposed interim surplus criteria.

It should be noted that the surplus depletion schedules shown in these guidelines are estimated and are intended to provide an approximation of the amounts of surplus water that would be provided at the various elevations of Lake Mead.

Draft
Colorado River Interim Surplus Guidelines
for
Basin States Alternative

1 INTRODUCTION

The Secretary of the Interior, acting through the U.S. Bureau of Reclamation, is implementing these specific interim guidelines under which surplus water conditions would be determined in the Colorado River Basin.

The long-term management objectives of the Colorado River system require the Secretary to:

- Minimize flood damages from river flows,
- Release water only in accordance with the 1964 Decree in Arizona v. California (Decree),
- Protect and enhance the environmental resources of the basin,
- Provide reliable delivery of water for beneficial consumptive use,
- Increase flexibility of water deliveries under a complex allocation system,
- Encourage efficient use of renewable water supplies,
- Minimize curtailment to users who depend on such water supplies, and
- Consider power generation needs.

On an annual basis, the Secretary has applied factors, including but not limited to those found in Article III(3) (b) (i-iv) of the LROC, in annual determinations of the availability of surplus quantities for pumping or release from Lake Mead. As a result of actual operating experience through preparation of annual plans of operation, particularly during recent years when there has been increasing demand for surplus water, the Secretary has determined that there is a need for more specific surplus criteria, consistent with the Decree and applicable Federal law, to assist in the Secretary's annual decision making during an interim period.

Additionally, through adoption of specific interim surplus criteria, the Secretary will afford mainstream users of Colorado River water, particularly those in California who currently utilize surplus flows, a greater degree of predictability with respect to the likely existence, or lack thereof, of surplus conditions on the river in a given year. Adoption of the interim surplus criteria is intended to recognize California's plan to reduce reliance on surplus deliveries, to assist California in moving towards its allocated share of Colorado River water, and to avoid hindering such efforts. Implementation of interim surplus criteria would take into account progress, or lack thereof, in California's efforts to achieve these objectives. The surplus criteria identify the estimated specific amount of surplus water to be made available in a given year, based upon factors such as the elevation of Lake Mead. The increased level of predictability with respect to the prospective existence and quantity of surplus water, will assist in the planning and operations by all entities that receive surplus Colorado River water pursuant to contracts with the Secretary.

2 BACKGROUND

2.1 LONG RANGE OPERATING CRITERIA

The Long Range Operating Criteria (LROC) provides that the Secretary will determine the extent to which the reasonable beneficial consumptive use requirements of mainstream users in the Lower Division can be met. Pursuant to Article II(B)2 of the Decree, if there exists sufficient water available in a single year for pumping or release from Lake Mead to satisfy annual consumptive use in the states of California, Nevada, and Arizona in excess of 7.5 maf, such water may be determined by the Secretary to be made available as "surplus" water. The Secretary is authorized to determine the conditions upon which such water may be made available. The Colorado River Basin Project Act directed the Secretary to adopt criteria for coordinated long-range operation of reservoirs on the Colorado River in order to comply with and carry out the provisions of the Colorado River Compact, the Boulder Canyon Project Act, the Colorado River Storage Project Act and the U.S.-Mexico Water Treaty.

These Guidelines serve to implement Section III (3) of the LROC. The guidelines do not apply to determinations of surplus to the United Mexican States (Mexico) pursuant to the United States-Mexico Water Treaty of 1944.

2.2 ANNUAL OPERATING PLAN

The Secretary prepares, on an annual basis, an Annual Operating Plan (AOP) describing the projected operation of the Colorado River reservoirs for the current year. The AOP is prepared in consultation with the seven Basin States Governors' representatives; the Upper Colorado River Commission; appropriate Federal agencies; representatives of the academic and scientific communities, environmental organizations, and the recreation industry; water delivery contractors; contractors for the purchase of Federal power; others interested in Colorado River operations; and the general public, through the Colorado River Management Work Group. The AOP describes actual operations under the LROC, as required by the CRBPA.

2.3 ENVIRONMENTAL CONSULTATION AND DOCUMENTATION

Environmental analyses have been conducted for this proposal pursuant to the National Environmental Protection Act (NEPA) and the Endangered Species Act (ESA) involving the following consultation and documentation:

- DEIS published in July 2000
- ESA consultation with U.S. Fish and Wildlife Service and National Marine Fisheries Service
- Consultation with Tribes
- Consultation with Mexico pursuant to international agreement
- Final EIS published in December 2000

3 CONDITIONS OF IMPLEMENTATION

3.1 EFFECTIVE DATES

These guidelines will be in effect 30 days from publication of the Secretary's Record of Decision (ROD) in the Federal Register. The guidelines will, unless subsequently modified, remain effective through December 31, 2016. After the interim period, the surplus criteria will revert to the "no action" conditions (i.e., determinations will be made on an annual basis through the AOP process.)

3.2 ALLOCATION OF SURPLUS WATER

The interim surplus criteria set forth in Section 4 identify the circumstances for the Secretary's annual determination of the availability of surplus water. These criteria do not address the allocation of surplus water. Surplus water will continue to be allocated for use among the Lower Division States in a manner consistent with the percentages identified in the Decree. While these criteria will not specifically address the allocation of surplus within a State or among the Lower Basin States, the Secretary recognizes that the Lower Division States and individual contractors for Colorado River water are considering arrangements that may affect the utilization of surplus water during the period identified in Section 3.1. It is expected that water orders from Colorado River contractors will be submitted to reflect forbearance arrangements made by Lower Division states and individual contractors. The Secretary will deliver water to contractors in a manner consistent with these arrangements, to the extent that the water orders from contractors reflect these arrangements. Surplus water will only be delivered to entities with contracts for surplus water.

3.3 MODELING AND DATA

The August 24-Month Study projections for the January 1 system storage and reservoir water surface elevations will be used to determine the applicability of interim surplus guidelines.

In preparation of the AOP, Reclamation will utilize the 24-Month Study and/or other modeling methodologies appropriate for the determinations and findings necessary in the AOP. Reclamation will utilize the best available data and information, including the National Weather Service forecasting to make these determinations.

3.4 CALIFORNIA'S COLORADO RIVER WATER USE PLAN IMPLEMENTATION PROGRESS

The Secretary will annually review the status of implementation of the California Colorado River Water Use Plan during the development of the AOP. California will need to reduce its need for surplus Colorado River water by the following amounts by the dates indicated:

Date	Amount (acre-feet)
January 1, 2006	280,000
January 1, 2011	380,000

In the event that California has not reduced its use by the above quantities, the interim surplus determinations will be based upon the 70R Strategy, for either the remainder of the period identified in Section 3.1 or until such time as California complies with the reductions identified in Section 3.1.

3.5 UNUSED APPORTIONMENTS

Nothing in these guidelines precludes the Secretary from making unused normal or surplus apportionments of Colorado River water available to another State pursuant to Article II(B)6 of the Decree.

3.6 PERIODIC REVIEW

These guidelines for interim surplus criteria serve to implement Article III(3) of the LROC and will be reviewed concurrently with the LROC 5-year review. The Secretary will base annual determination of surplus conditions on these criteria, unless extraordinary circumstances arise. Such circumstances could include operations necessary for safety of dams or other emergency situations, or other activities arising from actual operating experience.

4 GUIDELINES

The following guidelines will be used, together with other appropriate considerations as required in the Colorado River Basin Project Act, the LROC and the Decree to guide the determination of the availability of surplus water for use within the Lower Division States. The following sections describe the Lake Mead water surface elevations at which various specified amounts of surplus water would be made available for use within the Lower Division states. The Secretary expects to make the specified quantities of water identified in Sections 4.1 through 4.5 available as surplus during the

15-year period. The precise amounts of annual surplus quantities will continue to be reviewed on an annual basis during the preparation of the AOP, as required by applicable federal law. The review will use the methodology for the Basin States Alternative set forth in Chapter 2 of the FEIS, actual operating experience, and updated information on the demand for Colorado River water by Lower Division contractors.

4.1 LAKE MEAD BELOW ELEVATION 1125 FEET

If the projected January 1 Lake Mead elevation is below 1125 feet msl, the annual pumping and release from Lake Mead will be sufficient to satisfy up to 7.5 MAF of annual consumptive use in accordance with the Decree.

4.2 LAKE MEAD AT OR ABOVE ELEVATION 1125 FEET

If the projected January 1 Lake Mead elevation is at or above 1125 feet msl and below 1145 feet msl, surplus water would be made available. The estimated annual amounts of surplus water available for pumping and release from Lake Mead (in addition to the 7.5 maf normal apportionment) are listed in the following schedule:

Year	Amount Available (kaf)
2002	200
2003	200
2004	150
2005	150
2006	150
2007	150
2008	150
2009	150
2010	150
2011	200
2012	200
2013	250
2014	250
2015	300
2016	300

4.3 LAKE MEAD AT OR ABOVE ELEVATION 1145 FEET

If the projected January 1 Lake Mead elevation is at or above 1145 ft. msl but below the spill avoidance strategy assuming the runoff value of the 70^{th} percentile of exceedance based on the historic record of runoff above Lake Powell, surplus water would be made available. The annual amounts of surplus water available for pumping and release from

Lake Mead (in addition to the 7.5 maf normal apportionment) are listed in the following schedule:

Year	Amount Available (kaf)
2002	650
2003	600
2004	550
2005	550
2006	500
2007	500
2008	450
2009	450
2010	450
2011	450
2012	450
2013	450
2014	450
2015	450
2016	450

4.4 70R STRATEGY

If the projected January 1 Lake Mead storage provides insufficient space for the coming year (based on the 70R Strategy), and is below the flood control release criteria listed below, the Secretary would determine annually the quantity of surplus water available. The quantity is determined by assuming the 70^{th} percentile historical runoff, along with normal 7.5 maf delivery to Lower Division states, for the next year. Applying these values to current reservoir storage, the projected reservoir storage at the end of the next year is calculated. The surplus is determined if the estimated space available at the end of the next year is less than the space needed by flood control criteria. The quantity of the surplus is the difference between the space required and the estimated available space. The above methodology would require calculation of the annual quantity each year during the period identified in Section 3.1. The estimated annual amounts of surplus water available for pumping and release from Lake Mead (in addition to the 7.5 maf normal apportionment) are listed in the following schedule:

Year	Amount Available (kaf)
2002	1000
2003	950
2004	900
2005	900
2006	900
2007	900
2008	900
2009	950
2010	1000
2011	1000
2012	1000
2013	1050
2014	1050
2015	1050
2016	1050

4.5 FLOOD CONTROL SURPLUS

If the projected January 1 system contents projects Hoover Dam flood control releases based on the 1984 Hoover Dam, Lake Mead, Water Control Manual, the annual pumping and release from Lake Mead will be sufficient to satisfy all reasonable and beneficial consumptive uses in the Lower Basin with valid surplus contracts with the Secretary of the Interior. The estimated annual amounts of surplus water available for pumping and release from Lake Mead (in addition to the 7.5 maf normal apportionment) are listed in the following schedule:

Year	Amount Available (kaf)
2002	1350
2003	1350
2004	1350
2005	1350
2006	1400
2007	1450
2008	1500
2009	1550
2010	1600
2011	1600
2012	1650
2013	1650
2014	1650
2015	1700
2016	1700

ATTACHMENT J

Detailed Modeling Documentation

The river system operation analysis for this FEIS was conducted with Reclamation's Colorado River Simulation System model implemented in the RiverWare modeling system. This attachment contains detailed documentation of the modeling process.

Detailed Modeling Documentation

This attachment describes the reservoir operating rules and related data used in Reclamation's Colorado River Simulation System, as implemented in the RiverWare modeling system.

BACKGROUND

Long-term policy and planning studies on the Colorado River have typically used model results from the Colorado River Simulation System (CRSS), a Fortran-based modeling system, developed in the 1980's. CRSS originally ran on a Cyber mainframe computer, but was ported to run on both personal computers and Unix Workstations in 1994. CRSS modeled twelve major reservoirs and some 115 diversion points throughout the Upper and Lower basins on a monthly time step. A major drawback of CRSS was that the operating policies or rules were "hardwired" into the modeling code, making modification of those policies difficult.

Based on the need to initiate surplus and shortage studies for the Lower Basin in the early 1990's, Reclamation developed an annual time step model, CRSSez (BOR, 1998). CRSSez primarily models the operation of Lakes Powell and Mead, representing the reservoirs above Powell as one aggregate reservoir, and the effect of reservoirs below Mead as part of the water demand necessary from Mead. CRSSez was used in the Interim Surplus Criteria EIS process to facilitate the development of possible alternatives to be analyzed.

Also in 1994, Reclamation began a collaborative research and development program with the University of Colorado and the Tennessee Valley Authority with the goal of developing a general-purpose modeling tool that could be used for both operations and planning on any river basin. This modeling tool, known as RiverWare, is now being used by the Upper and Lower Colorado Regions for both planning and monthly operations (Fulp, 1999). A major advantage of RiverWare is that the operational policies or rules are no longer "hardwired" into the modeling code (Zagona, et al, 1999). The user expresses and prioritizes the rules through the RiverWare graphical user interface, and RiverWare then interprets the rules when the model is run. Multiple rule sets can be run with the same model and this provides the capability for efficient "what-if" analysis with respect to different policies.

Reclamation replaced the original CRSS model with a new model implemented in RiverWare in 1996. The new model has the same spatial and temporal resolution, uses the same basic input data (hydrology and consumptive use schedules), and uses the same physical process algorithms as the original CRSS. A rule set was also developed to mimic the policies contained in the original model. Comparison runs were made between the original CRSS and the new model and rule set, with typical differences of less than 0.5% (BOR, 1996).

The second phase of the program to replace CRSS consists of examining the rules extracted from CRSS and developing new rule sets that reflect current operational policy as well as to investigate and improve, where necessary, the physical process methodologies. A team of Reclamation engineers from the Upper and Lower Colorado Regions has been established for these purposes and this phase is on going.

DESCRIPTION OF THE MODEL

As previously mentioned, the features represented in the model are identical to the original CRSS model. In summary, twelve reservoirs are modeled (Fontenelle, Flaming Gorge, Taylor Park, Blue Mesa, Morrow Point, Crystal, Navajo, Starvation, Powell, Mead, Mohave, Havasu) and approximately 115 diversions are modeled (demands and return flows) throughout the basin. The Lower and Upper Basin diversion and depletion schedules used in this EIS are documented in Section 3.4.5 and Attachments G and J respectively. The hydrologic "natural" inflows (flows corrected for upstream regulation and consumptive uses and losses) at 29 inflow points throughout the basin were also used from the standard CRSS hydrology data set covering the period 1906-1990.

For the analysis conducted for this EIS, only the operation of Lake Powell was updated to reflect current operational policy in the Upper Basin. Operation of the other reservoirs in the Upper Basin essentially followed the operation in the original CRSS. Operation of Lakes Mead, Mohave, and Havasu also followed that of the original CRSS, with the exception of the surplus and shortage rules as described below.

RESERVOIRS ABOVE LAKE POWELL

The reservoirs above Lake Powell are operated to meet monthly storage targets (or "rule curves") and downstream demands. The basic procedure is that given the inflow for the current month, the release will be either the release necessary to meet the target storage or the release necessary to meet demands downstream of the reservoir, whichever is greater. The rule curves are input for each reservoir, but are modified during the run for Flaming Gorge, Blue Mesa, and Navajo to simulate operations based on the imperfect inflow forecasts that are encountered in actual reservoir operations. Furthermore, each reservoir is constrained to operate within user-supplied minimum and maximum releases (mean monthly release in cfs) as specified in the following table:

Reservoir	Min Release	Max Release
Fontenelle	500	18700
Flaming Gorge	800	4900
Starvation	100	5000
Taylor Park	50	5000
Blue Mesa	270	5000
Morrow Point	300	5000
Crystal	300	4200
Navajo	300	5900

For Flaming Gorge, Blue Mesa, and Navajo, the target storage is computed by using an inflow forecast for the spring runoff season (January through July), again to mimic the imperfect forecasts seen in actual operations. The forecasted inflow (for the current month through July) is computed as a weighted average of the long-term average natural inflow and the natural inflow assumed for the year being modeled. The weights used are:

Month	Natural Inflow Weight	Average Natural Inflow weight
January	0.3	0.7
February	0.4	0.6
March	0.5	0.5
April	0.7	0.3
May	0.7	0.3
June	0.7	0.3
July	0.6	0.4

The long-term, average natural inflows into each reservoir are (1000 af):

Reservoir	Jan	Feb	Mar	Apr	May	Jun	Jul
Flaming Gorge	23.3	20.9	33.8	87.9	250.4	327.8	157.5
Blue Mesa	34.0	39.5	94.6	176.0	339.8	561.6	346.8
Navajo	18.8	24.6	69.3	176.9	297.3	284.7	120.1

Based on the inflow forecast, the rule computes the volume necessary to release from the current month through July, assuming the reservoir will fill in July:

> Release needed for the current month = (current contents - live capacity + predicted remaining inflow) divided by the number of months remaining until the end of July

The target storage for the current month is then computed, adjusting for any gains or losses above the reservoir:

Target storage = previous storage - release needed + gains - losses

LAKE POWELL OPERATION

As previously stated, the operation of Lake Powell was modified to reflect current operating polices. In the original CRSS rules, Lake Powell was operated on a rule curve that was *not* adjusted for an inflow forecast. Two other higher priority rules ensured that the minimum objective release of 8.23 million afy was met and that equalization of Lakes Powell and Mead was accomplished when necessary.

The rule curve operation of Lake Powell was replaced by a new rule that better represents current operational practices. This new rule consists of a forecast-driven, spring runoff operation (January through July) that attempts to fill the reservoir to a July target storage and a fall operation (August through December) that attempts to draw down the reservoir to a December target storage. For this EIS, the July and December targets were 23.822 maf (500 kaf of space) and 21.900 maf (2.422 kaf of space) respectively. In addition, a rule was added to simulate the occurrence of Beach Habitat Building Flows (BHBF's or "spike" flows). The minimum objective release and equalization rules were kept essentially the same as in the original CRSS rules. Release constraints that reflect the 1996 Record of Decision on the Operation of Glen Canyon Dam were also added to the Lake Powell rule set.

LAKE POWELL INFLOW FORECAST

Since the original CRSS rules computed an inflow forecast for Lake Powell and adjusted it for use by the flood control operation at Lake Mead, the same forecasting algorithm could be applied to the new operation of Lake Powell. The unregulated Lake Powell inflow forecast from the current month through July is computed as:

natural flow into Lake Powell - estimated Upper Basin depletions + the forecast error

where the forecast error is computed using equations derived from an analysis of past Colorado River forecasts and runoff data for the period 1947 to 1983.

As detailed in the original CRSS overview document (BOR, 1985), analysis of these data revealed two strongly established patterns: (1) high runoff years are under-forecast, and low runoff years are over-forecast; (2) the error in the current month's seasonal forecast is strongly correlated with the error in the preceding month's forecast. A regression model was developed to aid in determining the error to be incorporated into the seasonal forecast for each month from January to June. The error is the sum of a deterministic and a random component. The deterministic component is computed from the regression equation. The random component is computed by multiplying the standard error of the regression equation by a random mean deviation selected from a standard normal distribution. The forecast error equation has the following form (all runoff units are maf):

$$E_i = a_i X_i + b_i E_{(i-1)} + C_i + Z_r d_i$$

where:

- i = month
- E_i = error in the forecast for month "i."
- X_i = natural runoff into Lake Powell from month "i" through July.
- a_i = linear regression coefficient for X_i.
- $E_{(i-1)}$ = previous month's forecast error
- b_i = linear regression coefficient for $E_{(i-1)}$.
- c_i = constant term in regression equation for month "i."
- Z_r = randomly determined deviation
- d_i = standard error of estimate for regression equation for month "i."

The following table summarizes the regression equation coefficients for each month:

Month	a_i	b_i	c_i	d_i
January	0.70	0.00	-8.195	1.270
February	0.00	0.80	-0.278	0.977
March	0.00	0.90	0.237	0.794
April	0.00	0.76	0.027	0.631
May	0.00	0.85	0.132	0.377
June	0.24	0.79	0.150	0.460

The magnitude of the June forecast error is constrained to not exceed 50 percent of the May forecast error and the July forecast error is equal to 25 percent of the June forecast error.

Spring Runoff Operation (January through July)

To accomplish the spring operation, the unregulated forecast is first adjusted to account for potential reservoir regulation above Powell. This potential regulation is currently computed as just the sum of the available space (live capacity – previous month's storage) in Fontenelle, Flaming Gorge, Blue Mesa, and Navajo. Using the regulated forecasted inflow, the total volume of water necessary to release from the current month through July is computed as:

total volume to release = previous storage – July target storage
+ forecasted regulated inflow – loss due to evaporation
– loss due to bank storage
–

The release for the current month is then computed by multiplying the total volume to release by a fraction for the current month, where the fraction reflects a user-supplied preferred weighting pattern. The weights and resulting fractions used for this study are as follows:

Spring Season	Weights	Fractions
January	0.170	0.170
February	0.160	0.193
March	0.130	0.194
April	0.100	0.185
May	0.100	0.227
June	0.160	0.471
July	0.180	1.000

The fraction is computed as current month's weight divided by the sum of the current and remaining month's weights for the season.

During the spring operation, however, the computed release is constrained to be at least as great as the total volume divided by the number of months remaining. This constraint ensures that sufficient water is released early in the season during high forecast years. Lake Powell's spring operational release is further constrained in each month to be within a minimum and maximum range (currently set to 6500 and 25000 cfs respectively).

FALL OPERATION (AUGUST THROUGH DECEMBER)

Conceptually, the computation for the fall operation is identical to that done for the spring operation. The regulated inflow forecast is simply the natural inflow, adjusted for Upper Basin depletions, and potential reservoir regulation with no forecast error added. The potential reservoir regulation is again computed as the sum of the available space in Fontenelle, Flaming Gorge, Blue Mesa, and Navajo, where the space is the target storage in December for each reservoir minus the previous month's storage. User-supplied weights are also used to compute the current month release from the total volume to release in the fall. The weights and resulting fractions are as follows:

Fall Season	Weights	Fractions
August	0.266	0.266
September	0.200	0.272
October	0.156	0.292
November	0.156	0.413
December	0.222	1.000

Two additional constraints are placed on the computed monthly release to ensure a smooth operation. In July, the release is constrained to be at least 1.0 maf if Powell's storage is greater than 23.0 maf. From July through December, the release is constrained to not exceed 1.5 maf, as long as a 1.5 maf release results in a storage at Lake Powell less than 23.822 maf. Powell's fall operational release is further constrained in each month to be within a minimum and maximum range (currently set to 6500 and 25000 cfs respectively).

Minimum Objective Release

A higher priority rule ensures that the previously described Powell operation will satisfy a minimum objective release to the Lower Basin, currently equal to 8.23 maf over each water year (October through September). Similar to the weighting and release fraction scheme used for the operational rule, a preferred release pattern for each month to meet the minimum objective release is supplied and a fraction is computed. The release pattern (in kaf) and resulting fractions are as follows:

Month	Release	Fraction
October	600	0.073
November	600	0.079
December	700	0.100
January	800	0.126
February	700	0.127
March	600	0.124
April	600	0.142
May	600	0.165
June	700	0.231
July	800	0.343
August	900	0.588
September	630	1.000

The fraction is computed as current month's release divided by the sum of the current and remaining month's releases through September.

Each month the rule computes the volume of water remaining to meet the minimum objective release for the current water year (accounting for the water released previously in the water year) and multiplies that volume by the release fraction. The release determined by the operational rule must then be at least as great as this resulting minimum objective release for the month.

EQUALIZATION OF LAKES POWELL AND MEAD

The equalization of storage between Lakes Powell and Mead is implemented in a rule that first determines if equalization needs to occur, and if so, then determines how much water to release from Powell to accomplish it. The rule is in effect from January through September of each year. The rule states that equalization needs to occur if two criteria are met: (1) if the storage in the Upper Basin meets the 602(a) requirement, and (2), if the projected end-of-water-year (EOWY) storage in Lake Powell is greater than that in Lake Mead.

The storage in the Upper Basin is computed for each month (January through September) and consists of the predicted EOWY storage in Lake Powell, plus the sum of the previous month's storage for Flaming Gorge, Blue Mesa, and Navajo. That storage is then compared to the computed value of 602(a) storage, described below to see if the 602(a) requirement is met each month. The method of estimating the EOWY storage is described below.

The release for equalization is computed by taking half of the difference between the predicted EOWY contents of Lake Powell and Lake Mead and dividing by the number of months remaining through September. Evaporation and bank storage losses at Lakes Powell and Mead are included in the calculation, resulting in an iterative procedure to arrive at the computed equalization release. The iteration stops when the forecasted EOWY contents of Lake Powell and Lake Mead are within a user-specified tolerance. That tolerance is currently set to 25000 acre-feet.

The computed equalization release for each month is constrained in three ways. If the additional release due to equalization would cause the total Upper Basin storage to drop below the 602(a) requirement, then the amount of the equalization release is reduced to prevent this from happening. Likewise, the equalization release is reduced if it would cause Lake Mead contents to exceed its exclusive flood control space. Finally, the equalization release is constrained to be less than or equal to the maximum power plant capacity at Lake Powell (currently set to 33,100 cfs).

602(a) STORAGE REQUIREMENT

As stated in the CRSS overview document (BOR, 1985), "602(a) storage refers to the quantity of water required to be in storage in the Upper Basin so as to assure future deliveries to the Lower Basin without impairing annual consumptive uses in the Upper Basin". The current implementation of that storage requirement duplicates the original CRSS calculation. It computes the storage necessary in the Upper Basin to meet the minimum objective release and Upper Basin depletions over the next "n" years, assuming the inflow over that period would follow that seen in the most "critical period on record".

The critical period in the Colorado River basin occurred in 1953-1964, a length of 12 years. Inflows from these years are used in the calculation of 602(a) storage.

At the beginning of each calendar year, a value for 602(a) storage is computed by the following formula:

602a = {(UBDepletion + UBEvap)* (1 - percentShort/ 100) + minObjRel - criticalPeriodInflow} * 12 + minPowerPoolStorage

where:

602a = the 602(a) storage requirement

UBDepletion = the average over the next 12 years of the Upper Basin scheduled depletions

UBEvap = the average annual evaporation loss in the Upper Basin (currently set to 560 kaf)

percentShort = the percent shortage that will be applied to Upper Basin depletions during the critical period (currently set to zero)

minObjRel = the minimum objective release to the Lower Basin (currently set to 8.23 maf)

criticalPeriodInflow = average annual natural inflow into the Upper Basin during the critical period (1953-1964) (currently set to 12.18 maf)

minPowerPoolStorage = the amount of minimum power pool to be preserved in Upper Basin reservoirs (currently set to 5.179 maf)

All parameter values currently used were as found in the original CRSS data files ported from the Cyber mainframe in 1994.

PREDICTING END-OF-WATER-YEAR (EOWY) CONTENTS OF LAKES POWELL AND MEAD

Lake Powell EOWY content is predicted each month by taking the previous month's storage, adding the estimated inflow, subtracting the estimated release, and subtracting the estimate of evaporation and change in bank storage. All estimated values are for the period from the current month through September. The estimated inflow is just the regulated inflow forecast previously discussed, where the forecast error is included through July. The estimated release is based on the spring operation (through July) and the fall operation for August and September. The estimated evaporation and bank storage losses are based on an initial estimate of the EOWY content.

Similarly, the Lake Mead EOWY content is predicted each month by taking the previous month's content, adding the estimated Powell release, subtracting the estimated Mead release, adding the average gain between Powell and Mead, subtracting the Southern Nevada depletion, and subtracting the estimate of evaporation and change in bank storage. Again, all values are for the period from the current month through September. Lake Mead's release is estimated as the sum of the depletions downstream of Mead and the reservoir regulation requirements (including evaporation losses) for Lakes Mohave and Havasu minus the gains below Mead.

BEACH /HABITAT BUILDING FLOWS (BHBF'S)

Under the current rule that implements BHBF's, a BHBF is triggered for the current month if the following conditions are met:

- in January, if the unregulated inflow forecast for January through July (the natural flow – Upper Basin depletions plus forecast error) is greater than the "January trigger volume" (currently set to 13.0 maf)
- in January through July, if the current month's Powell release is greater than the "release trigger" (currently set to 1.5 maf) *or* if the release volume for the current month through July equally distributed over those months would result in a release greater than the "release trigger"

Once a BHBF has been triggered, if Powell would have had to spill in that month anyway, the total outflow from Powell is not increased; rather the volume for the BHBF (currently set to 200 kaf) is taken from the total outflow already determined by the operational rule. If Powell was not going to spill in that month, then the total outflow from Powell is increased (i.e., the volume for the BHBF is taken from Powell's storage). Under the case where the BHBF is triggered even though the current month's release is less than the "release trigger", the rule re-sets Powell's outflow for that month to the trigger release amount (1.5 maf).

Under all circumstances, only one BHBF is made per calendar year.

LAKE MEAD OPERATION

Lake Mead is operated primarily to meet downstream demand, including downstream depletions (both U.S. and Mexico) and reservoir regulation requirements. In any month, the rule computes the downstream depletions based on schedules that have been set as input data or by other rules (for the case of surplus or shortage in the Lower Basin). The reservoir regulation requirements for Lakes Mohave and Havasu include water necessary to meet their storage targets and evaporation losses for each month. The operation rule computes the release necessary from Lake Mead to meet that total downstream demand minus gains below Mead. This release may be increased, however, based on flood control procedures.

MEAD FLOOD CONTROL

There are three flood control procedures currently in effect for different times of the year. These procedures were developed in the original CRSS and were based on the Field Working Agreement between Reclamation and the Army Corps of Engineers (ACOE, 1982). The first procedure is in effect throughout the year. Its objective is to maintain a minimum space of 1.5 maf in Lake Mead, primarily for extreme rain events. This space is referred to as the exclusive flood control space and is represented by the space above elevation 1219.61. The second procedure is used during the spring runoff forecast season (January through July). The objective during this period is to route the maximum forecasted inflow through the reservoir system using specific rates of Hoover Dam discharge, assuming that the lake will fill (to elevation 1219.61) at the end of July. The third procedure is used during the space building or drawdown period (August through December). The objective during this period is to gradually draw down the reservoir system to meet the total system space requirements in each month in anticipation of the next year's runoff.

EXCLUSIVE FLOOD CONTROL SPACE REQUIREMENT

As previously noted, this requirement states that space in Lake Mead must be a minimum of 1.5 maf at all times. If the release computed to meet downstream demand results in a Lake Mead storage that would violate this space requirement, the rule computes the additional release necessary to maintain that space.

SPRING RUNOFF SEASON (JANUARY THROUGH JULY)

The flood control policy requires that the maximum forecast be used where that forecast is defined as the estimated inflow volume that, on average, will not be exceeded 19 times out of 20 (a 95% non-exceedance). The rule first computes the inflow forecast to Lake Mead by taking the Lake Powell forecast previously described and adds the long-term, average natural tributary inflows between Lakes Powell and Mead. The maximum forecast is then estimated by adding an additional volume (the "forecast error term") to that inflow forecast. The forecast error term is given in the following table, taken from the original CRSS data:

Forecast Period	Forecast Error Term (maf)
January – July	4.980
February – July	4.260
March – July	3.600
April – July	2.970
May – July	2.525
June – July	2.130
July - July	0.750

The Field Working Agreement defines an iterative algorithm by which the current month's release is determined. Certain release levels are specified and are given in the following table:

Release Level	Release (cfs)	Description
1	19000	Parker powerplant capacity
2	28000	Davis powerplant capacity
3	35000	Hoover powerplant capacity (in 1987)
4	40000	Approx. max. flow non-damaging to streambed
5	73000	Hoover controlled discharge capacity

The flood control release needed for the current month is determined by:

> release needed for the current month = maximum forecasted inflow - current storage space in Lake Powell (below 3700 feet) – current storage space in Lake Mead (below 1229 feet) + 1.5 maf (exclusive space) - evaporation and bank storage losses from Lakes Powell and Mead - Southern Nevada depletion – future volume of water released (assuming a release level from the table for the remaining months through July)

If the computed release for the current month is greater than that assumed for the future months, the future level is increased and the current month release is re-computed. The computation stops once the computed release for the current month is less than or equal to that assumed for the future months. If the computed release is greater than the previously assumed level, that release is used for the current month; otherwise, the previously assumed level is used.

The rule sets Lake Mead's release to the flood control release if it is greater than the release previously computed to meet downstream demands.

SPACE BUILDING (AUGUST THROUGH DECEMBER)

The flood control policy states the flood control storage space in Lake Mead (storage below elevation 1229 feet) required at the beginning of each month from August through January:

Date	Space Required (maf)
August	1.50
September	2.27
October	3.04
November	3.81
December	4.58
January	5.35

However, these targets may be reduced to the minimum of 1.5 maf in each month if additional space is available upstream in active storage. Certain upstream reservoirs are specified with a maximum creditable space for each:

Reservoir	Max. Creditable Storage Space (maf)
Powell	3.8500
Navajo	1.0359
Blue Mesa	0.7485
Flaming Gorge plus Fontenelle	1.5072

In each month (July through December), if the release computed to meet downstream demands results in an end-of-month Lake Mead storage that would violate the space requirement adjusted for upstream storage, the rule computes the additional release necessary to maintain that space. However, these releases are constrained to be less than or equal to 28,000 cfs.

LAKE MOHAVE AND LAKE HAVASU OPERATION

Lakes Mohave and Havasu are operated to meet a user-specified target storage at the end of each month. These storage targets are given in the following table:

Month	Mohave Target Storage (kaf)	Havasu Target Storage (kaf)
January	1644.0	539.1
February	1698.7	539.1
March	1698.7	557.4
April	1698.7	593.6
May	1753.9	611.4
June	1666.0	611.4
July	1543.0	580.0
August	1417.0	561.1
September	1371.1	557.4
October	1371.1	548.2
November	1478.0	542.7
December	1585.0	539.1

LOWER BASIN SHORTAGE STRATEGIES

As discussed in Section 3.3.3.4, although there are no established shortage criteria for the Lower Basin, shortage rules were developed and used in the model simulation to address concerns related to low Lake Mead elevations. For this DEIS, a "two-level" shortage protection strategy was used.

In Level 1 shortage, the shortage determination is based on comparing the January 1 Lake Mead elevation to a user-input trigger elevation, where the trigger elevations are determined from other modeling studies to protect a significant elevation within a given degree of confidence. If Lake Mead's elevation at the beginning of the year is less than the trigger elevation, a Level 1 shortage is declared and certain Lower Basin depletions are reduced. The shortage remains in effect for that calendar year.

For this DEIS, Level 1 protection of elevation 1083 feet (minimum power pool) and Level 1 protection of elevation 1050 feet (minimum water level for operation of Southern Nevada's upper diversion intake) were studied separately. Trigger elevations were input to protect each elevation with an 80% probability; however, actual model runs showed that the protection was less (approximately 74%). As discussed in Section 3.3.4.1, these trigger elevations will be adjusted for the Final EIS to ensure an 80% protection probability.

Under Level 1 shortage, the Central Arizona Project (CAP) depletion is set to a given amount (1.0 maf for this DEIS) and Southern Nevada Water Authority (SNWA) is reduced by 4% of the total reduction as given by:

$$SNWS_{short} = SNWS_{norm} - (0.04*(CAP_{norm}-CAP_{short})/0.96)$$

where the subscripts denote the normal and shortage depletion amounts. Metropolitan Water District (MWD) and other water users (including Mexico) do not take a Level 1 shortage.

Under Level 2 shortages, further cuts are imposed to keep Lake Mead above elevation 1000 feet (the minimum water level for operation of SNWA's lower diversion intake). At the beginning of each year, the rule estimates the end-of-water-year (EOWY) Lake Mead elevation (using Level 1 shortage schedules and normal schedules for other users). If the EOWY elevation is below 1000 feet, CAP and SNWA are cut further to keep Lake Mead above 1000 feet. If CAP delivery is reduced to zero, MWD and Mexico have shortages imposed, again in an amount necessary to keep the reservoir above 1000 feet. Shortages to Mexico consist of shorting Mexico proportionately to the total shortages imposed on United States (U.S.) users:

$$Mex_{short} = Mex_{norm} * (U.S._{shortage}/U.S._{norm})$$

For this DEIS, however, Level 2 shortages were never severe enough to impose shortages on MWD and Mexico.

LOWER BASIN SURPLUS STRATEGIES

As discussed in Chapter 2, several surplus strategies were proposed for inclusion in this DEIS. Of the five alternatives that were developed and analyzed in detail (the No Action Alternative and the four action alternatives), four distinct strategies were used: the Flood Control Strategy, the R strategy, the P strategy, and the Multi-tiered Trigger strategy.

FLOOD CONTROL STRATEGY

Under the Flood Control strategy, a surplus condition is based on the flood control procedures previously described for Lake Mead. For each month, the rule calculates the release necessary for flood control and declares a surplus for the remainder of the calendar year if that release is greater than the release necessary to meet normal downstream demand. Monthly "full" surplus schedules are then set for the remainder of the year, where the monthly surplus schedules are determined by applying monthly percentages to the annual "full" surplus values given in Attachment G (Table G-4). Mexico receives up to an additional 200 kaf only under a flood control surplus. Under most cases, the flood control release is sufficient to meet the increased downstream demand; however, if that is not the case, the rule increases the release so that the surplus demands are met.

All alternatives analyzed in this EIS used the Flood Control surplus strategy, in addition to any other strategies.

R STRATEGY

Under the R surplus strategy, a surplus condition is based on the system space requirement at the beginning of each year. Based on an assumed runoff, Upper and Lower Basin depletion schedules, and Lake Powell and Lake Mead contents at the beginning of the year, the volume of water in excess of the system space requirement at the end of the year is estimated. If that volume is greater than zero, a surplus is declared and full surplus schedules are met for the year. It should be noted that variations of the R strategies include a "volume limited" surplus, where just the computed surplus volume is distributed to certain Lower Basin users (i.e., a full surplus is not assumed).

The assumed runoff corresponds to a particular percentile historical runoff. For example, the 75R strategy assumes a runoff corresponding to the 75^{th} percentile (75% of the historical values are less than that value, or approximately 18.1 maf of natural inflow into Lake Powell).

Based on the original CRSS implementation, the surplus volume is computed by:

SurVol = (PowellStorage + MeadStorage – maxStorage) x (1.0 + aveBankStorCoeff) + runoff – UBdemand – Lbdemand

Where:

PowellStorage = Lake Powell content at the beginning of the year
MeadStorage = Lake Mead content at the beginning of the year
maxStorage = maximum combined storage at Lakes Powell and Mead that will meet the system space requirement at the beginning of the year, assuming 30% of that requirement will be met by the reservoirs upstream of Powell (live capacity of Lakes Powell and Mead - 0.7 x 5.35 maf = 47.96 maf)
aveBankStorageCoeff = average of Lake Powell and Lake Mead bank storage

coefficients
runoff = assumed percentile runoff
UBdemand = Upper Basin depletion scheduled for the year + the average evaporation loss in the Upper Basin (same as assumed in equalization, 560 kaf)
LBdemand = sum of the depletions below Powell + the evaporation losses in the Lower Basin (average loss of 900 kaf at Mead and computed for Lakes Mohave and Havasu, based on the target storage) – average gains between Powell and Mead (801 kaf) – average gains below Mead (427 maf)

P STRATEGY

Under the Protection or P strategy, a surplus is determined if there is sufficient water in Lake Mead to meet normal Lower Basin depletions (7.5 maf), while avoiding the likelihood of a future shortage determination. Analogous to Level 1 shortages, the surplus determination is based on comparing the January 1 Lake Mead elevation to a user-input trigger elevation, where the trigger elevations are determined from other modeling studies to protect the shortage line with a given degree of confidence. If the Lake Mead elevation is greater than the trigger elevation, a full surplus is declared for that calendar year.
For this DEIS, an 80% confidence of avoiding future Level 1 shortages was used to compute the trigger elevations (Section 2.3.5).

MULTI-TIERED TRIGGER STRATEGY

Under the multi-tiered trigger strategies, various amounts of surplus water are made available, depending upon Lake Mead's elevation at the beginning of each calendar year. Both the Six States Alternative and the California Alternative use this strategy. The trigger elevations used in this DEIS for each alternative are discussed in Sections 2.3.3 and 2.3.4 respectively. The surplus depletion schedules used for each alternative are detailed in another attachment.

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ATTACHMENT K

Upper Division Depletion Schedule

This attachment consists of a table displaying the schedule of projected Colorado River system depletions, or consumptive use, by the Upper Division. These depletions were used to model the operation of the river system under baseline conditions and the interim surplus criteria alternatives. Shown in the table are projected depletions of the Upper Division states and Arizona's apportionment of water from the Upper Basin. The depletion schedule was developed by the Upper Basin states and was compiled and provided by the Upper Colorado River Commission in December 1999. The depletion schedule was then modified slightly to incorporate data received subsequently from the Ten Tribes Partnership, presented in Attachment Q.

Table K-1
Upper Basin Depletion Schedule (kaf)

Calendar Year	Colorado	Utah	Wyoming	New Mexico	Arizona	Reservoir Evaporation	Total Upper Basin
2002	2419	859	501	449	45	574	4847
2003	2433	873	503	466	45	574	4893
2004	2447	886	505	484	45	574	4940
2005	2494	899	507	501	45	574	5019
2006	2501	913	508	510	45	574	5052
2007	2509	926	510	520	45	574	5084
2008	2517	940	512	529	45	574	5117
2009	2524	953	514	539	45	574	5149
2010	2580	1009	517	548	50	574	5278
2011	2583	1013	519	552	50	574	5291
2012	2586	1017	520	557	50	574	5303
2013	2588	1020	522	561	50	574	5316
2014	2591	1024	524	565	50	574	5328
2015	2594	1028	526	570	50	574	5341
2016	2597	1032	527	573	50	574	5353
2017	2600	1036	529	576	50	574	5365
2018	2603	1041	531	579	50	574	5378
2019	2606	1045	532	583	50	574	5390
2020	2626	1055	535	589	50	574	5429
2021	2629	1062	537	590	50	574	5443
2022	2633	1069	540	591	50	574	5457
2023	2636	1077	542	593	50	574	5471
2024	2639	1084	544	594	50	574	5485
2025	2643	1091	547	595	50	574	5499
2026	2646	1099	549	597	50	574	5514
2027	2649	1107	551	599	50	574	5529
2028	2652	1114	553	600	50	574	5545
2029	2656	1122	556	602	50	574	5560
2030	2675	1129	571	604	50	574	5603
2031	2677	1134	575	604	50	574	5614
2032	2679	1139	580	604	50	574	5626
2033	2680	1145	584	604	50	574	5637
2034	2682	1150	588	604	50	574	5649
2035	2684	1155	593	605	50	574	5660
2036	2686	1160	597	605	50	574	5671
2037	2688	1165	601	605	50	574	5683
2038	2689	1171	605	605	50	574	5694
2039	2691	1176	610	605	50	574	5706
2040	2703	1177	615	605	50	574	5724
2041	2708	1180	622	605	50	574	5739
2042	2712	1184	629	605	50	574	5754
2043	2717	1187	637	605	50	574	5769
2044	2721	1190	644	605	50	574	5784
2045	2726	1194	651	605	50	574	5800
2046	2731	1197	658	605	50	574	5815
2047	2735	1200	665	605	50	574	5830
2048	2740	1203	673	605	50	574	5845
2049	2744	1207	680	605	50	574	5860
2050	2776	1207	687	605	50	574	5899

ATTACHMENT L

Sensitivity Analysis Comparing Baseline with Transfers to Baseline Without Transfers

This attachment illustrates the water surface elevations of Lake Powell and Lake Mead under baseline conditions with and without the California water transfers. The transfers involve changes in the delivery point for certain quantities of water as proposed in part of California's Colorado River Water Use Plan.

Sensitivity Analysis Comparing the Modeled Baseline Without Transfers to Baseline With Transfers Conditions

OVERVIEW

This attachment provides a summary of the sensitivity analysis conducted to assess the potential effect of the modeled California intrastate water transfers. The sensitivity analysis compares the results of the modeled baseline without transfers condition to those of the baseline with transfers condition.

Only two potential hydrologic effects resulting from the modeled California intrastate water transfers were observed. The first effect is the lower amount of surplus water that California would receive under the baseline without transfers condition reflecting a lower depletion schedule that was used to model California's maximum full surplus demand projections. The second is the potential change in river flows for that portion of the river located between Parker Dam and Imperial Dam. This potential change in river flows is associated with the change in the point of delivery of water that is being transferred between the agricultural agencies and MWD.

Additional discussion on these two potential hydrologic effects and other hydrologic aspects evaluated under this sensitivity analysis follows:

LAKE POWELL WATER SURFACE ELEVATIONS

The Lake Powell water surface elevations observed under the modeled baseline without transfers condition were compared to the baseline with transfers condition. The result of this comparative analysis indicates that there is essentially no difference between the water surface levels observed under the two modeled baseline conditions. Figure L-1 presents a comparison of the 90th, 50th and 10th percentile values observed under the two modeled baseline conditions (with and without transfers). A summary of this same information is presented in tabular format in Tables L-1, L-2 and L-3, respectively.

LAKE MEAD WATER SURFACE ELEVATIONS

Similar to the water surface elevations observed for Lake Powell, the differences that were observed in Lake Mead water surface elevations under the two baseline conditions (with and without transfers) were minimal to none. Observed differences in the 90th, 50th and 10th percentile values of the two baseline conditions varied less than plus or minus two feet. A graphical comparison of the 90th, 50th and 10th percentile values for the two modeled baseline conditions is presented in Figure L-2. A similar comparison of the 90th, 50th and 10th percentile values for the modeled conditions are presented in tabular format in Tables L-4, L-5 and L-6, respectively.

HOOVER DAM FLOOD CONTROL RELEASES

The differences in the frequency of Hoover Dam (Lake Mead) flood control releases between the two modeled baseline conditions (with and without transfers) averaged one-half of one percent higher under the baseline with transfers condition during the 15-year interim surplus criteria period. This average difference increased to seven-tenths of one percent for the ensuing 34-year period. A graphical comparison of the frequency of Lake Mead flood releases under the two modeled baseline conditions is presented in Figure L-3. The slightly higher frequency of Hoover

Dam flood control releases observed under the baseline with transfers condition can be mostly attributed to the lower depletion schedule that was used to model California's full surplus demands under these modeled conditions (see discussion on Water Supply below). Since the magnitude of the surplus deliveries are lower under the baseline with transfers condition, more water remains in Lake Mead and this increases the probability of more frequent flood control releases, however slightly.

WATER SUPPLY

The water deliveries to the Lower Division states under the two baseline conditions (with and without transfers) were evaluated to determine the effect of the modeled water transfers, if any. A summary of the evaluation of each states' water deliveries under the two different baseline conditions follows:

Arizona

The observed magnitude and corresponding frequency of water deliveries to Arizona under the two baseline conditions were essentially the same. No significant differences in the amount of water that Arizona would receive under the two baseline conditions were observed. Figure L-4, presents a comparison of the 90th, 50th and 10th percentile values for the modeled Arizona water deliveries under the two baseline conditions, respectively. Figure L-5 presents a comparison of the frequency of occurrence of different amounts of annual water deliveries to Arizona during the modeled 15-year interim surplus criteria period. Figure L-6 presents a similar comparison for the ensuing 34-year period (2017 to 2050). As illustrated in these two figures, there is very little variation in both the frequency and magnitude of water deliveries to Arizona between the two modeled baseline conditions.

California

The observed water deliveries to California under the two baseline conditions differed as a result of the different depletion schedules used to model California's demands. Different depletion schedules incorporating different maximum full surplus demand schedules were used to model the two baseline conditions. California's modeled full surplus depletion schedule under the baseline without transfers condition begins at approximately 5.52 maf (year 2002), increases steadily to 5.56 maf by 2015, and remains at this level thereafter. California's modeled full surplus depletion schedule under the baseline with transfers condition begins at approximately 5.49 maf (year 2002), steadily decreases to approximately 5.2 maf by 2025 and generally remains close to this level thereafter. As a result of the different depletion schedules used to model the two baseline conditions, the observed magnitude of surplus deliveries to California is substantially higher under the baseline without transfers condition, as illustrated in Figure L-7 which compares the 90th percentile values of the modeled depletions. In general, the 90th percentile values coincide with the maximum full surplus depletion schedules that were used to model the respective baseline conditions. The frequency and magnitude of normal condition deliveries to California did not differ and there were no shortage condition deliveries observed as illustrated in Figure L-9. Figure L-8 presents a comparison of the frequency of occurrence of different annual water deliveries to California during the modeled 15-year interim surplus criteria period. Figure L-9 presents a similar comparison for the ensuing 34-year period (2017 to 2050). As illustrated in these two figures, only the magnitude of the surplus deliveries differ between the two baseline conditions (i.e. the frequency of surplus deliveries is similar).

Nevada

The observed magnitude and corresponding frequency of water deliveries to Nevada under the two different modeled baseline conditions were essentially the same. No significant differences in the amount of water that Nevada would receive under the two baseline conditions were observed. Figure L-10 presents a comparison of the 90th, 50th and 10th percentile values for the modeled Nevada water deliveries under the two baseline conditions, respectively. Figure L-11 presents a comparison of the frequency of occurrence of different annual water delivery amounts to Nevada during the modeled 15-year interim surplus criteria period. Figure L-12 presents a similar comparison for the ensuing 34-year period (2017 to 2050). As illustrated in these two figures, there is very little variation in both the frequency and magnitude of water deliveries to Nevada between the two modeled baseline conditions.

RIVER FLOWS

Only two river segments were observed to be affected by the modeled California intrastate water transfers, they are – the reach of river between Parker Dam and the Palo Verde Diversion Dam and the reach of river between the Palo Verde Diversion Dam and Imperial Dam. The reduced river flow (between 200,000 to 300,000 afy) below Parker Dam is associated with the change in diversion points resulting from the modeled California intrastate water transfers. This amount accounts for approximately 3 to 4 percent of the approximate average seven maf of annual flow that was observed in these reaches of the Colorado River. The transfers are anticipated to occur during the peak months when flows in these lower river reaches are at their seasonal highs. Figures L-13a through L-16b present a graphical comparison of the seasonal flow ranges that were projected downstream of the Palo Verde Diversion Dam for years 2006, 2016, 2025 and 2050. Therefore, in terms of mean monthly flows, the change in point of diversion of the transferred water may reduce the peak flows that range from 10,000 cfs to 12,500 cfs by as much as 800 cfs. While this reduction in mean monthly flows appears to be significant, the potentially reduced flows are still within the normal annual flow range of these reaches of the Colorado River (annual range is between 3,500 cfs to 12,500 cfs). As such, the potential reduced flows are not expected to result in any significant hydrological, environmental or socio-economic impacts.

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Figure L-1
Sensitivity Analysis – California Intrastate Water Transfers
Lake Powell End of July Water Surface Elevations – 90th, 50th and 10th Percentile Values

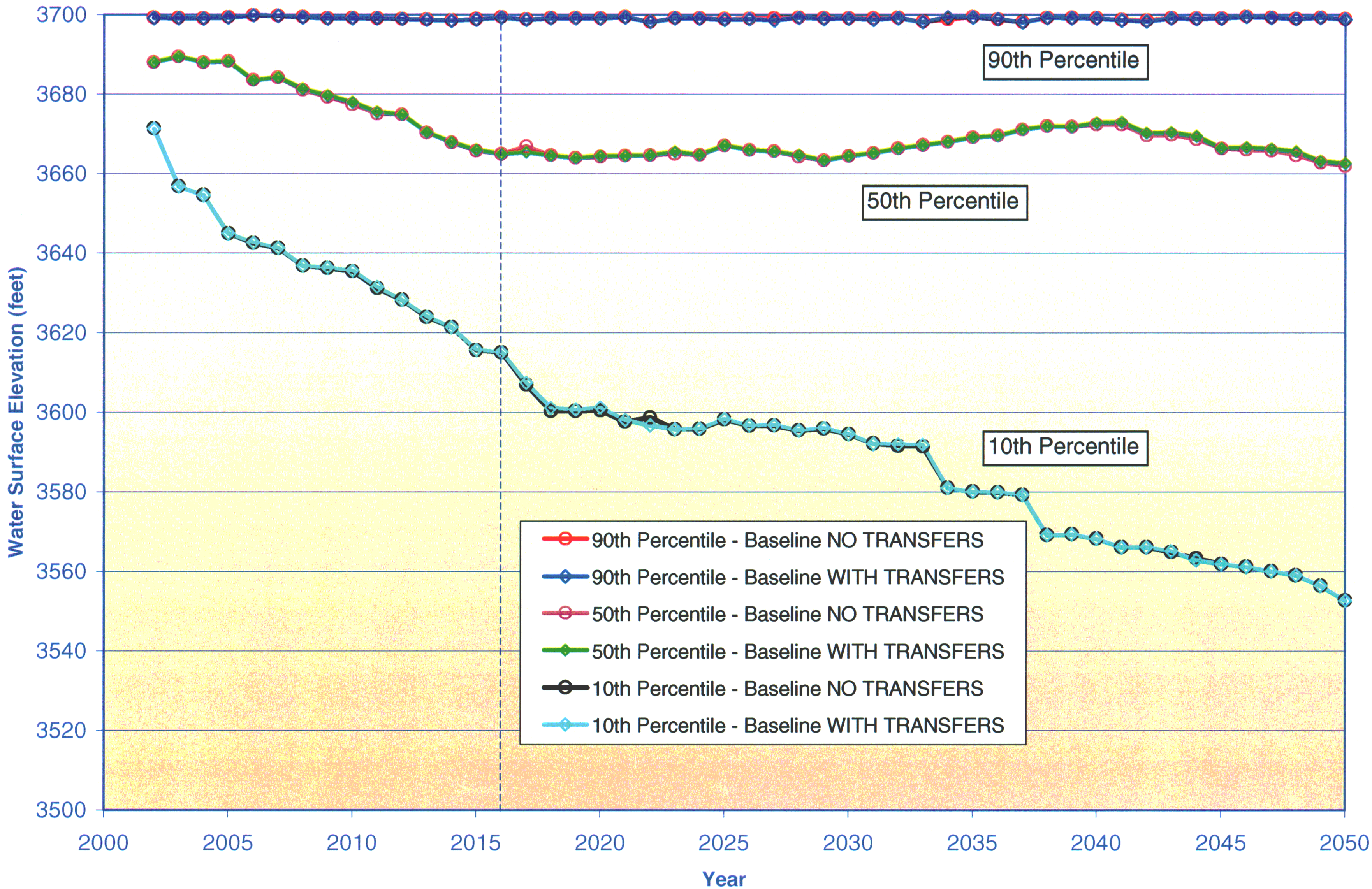


Table L-1

Lake Powell 90th Percentile Water Surface Elevations

Date	Baseline with Transfers	Baseline No Transfers
7/31/02	3699.2	3699.2
7/31/03	3699.2	3699.2
7/31/04	3699.1	3699.1
7/31/05	3699.3	3699.3
7/31/06	3699.8	3699.9
7/31/07	3699.7	3699.7
7/31/08	3699.4	3699.4
7/31/09	3699.0	3699.0
7/31/10	3699.2	3699.2
7/31/11	3699.0	3699.1
7/31/12	3698.9	3698.9
7/31/13	3698.8	3698.8
7/31/14	3698.5	3698.5
7/31/15	3698.8	3698.8
7/31/16	3699.3	3699.3
7/31/17	3698.7	3698.7
7/31/18	3699.1	3699.1
7/31/19	3699.1	3699.1
7/31/20	3699.1	3699.1
7/31/21	3699.4	3699.4
7/31/22	3698.1	3698.2
7/31/23	3699.1	3699.1
7/31/24	3699.1	3699.1
7/31/25	3698.8	3698.8
7/31/26	3698.9	3698.9
7/31/27	3699.1	3698.6
7/31/28	3699.3	3699.3
7/31/29	3699.1	3699.0
7/31/30	3699.0	3699.0
7/31/31	3699.0	3698.8
7/31/32	3699.2	3699.2
7/31/33	3698.2	3698.2
7/31/34	3698.8	3699.3
7/31/35	3699.4	3699.4
7/31/36	3698.7	3699.0
7/31/37	3698.1	3698.2
7/31/38	3699.2	3699.3
7/31/39	3699.2	3699.2
7/31/40	3699.1	3699.1
7/31/41	3698.6	3698.7
7/31/42	3698.5	3698.4
7/31/43	3699.1	3699.1
7/31/44	3699.0	3699.0
7/31/45	3699.1	3699.1
7/31/46	3699.5	3699.5
7/31/47	3699.3	3699.3
7/31/48	3698.9	3698.9
7/31/49	3699.2	3699.2
7/31/50	3698.8	3698.8

Table L-2

Lake Powell 50th Percentile Water Surface Elevations

Date	Baseline with Transfers	Baseline No Transfers
7/31/02	3688.0	3688.0
7/31/03	3689.4	3689.4
7/31/04	3688.0	3688.0
7/31/05	3688.2	3688.3
7/31/06	3683.5	3683.5
7/31/07	3684.2	3684.3
7/31/08	3681.0	3681.3
7/31/09	3679.3	3679.6
7/31/10	3677.4	3677.9
7/31/11	3675.0	3675.5
7/31/12	3674.8	3674.8
7/31/13	3670.4	3670.4
7/31/14	3667.8	3667.9
7/31/15	3665.8	3666.0
7/31/16	3665.0	3665.0
7/31/17	3666.9	3665.4
7/31/18	3664.5	3664.6
7/31/19	3663.9	3663.9
7/31/20	3664.2	3664.4
7/31/21	3664.5	3664.5
7/31/22	3664.6	3664.6
7/31/23	3665.0	3665.5
7/31/24	3664.7	3664.7
7/31/25	3667.0	3667.0
7/31/26	3666.0	3665.9
7/31/27	3665.6	3665.6
7/31/28	3664.3	3664.7
7/31/29	3663.4	3663.4
7/31/30	3664.4	3664.5
7/31/31	3665.2	3665.2
7/31/32	3666.4	3666.4
7/31/33	3667.2	3667.2
7/31/34	3668.0	3668.0
7/31/35	3669.1	3669.1
7/31/36	3669.6	3669.6
7/31/37	3671.1	3671.1
7/31/38	3672.0	3672.0
7/31/39	3671.8	3671.8
7/31/40	3672.4	3672.8
7/31/41	3672.3	3673.0
7/31/42	3669.5	3670.2
7/31/43	3669.7	3670.4
7/31/44	3668.7	3669.4
7/31/45	3666.3	3666.4
7/31/46	3666.0	3666.6
7/31/47	3665.8	3666.2
7/31/48	3664.6	3665.6
7/31/49	3662.8	3663.1
7/31/50	3661.9	3662.5

Table L-3

Lake Powell 10th Percentile Water Surface Elevations

Date	Baseline with Transfers	Baseline No Transfers
7/31/02	3671.4	3671.4
7/31/03	3656.8	3656.8
7/31/04	3654.6	3654.6
7/31/05	3645.0	3645.0
7/31/06	3642.5	3642.6
7/31/07	3641.2	3641.3
7/31/08	3636.8	3636.9
7/31/09	3636.2	3636.4
7/31/10	3635.4	3635.6
7/31/11	3631.1	3631.5
7/31/12	3628.2	3628.2
7/31/13	3623.9	3624.1
7/31/14	3621.5	3621.5
7/31/15	3615.6	3615.7
7/31/16	3615.0	3615.2
7/31/17	3606.9	3607.4
7/31/18	3600.3	3601.2
7/31/19	3600.3	3600.7
7/31/20	3600.5	3601.2
7/31/21	3597.7	3598.0
7/31/22	3598.7	3596.8
7/31/23	3595.7	3595.8
7/31/24	3595.8	3596.0
7/31/25	3598.2	3598.4
7/31/26	3596.6	3596.8
7/31/27	3596.7	3596.8
7/31/28	3595.5	3595.5
7/31/29	3595.9	3596.1
7/31/30	3594.5	3594.6
7/31/31	3592.2	3592.2
7/31/32	3591.6	3592.1
7/31/33	3591.4	3591.9
7/31/34	3581.0	3581.0
7/31/35	3580.1	3580.1
7/31/36	3579.9	3579.9
7/31/37	3579.3	3579.3
7/31/38	3569.1	3569.1
7/31/39	3569.4	3569.4
7/31/40	3568.2	3568.2
7/31/41	3566.1	3566.1
7/31/42	3566.1	3566.1
7/31/43	3564.9	3565.1
7/31/44	3563.2	3562.9
7/31/45	3561.9	3561.9
7/31/46	3561.2	3561.2
7/31/47	3560.0	3560.0
7/31/48	3559.1	3559.1
7/31/49	3556.4	3556.5
7/31/50	3552.6	3552.7

Figure L-2
Sensitivity Analysis – California Intrastate Water Transfers
Lake Mead End of December Water Surface Elevations – 90th, 50th and 10th Percentile Values

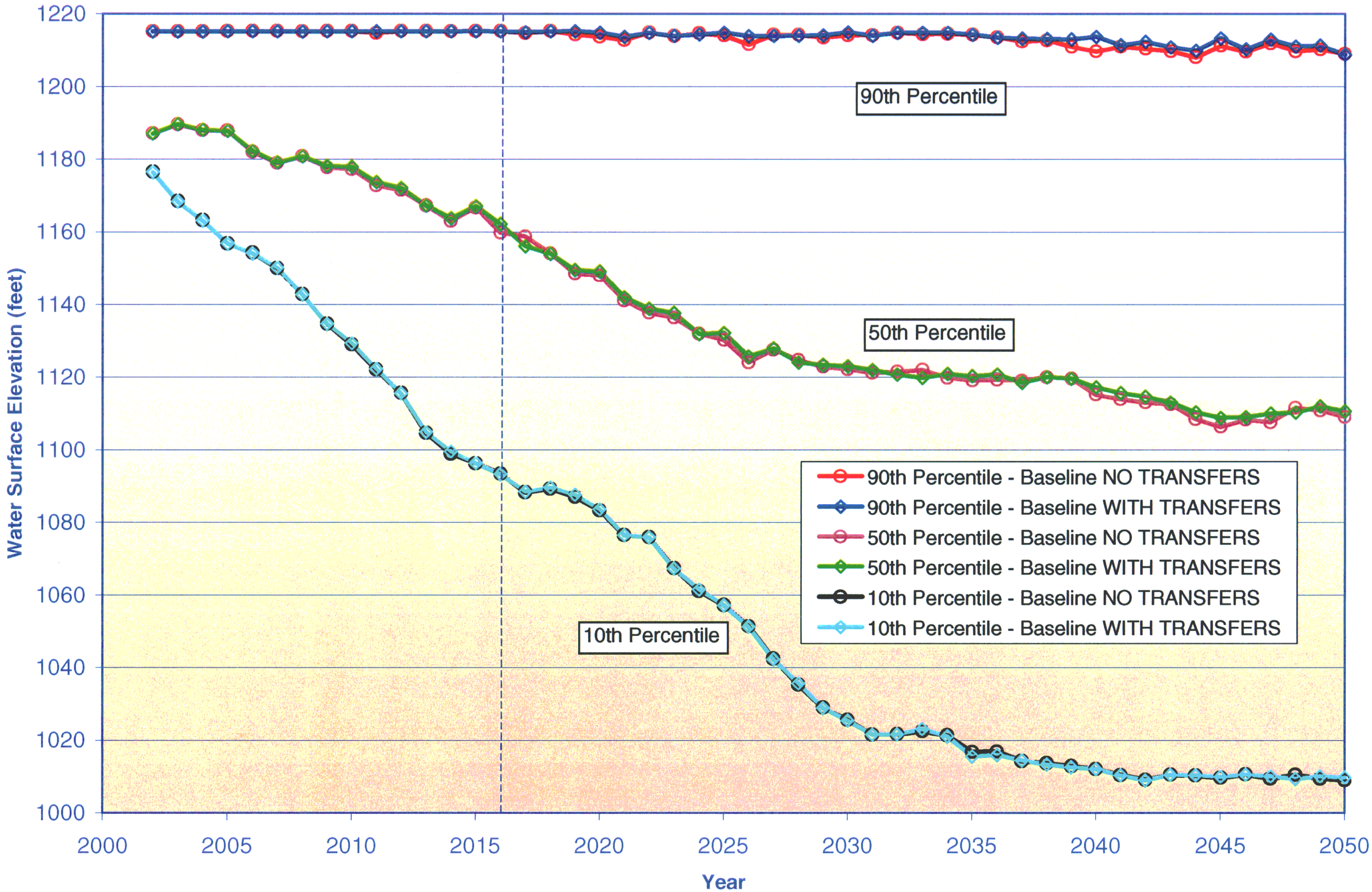


Table L-4

Lake Mead 90th Percentile Water Surface Elevations

Date	Baseline with Transfers	Baseline No Transfers
12/31/02	1215.2	1215.2
12/31/03	1215.2	1215.2
12/31/04	1215.1	1215.1
12/31/05	1215.2	1215.2
12/31/06	1215.2	1215.2
12/31/07	1215.2	1215.2
12/31/08	1215.1	1215.1
12/31/09	1215.2	1215.2
12/31/10	1215.2	1215.2
12/31/11	1214.7	1215.2
12/31/12	1215.3	1215.3
12/31/13	1215.2	1215.2
12/31/14	1215.2	1215.3
12/31/15	1215.3	1215.3
12/31/16	1215.2	1215.2
12/31/17	1214.7	1215.0
12/31/18	1215.2	1215.2
12/31/19	1214.2	1215.3
12/31/20	1213.7	1214.9
12/31/21	1212.8	1213.7
12/31/22	1214.8	1214.8
12/31/23	1213.9	1214.0
12/31/24	1214.6	1214.4
12/31/25	1214.0	1214.9
12/31/26	1211.5	1213.9
12/31/27	1214.2	1214.0
12/31/28	1214.2	1214.1
12/31/29	1213.5	1214.1
12/31/30	1214.1	1214.9
12/31/31	1214.1	1214.0
12/31/32	1214.7	1214.9
12/31/33	1214.3	1214.9
12/31/34	1214.5	1214.9
12/31/35	1214.2	1214.3
12/31/36	1213.5	1213.5
12/31/37	1212.3	1213.2
12/31/38	1212.7	1213.2
12/31/39	1210.9	1213.0
12/31/40	1209.5	1213.7
12/31/41	1210.9	1211.4
12/31/42	1210.3	1212.3
12/31/43	1209.6	1210.9
12/31/44	1207.9	1209.9
12/31/45	1211.1	1213.3
12/31/46	1209.5	1210.3
12/31/47	1211.8	1213.0
12/31/48	1209.7	1211.1
12/31/49	1210.1	1211.3
12/31/50	1208.9	1208.7

Table L-5

Lake Mead 50th Percentile Water Surface Elevations

Date	Baseline with Transfers	Baseline No Transfers
12/31/02	1187.0	1187.0
12/31/03	1189.5	1189.7
12/31/04	1187.8	1188.1
12/31/05	1187.8	1187.8
12/31/06	1182.0	1182.2
12/31/07	1178.9	1179.1
12/31/08	1180.8	1180.8
12/31/09	1177.6	1178.2
12/31/10	1177.1	1177.9
12/31/11	1172.7	1173.6
12/31/12	1171.4	1172.1
12/31/13	1167.2	1167.2
12/31/14	1163.0	1163.8
12/31/15	1166.6	1167.1
12/31/16	1159.8	1162.1
12/31/17	1158.7	1156.0
12/31/18	1154.0	1154.0
12/31/19	1148.5	1149.5
12/31/20	1148.0	1149.1
12/31/21	1141.1	1141.9
12/31/22	1137.7	1138.9
12/31/23	1136.4	1137.7
12/31/24	1131.9	1131.9
12/31/25	1130.3	1132.2
12/31/26	1124.0	1125.7
12/31/27	1127.5	1128.0
12/31/28	1124.7	1124.0
12/31/29	1122.9	1123.3
12/31/30	1122.2	1123.0
12/31/31	1121.3	1122.0
12/31/32	1121.5	1120.7
12/31/33	1122.0	1119.8
12/31/34	1119.8	1120.9
12/31/35	1119.1	1120.3
12/31/36	1119.3	1120.7
12/31/37	1119.1	1118.5
12/31/38	1120.0	1120.0
12/31/39	1119.6	1119.6
12/31/40	1115.2	1117.2
12/31/41	1113.9	1115.7
12/31/42	1113.0	1114.6
12/31/43	1112.5	1113.0
12/31/44	1108.4	1110.3
12/31/45	1106.3	1108.8
12/31/46	1108.3	1109.0
12/31/47	1107.6	1110.0
12/31/48	1111.5	1110.2
12/31/49	1110.8	1111.9
12/31/50	1109.0	1110.6

Table L-6

Lake Mead 10th Percentile Water Surface Elevations

Date	Baseline with Transfers	Baseline No Transfers
12/31/02	1176.4	1176.4
12/31/03	1168.3	1168.3
12/31/04	1163.1	1163.0
12/31/05	1156.7	1156.7
12/31/06	1154.1	1154.1
12/31/07	1149.9	1150.1
12/31/08	1142.8	1142.7
12/31/09	1134.6	1134.6
12/31/10	1129.0	1129.3
12/31/11	1122.1	1122.2
12/31/12	1115.6	1115.6
12/31/13	1104.6	1104.8
12/31/14	1098.8	1099.5
12/31/15	1096.2	1096.3
12/31/16	1093.4	1093.3
12/31/17	1088.3	1088.5
12/31/18	1089.3	1089.6
12/31/19	1087.0	1087.7
12/31/20	1083.3	1083.6
12/31/21	1076.5	1076.4
12/31/22	1075.9	1075.9
12/31/23	1067.4	1067.3
12/31/24	1061.1	1061.5
12/31/25	1057.2	1057.2
12/31/26	1051.4	1051.3
12/31/27	1042.4	1042.3
12/31/28	1035.3	1035.6
12/31/29	1029.0	1028.9
12/31/30	1025.5	1025.5
12/31/31	1021.6	1021.6
12/31/32	1021.7	1021.6
12/31/33	1022.5	1023.1
12/31/34	1021.3	1021.1
12/31/35	1016.7	1015.5
12/31/36	1016.8	1015.9
12/31/37	1014.2	1014.4
12/31/38	1013.6	1013.3
12/31/39	1012.8	1012.6
12/31/40	1012.0	1012.0
12/31/41	1010.4	1010.3
12/31/42	1009.0	1009.0
12/31/43	1010.4	1010.4
12/31/44	1010.2	1010.3
12/31/45	1009.6	1009.9
12/31/46	1010.5	1010.5
12/31/47	1009.4	1010.0
12/31/48	1010.4	1009.4
12/31/49	1009.4	1010.0
12/31/50	1008.9	1009.7

Figure L-3
Sensitivity Analysis – California Intrastate Water Transfers
Frequency of Flood Control Releases at Lake Mead

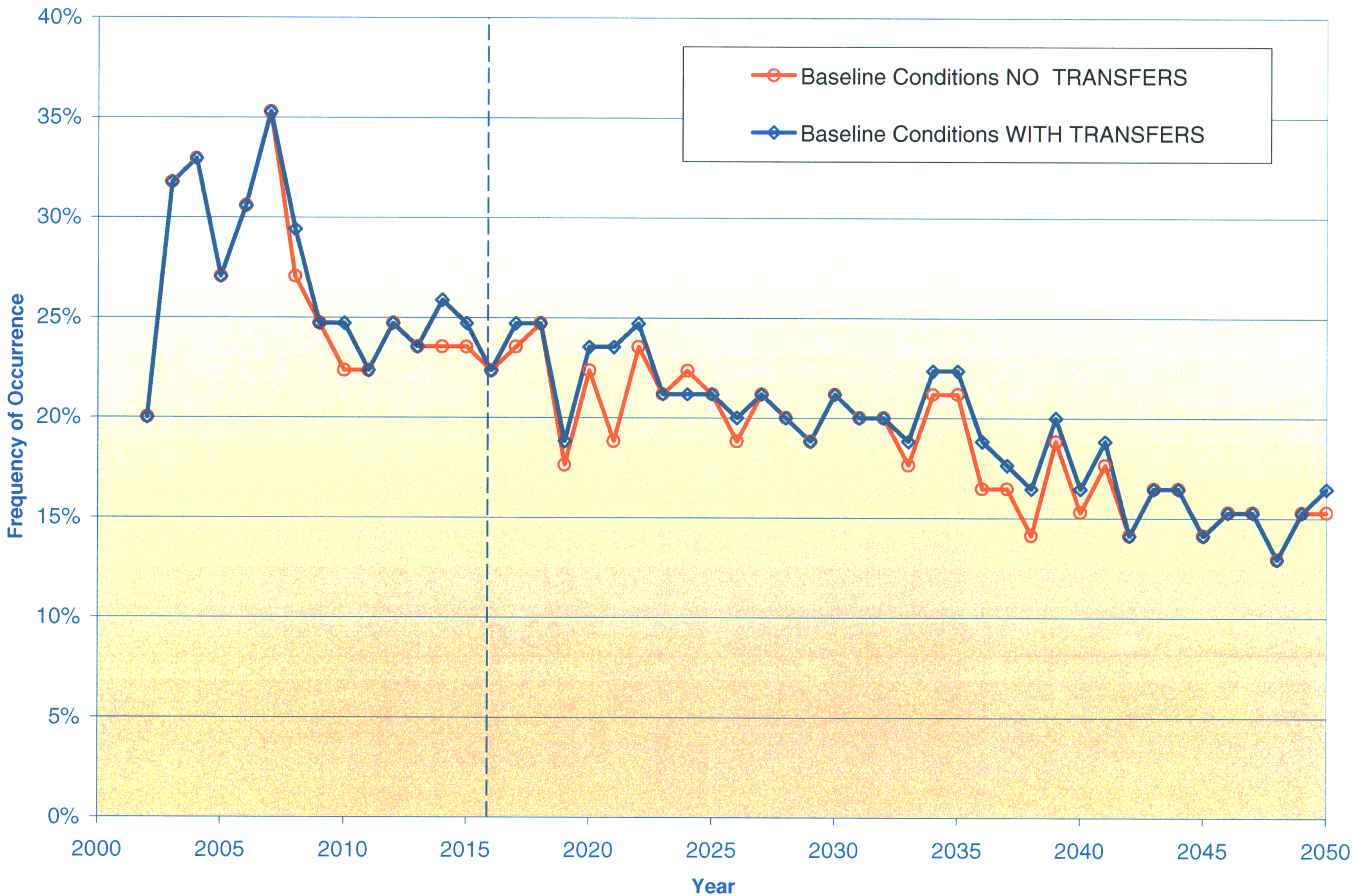


Figure L-4
Sensitivity Analysis – California Intrastate Water Transfers
Arizona Annual Depletions – 90th, 50th and 10th Percentile Values

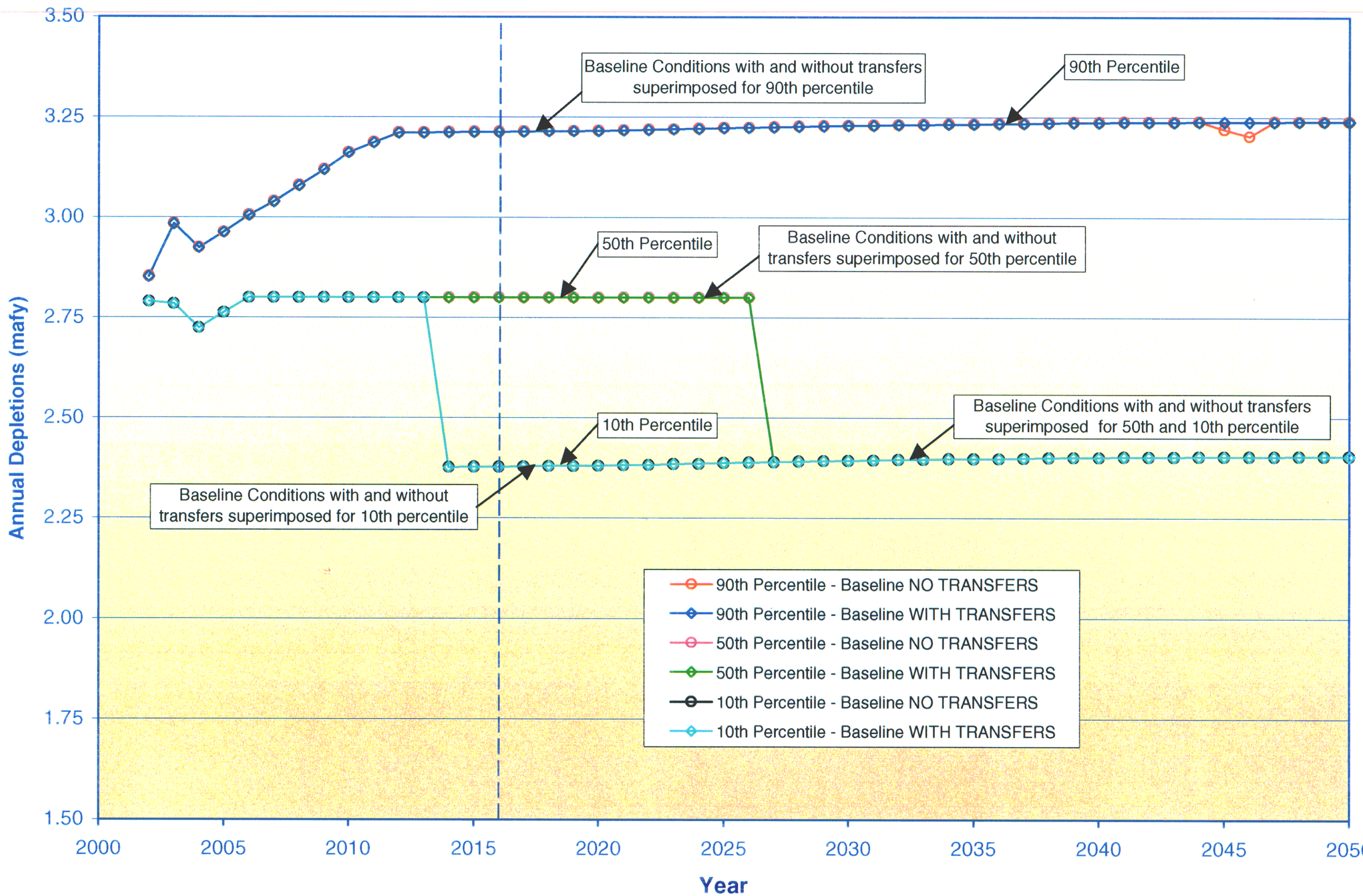


Figure L-5
Sensitivity Analysis – California Intrastate Water Transfers
Arizona Annual Depletions – Percent of Values Greater than or Equal to (Years 2002 – 2016)

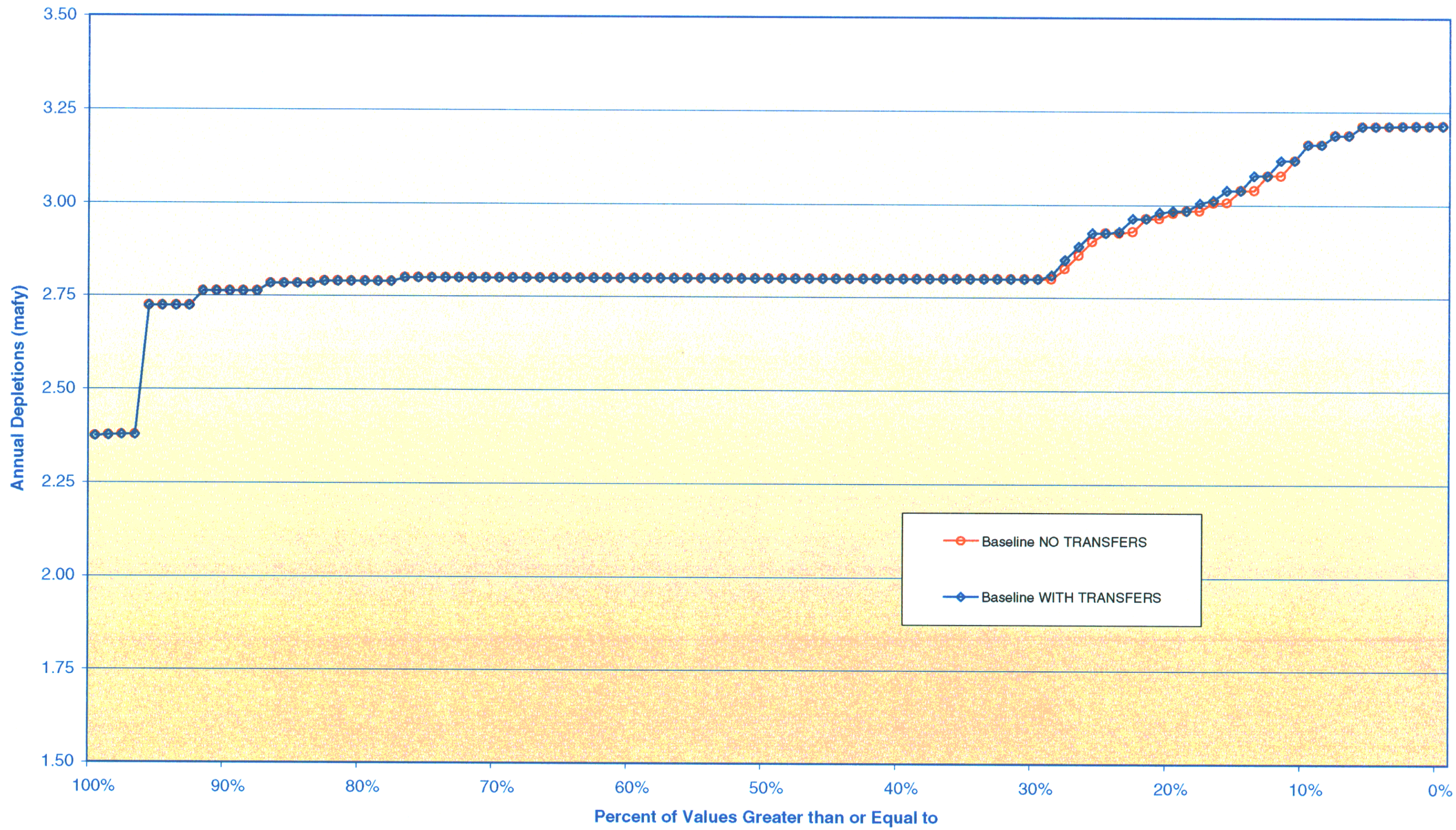


Figure L-6
Sensitivity Analysis – California Intrastate Water Transfers
Arizona Annual Depletions - Percent of Values Greater than or Equal to (Years 2017 – 2050)

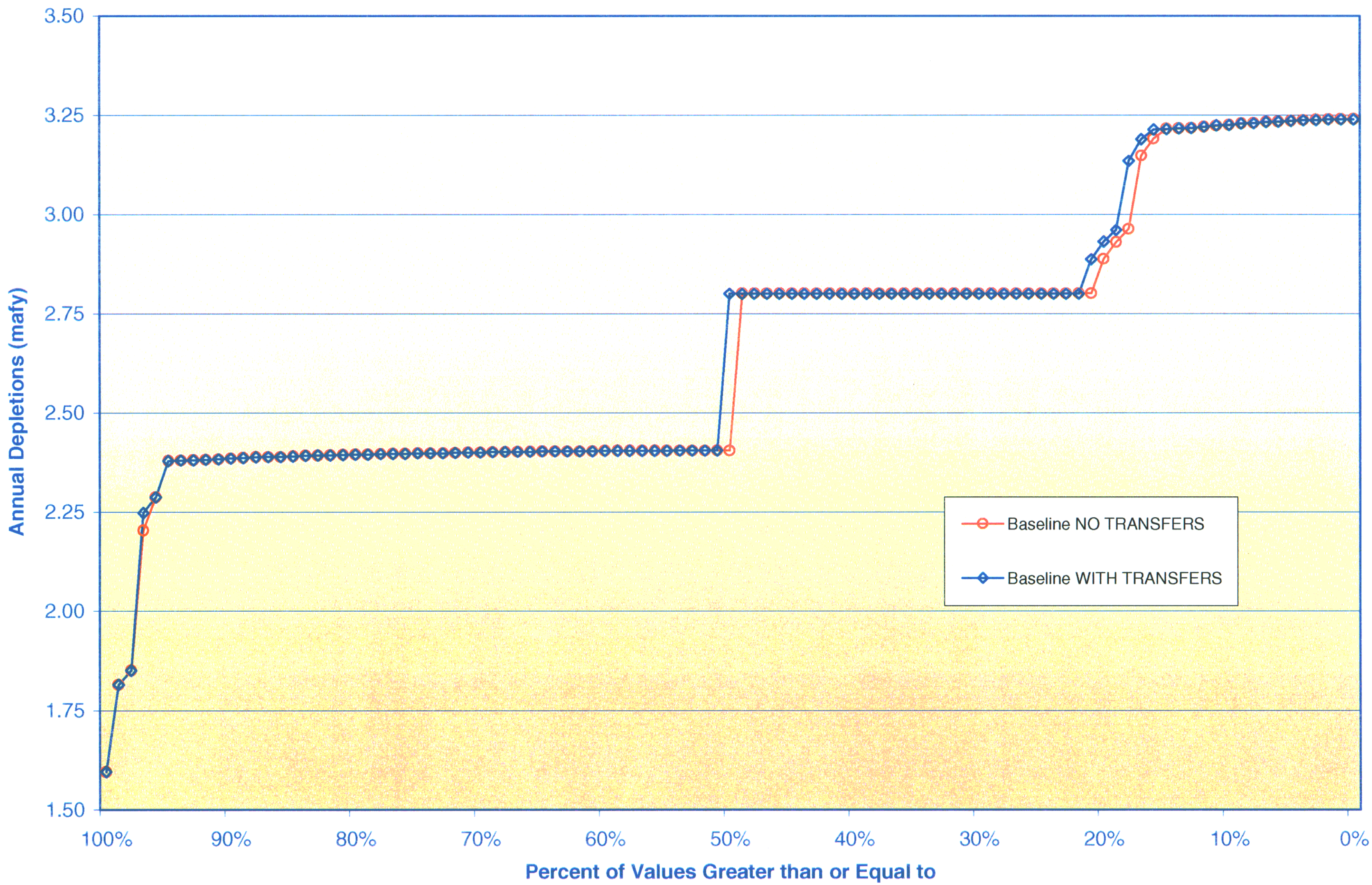


Figure L-7
Sensitivity Analysis - California Intrastate Water Transfers
California Annual Depletions – 90th, 50th and 10th Percentile Values

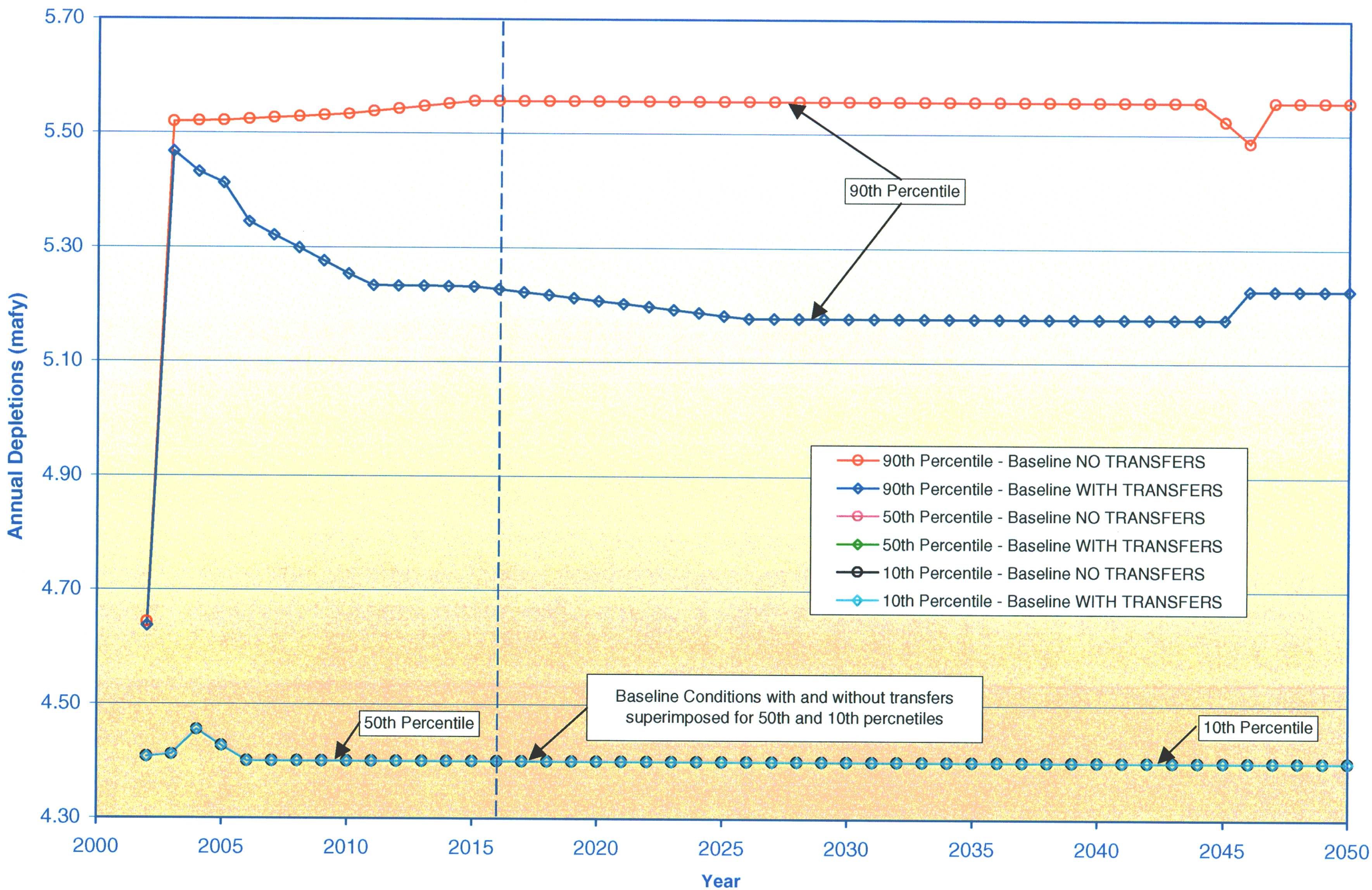


Figure L-8
Sensitivity Analysis - California Intrastate Water Transfers
California Annual Depletions – Percent of Values Greater than or Equal to (Years 2002 – 2016)

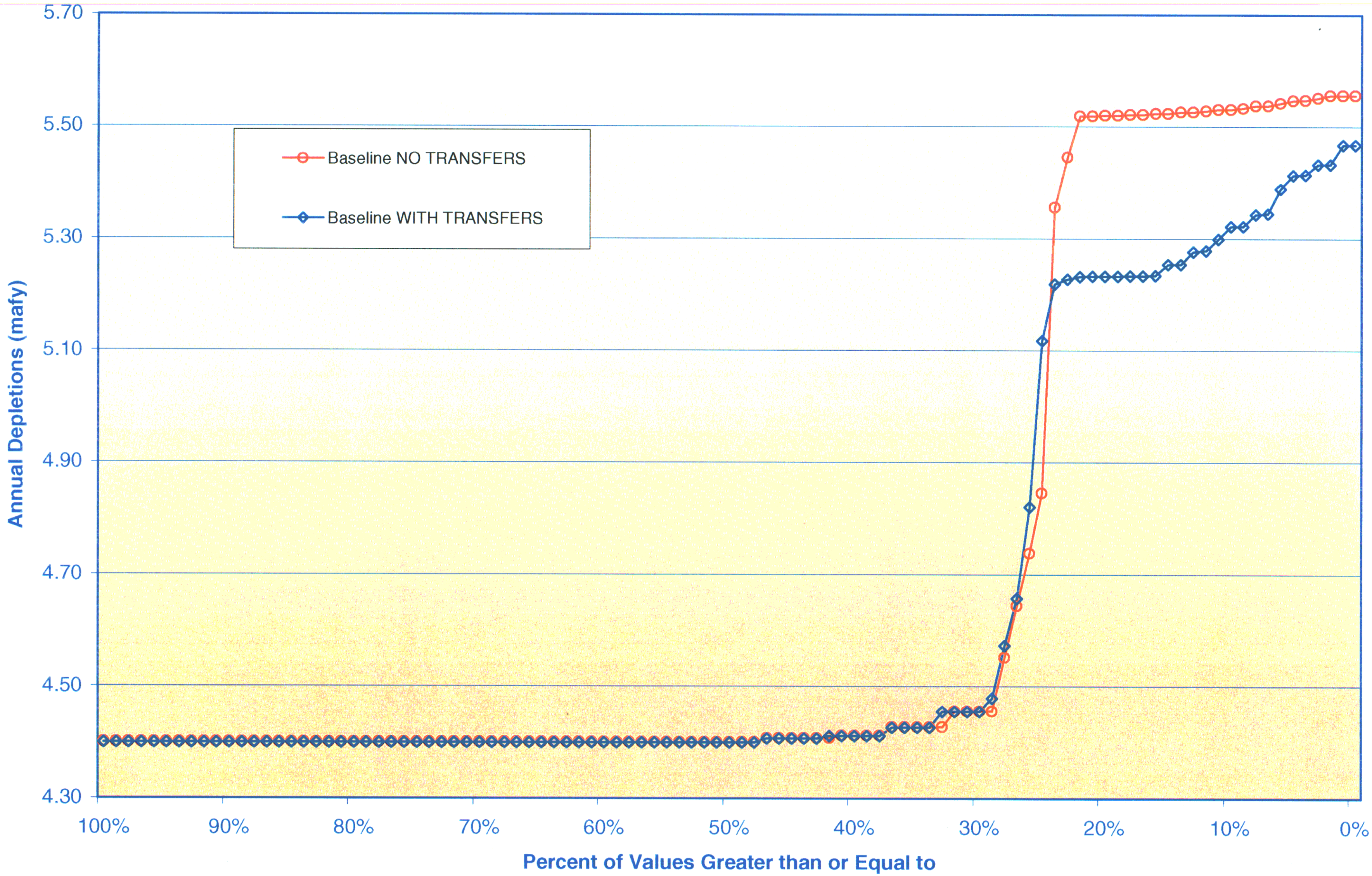


Figure L-9
Sensitivity Analysis - California Intrastate Water Transfers
California Annual Depletions – Percent of Values Greater than or Equal to (Years 2017 – 2050)

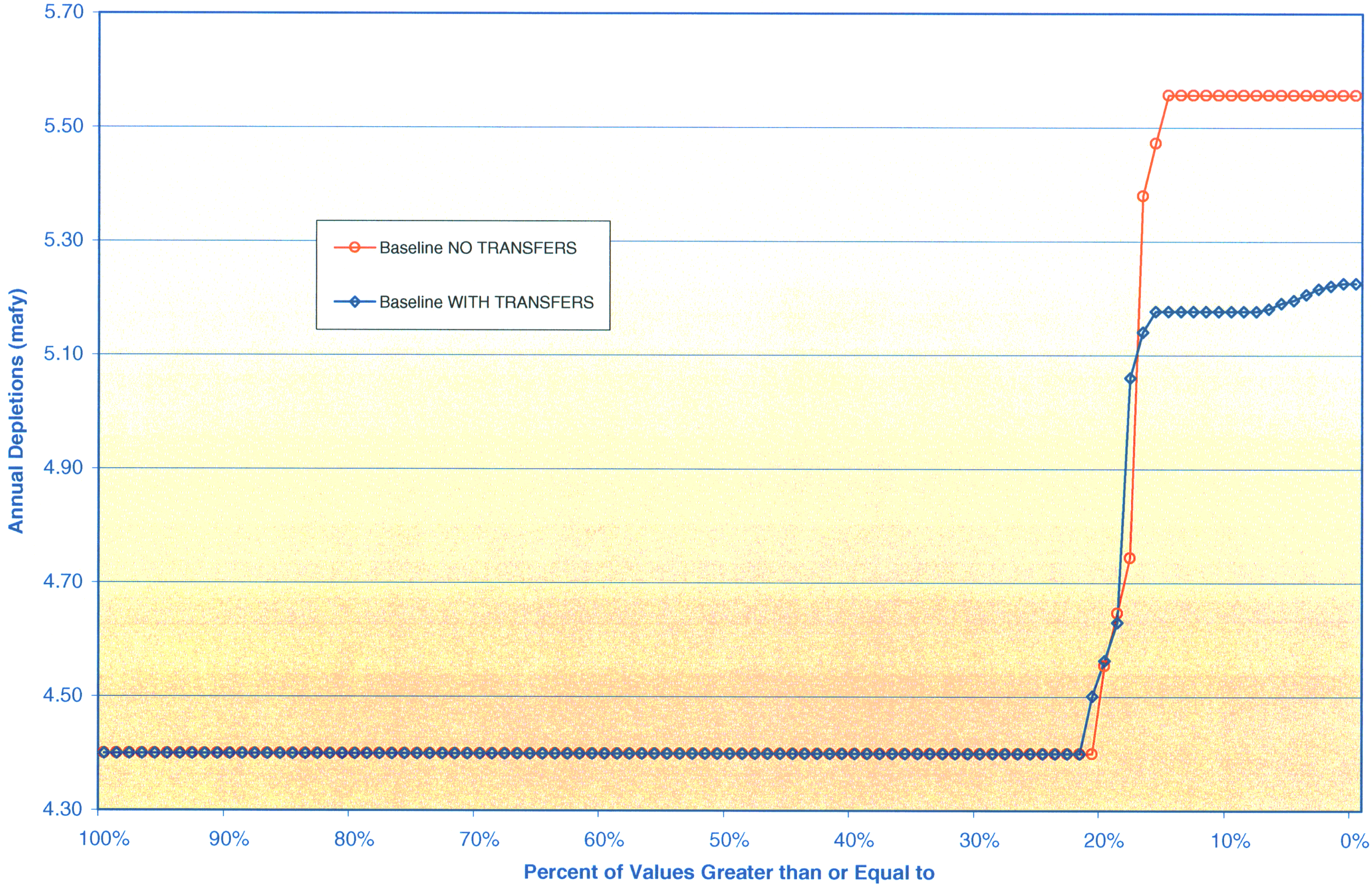


Figure L-10
Sensitivity Analysis - California Intrastate Water Transfers
Nevada Annual Depletions – 90th, 50th and 10th Percentile Values

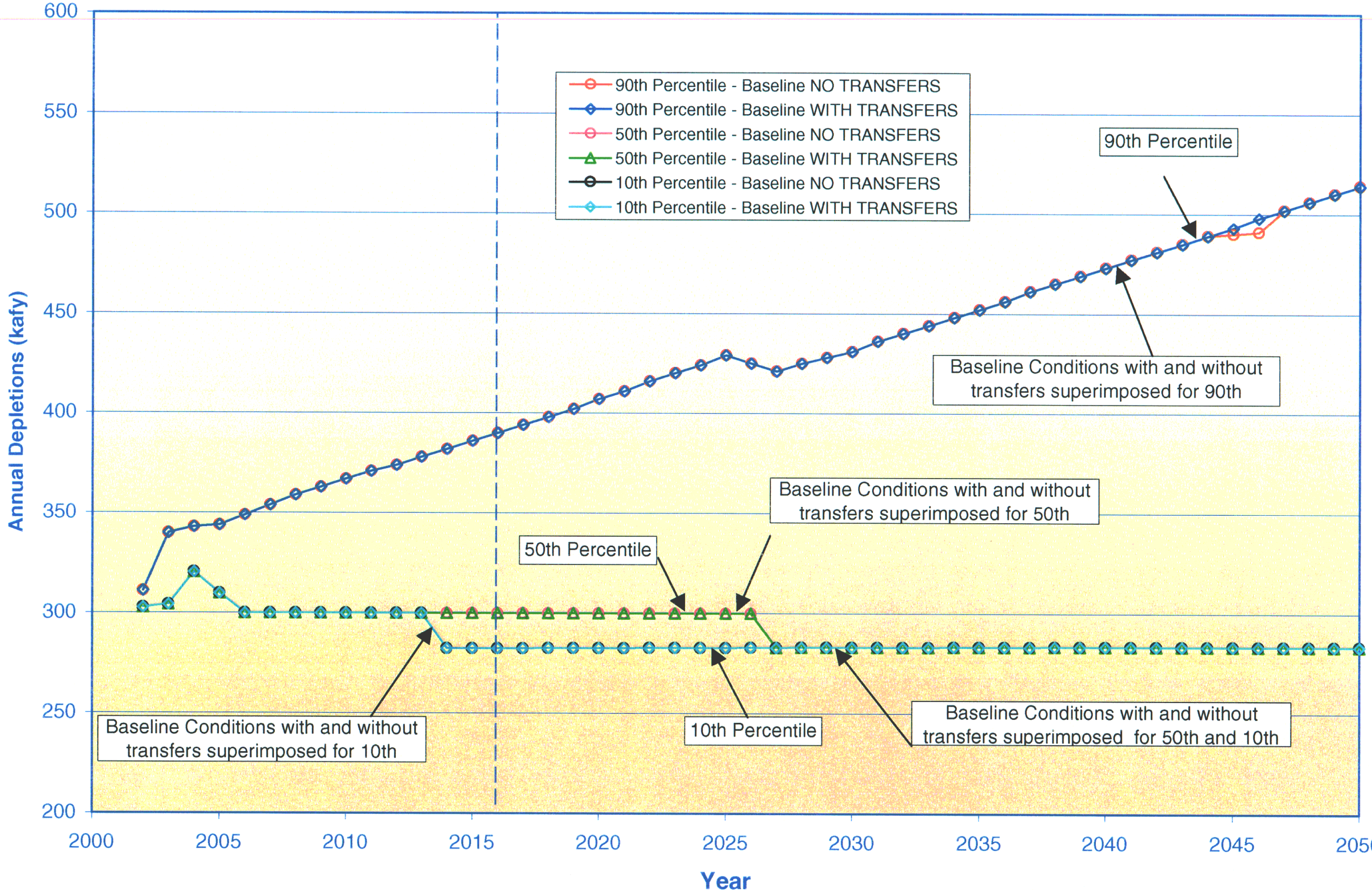


Figure L-11
Sensitivity Analysis - California Intrastate Water Transfers
Nevada Annual Depletions – Percent of Values Greater than or Equal to (Years 2002 – 2016)

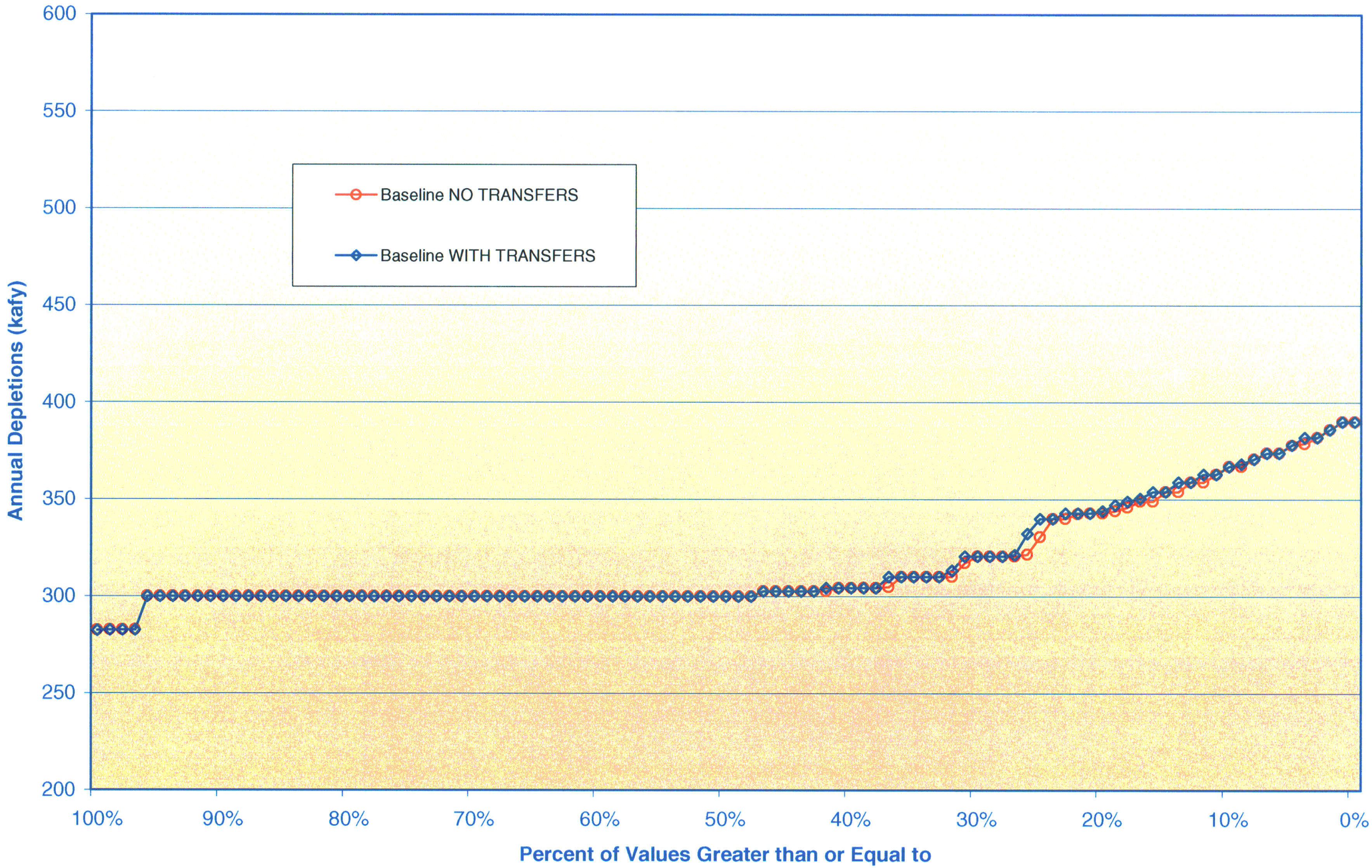


Figure L-12
Sensitivity Analysis - California Intrastate Water Transfers
Nevada Annual Depletions – Percent of Values Greater than or Equal to (Years 2017 – 2050)

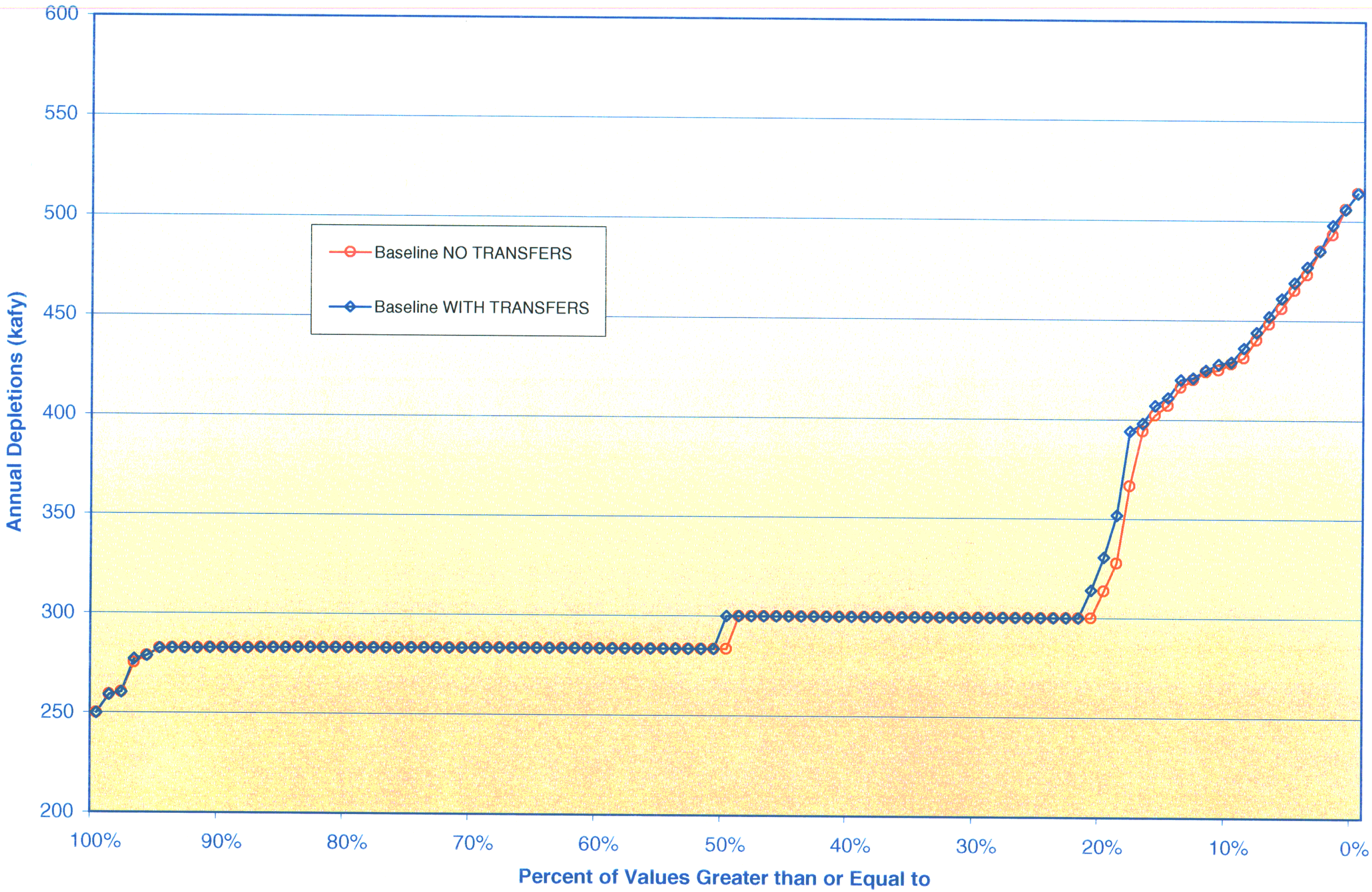
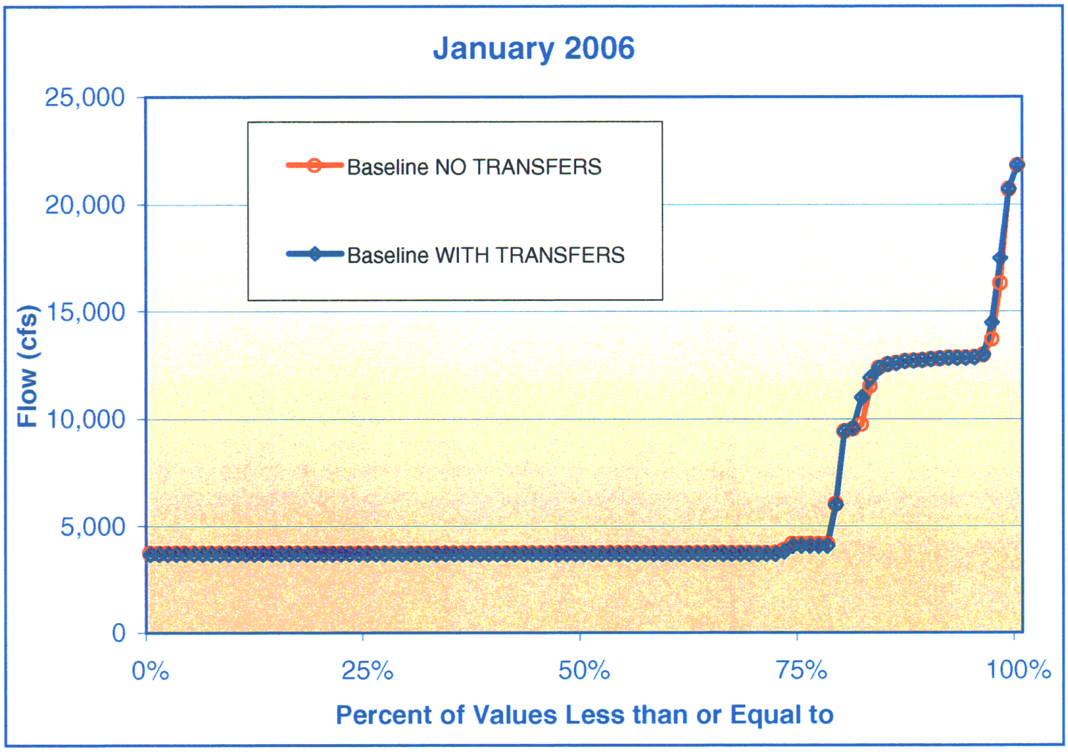


Figure L-13a
Sensitivity Analysis - California Intrastate Water Transfers
Colorado River Flow – Downstream of Palo Verde Diversion Dam
Winter Season Flows as Represented by January Flows
Years 2006 and 2016



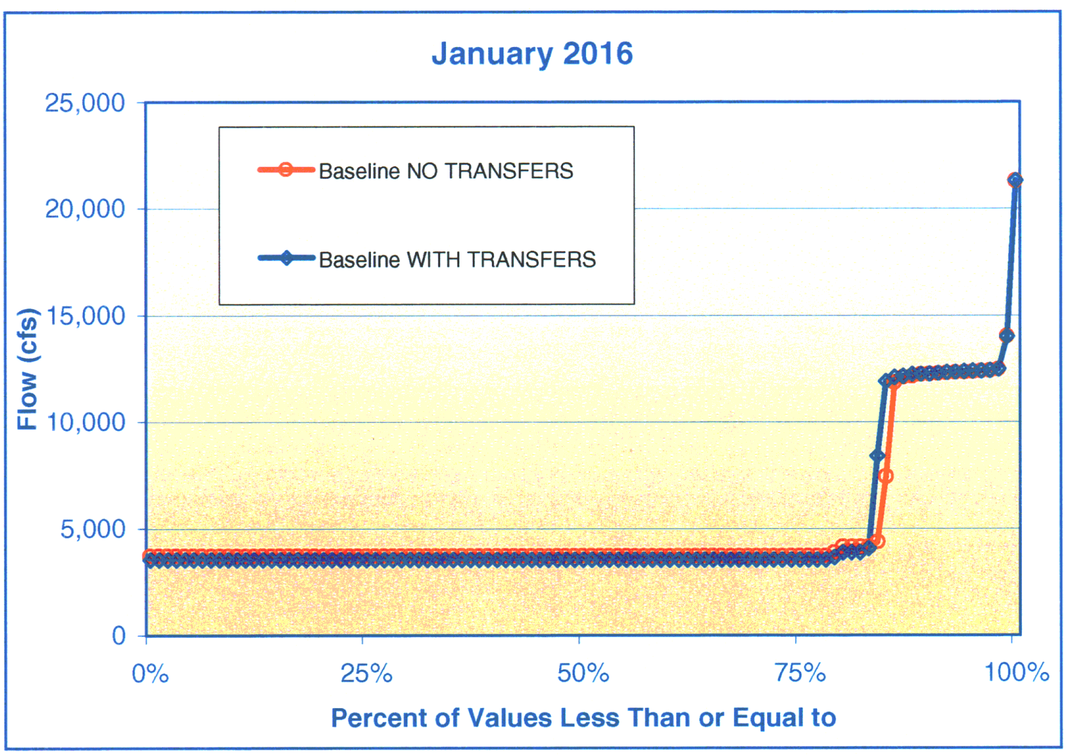
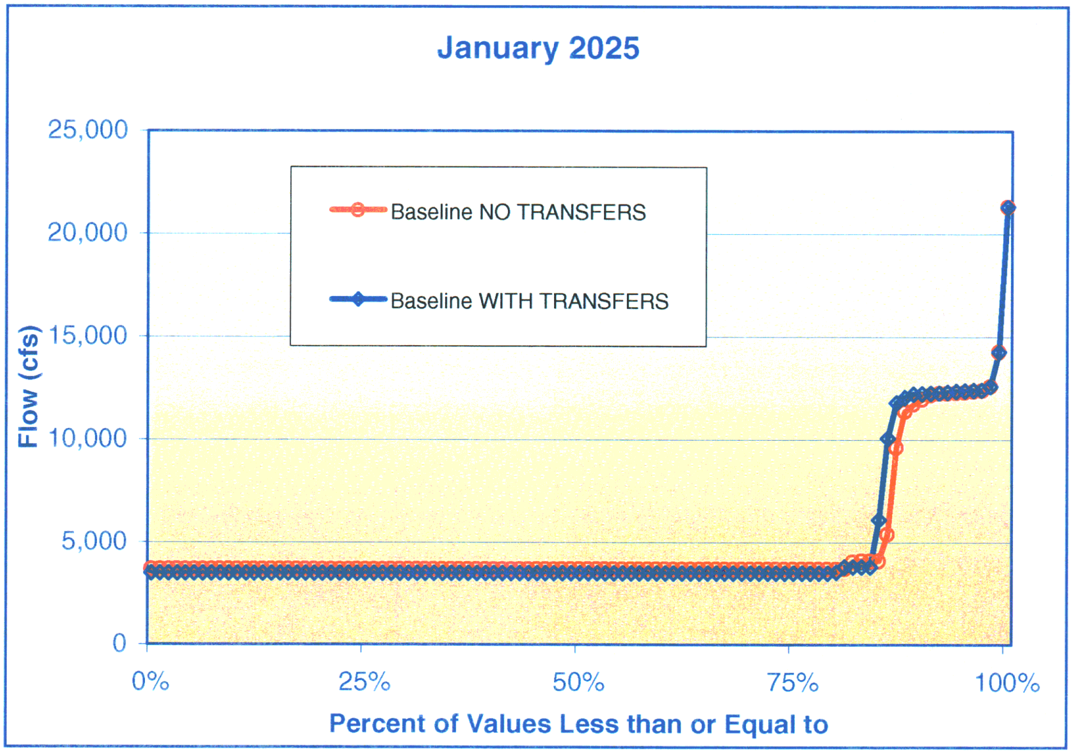


Figure L-13b
Sensitivity Analysis - California Intrastate Water Transfers
Colorado River Flow – Downstream of Palo Verde Diversion Dam
Winter Season Flows as Represented by January Flows
Years 2025 and 2050



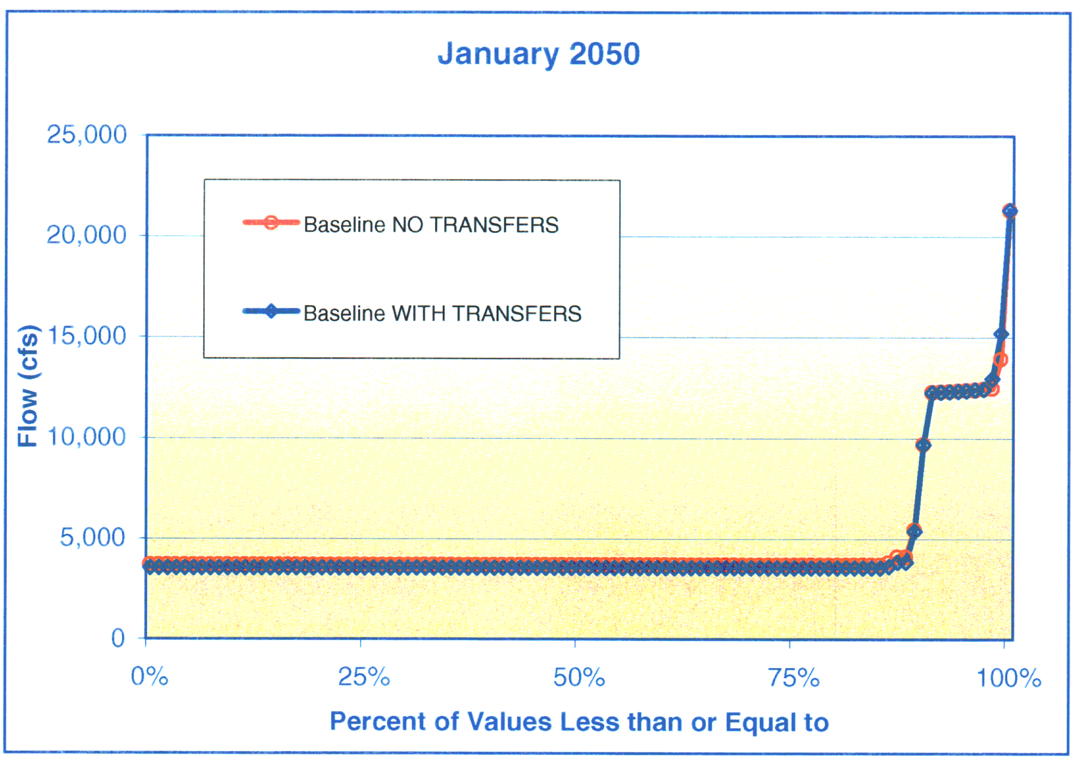
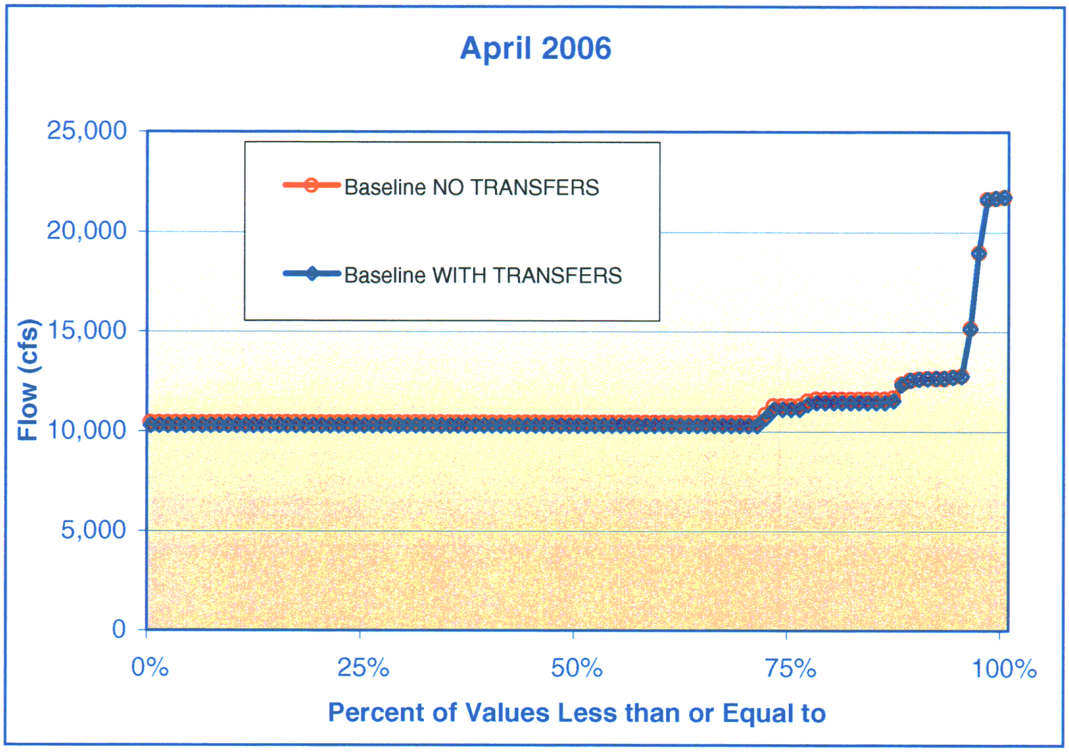


Figure L-14a
Sensitivity Analysis - California Intrastate Water Transfers
Colorado River Flow – Downstream of Palo Verde Diversion Dam
Spring Season Flows as Represented by April Flows
Years 2006 and 2016



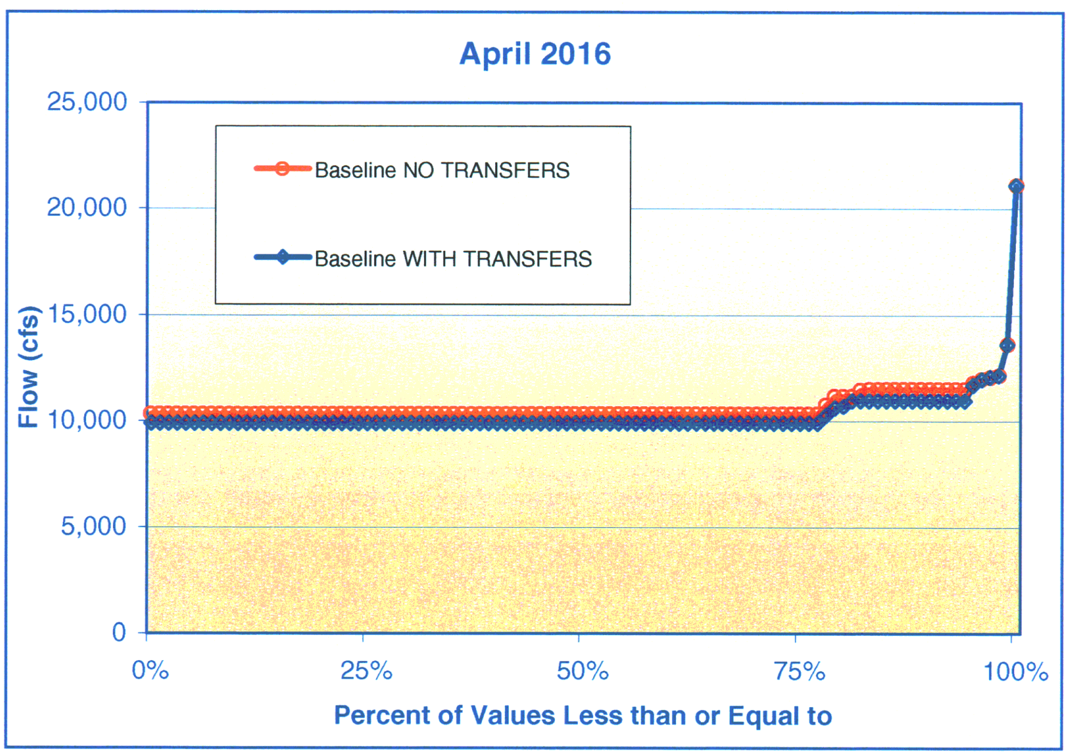
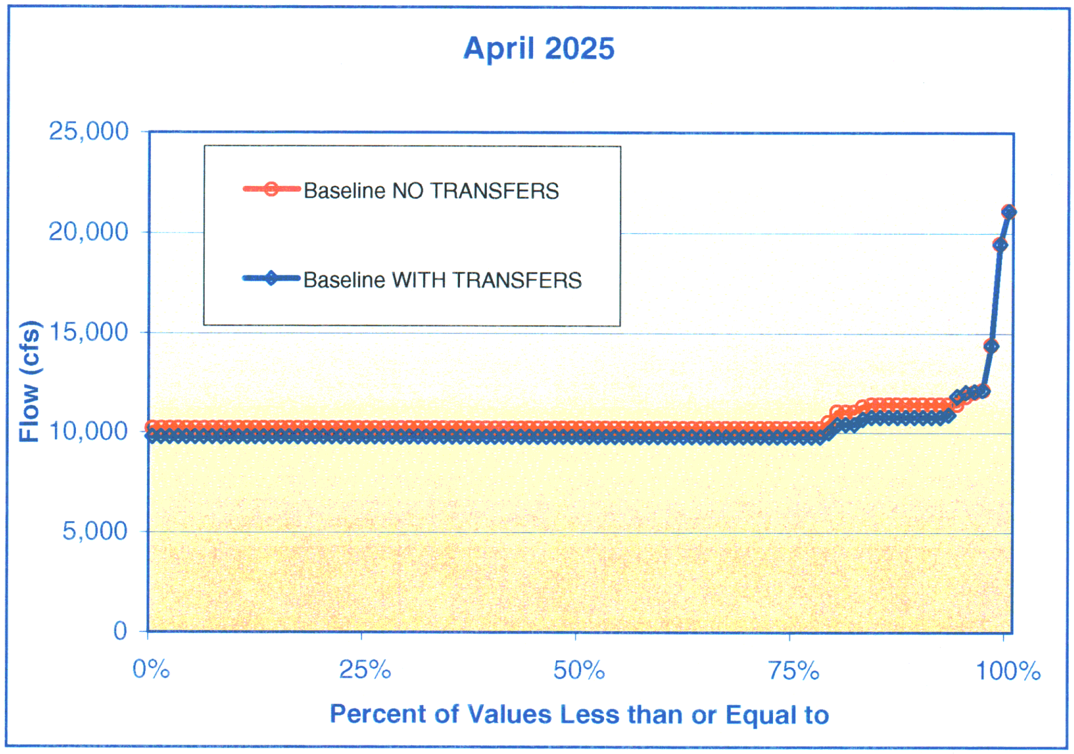


Figure L-14b
Sensitivity Analysis - California Intrastate Water Transfers
Colorado River Flow – Downstream of Palo Verde Diversion Dam
Spring Season Flows as Represented by April Flows
Years 20256 and 2050



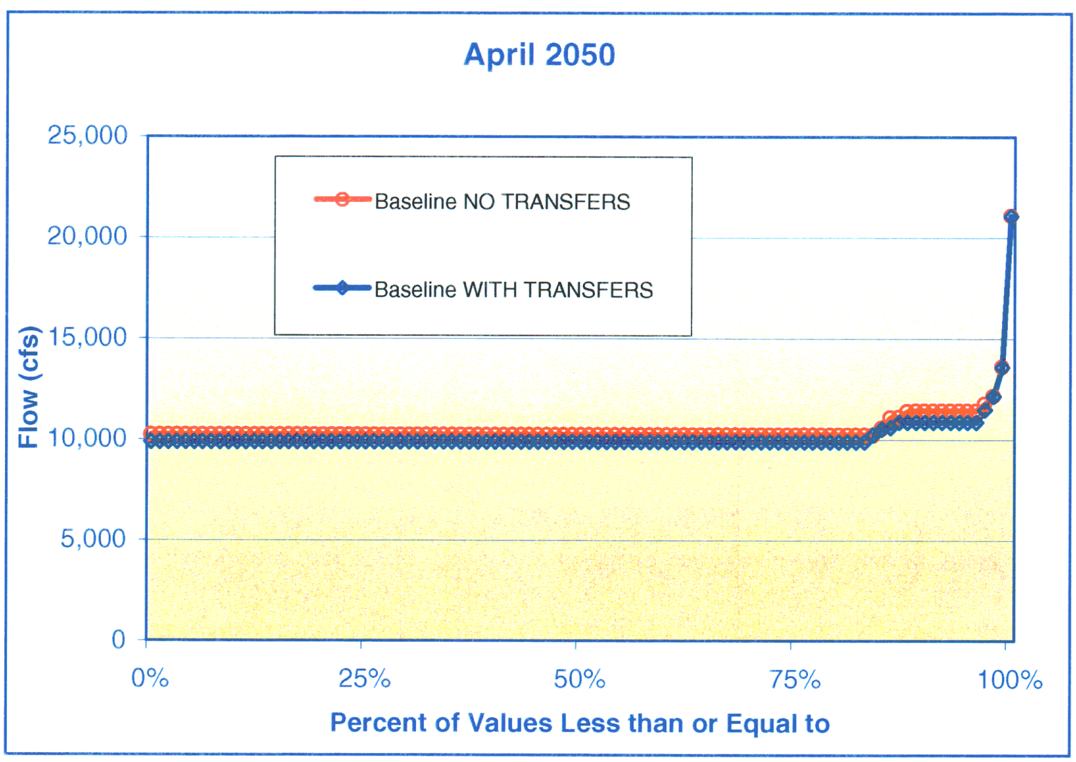
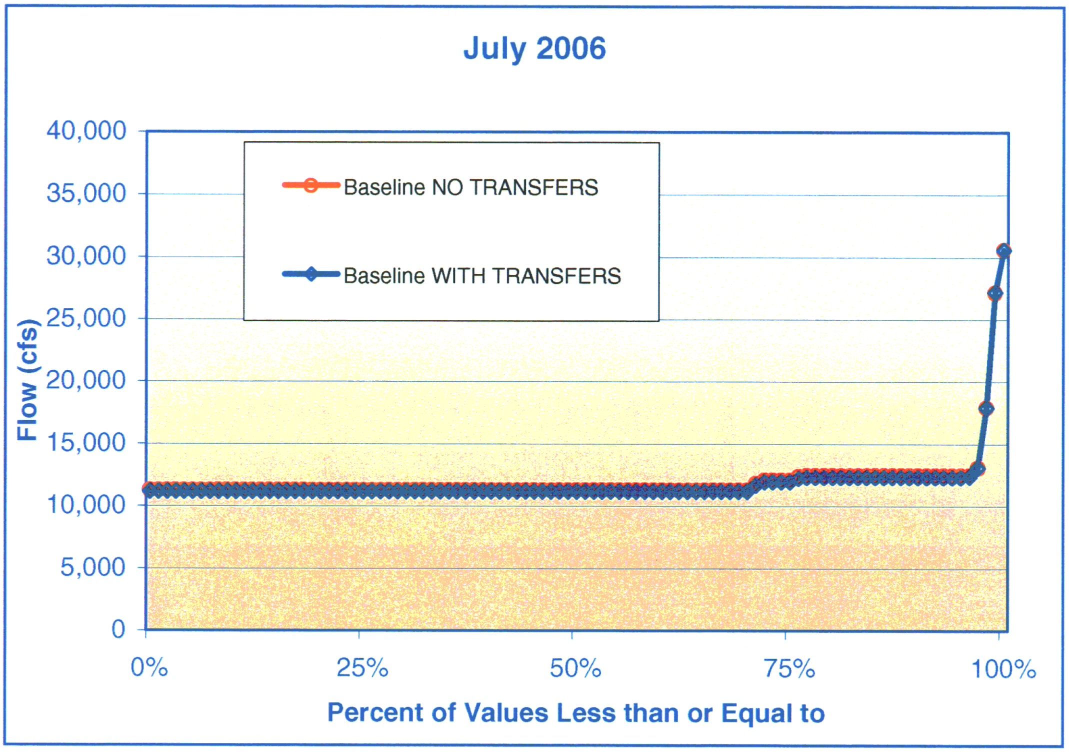


Figure L-15a
Sensitivity Analysis - California Intrastate Water Transfers
Colorado River Flow – Downstream of Palo Verde Diversion Dam
Summer Season Flows as Represented by July Flows
Years 2006 and 2016



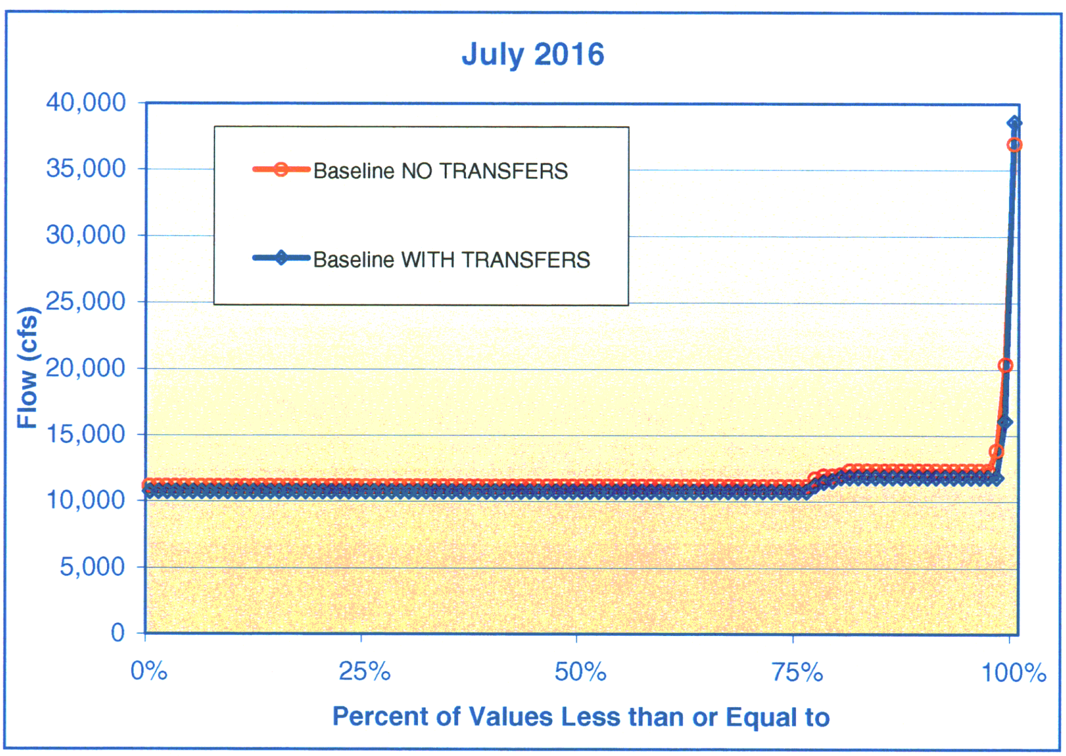
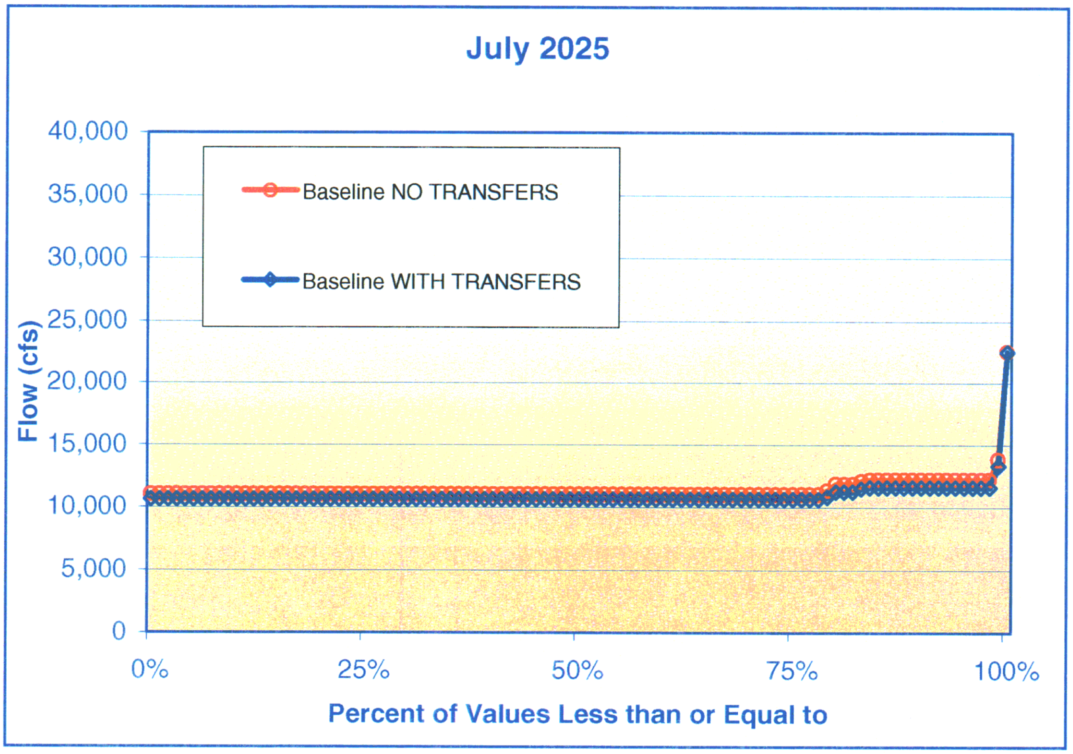


Figure L-15b
Sensitivity Analysis - California Intrastate Water Transfers
Colorado River Flow – Downstream of Palo Verde Diversion Dam
Summer Season Flows as Represented by July Flows
Years 2025 and 2050



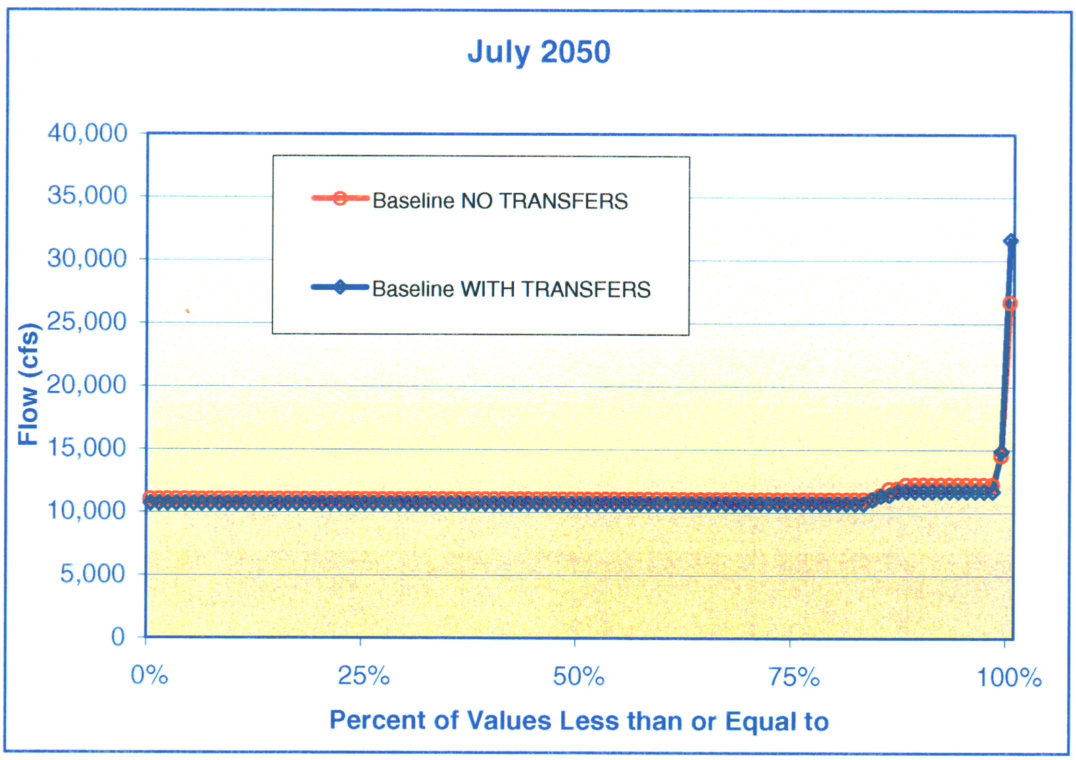
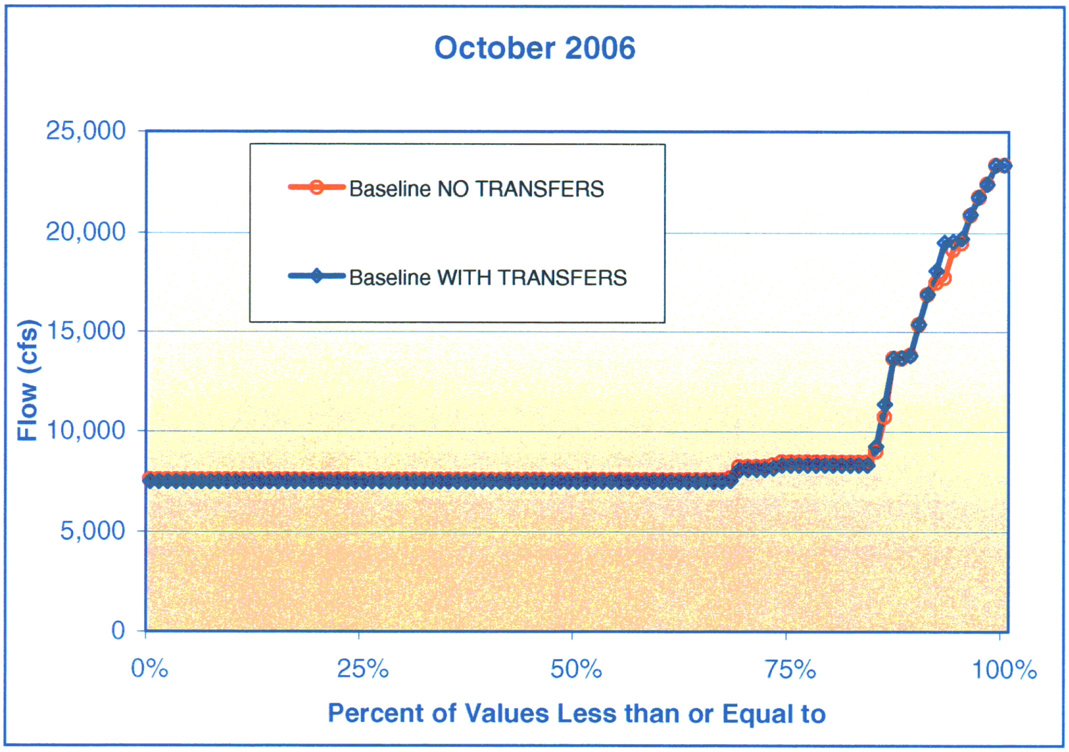


Figure L-16a
Sensitivity Analysis - California Intrastate Water Transfers
Colorado River Flow – Downstream of Palo Verde Diversion Dam
Fall Season Flows as Represented by October Flows
Years 2006 and 2016



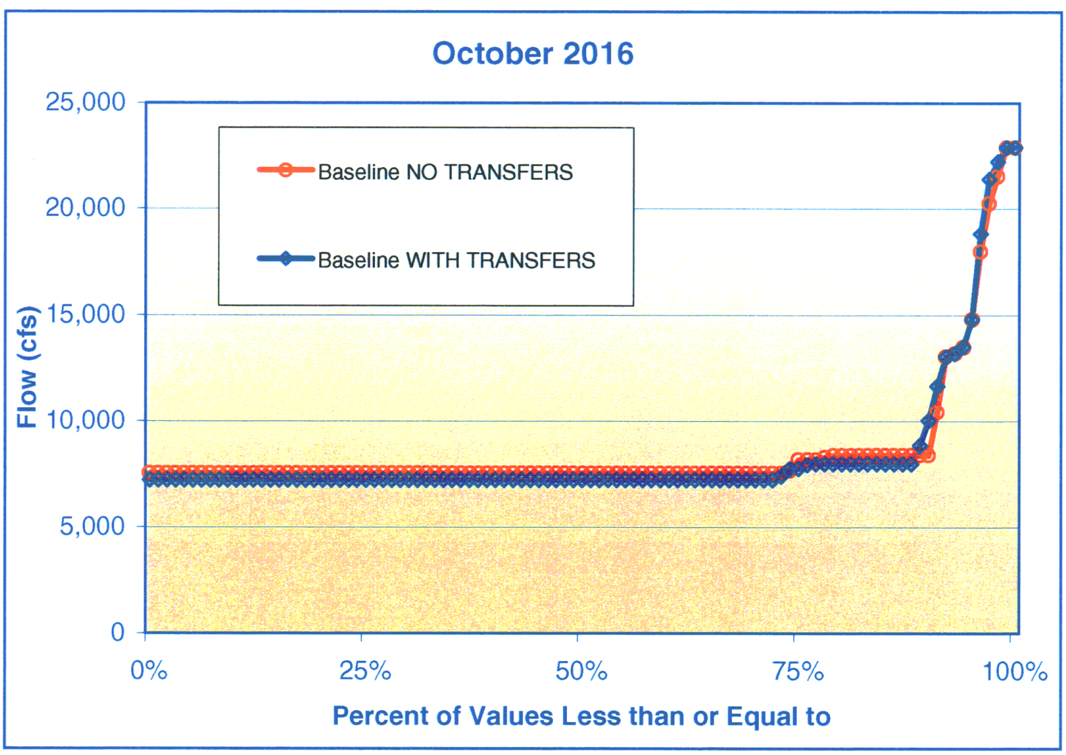
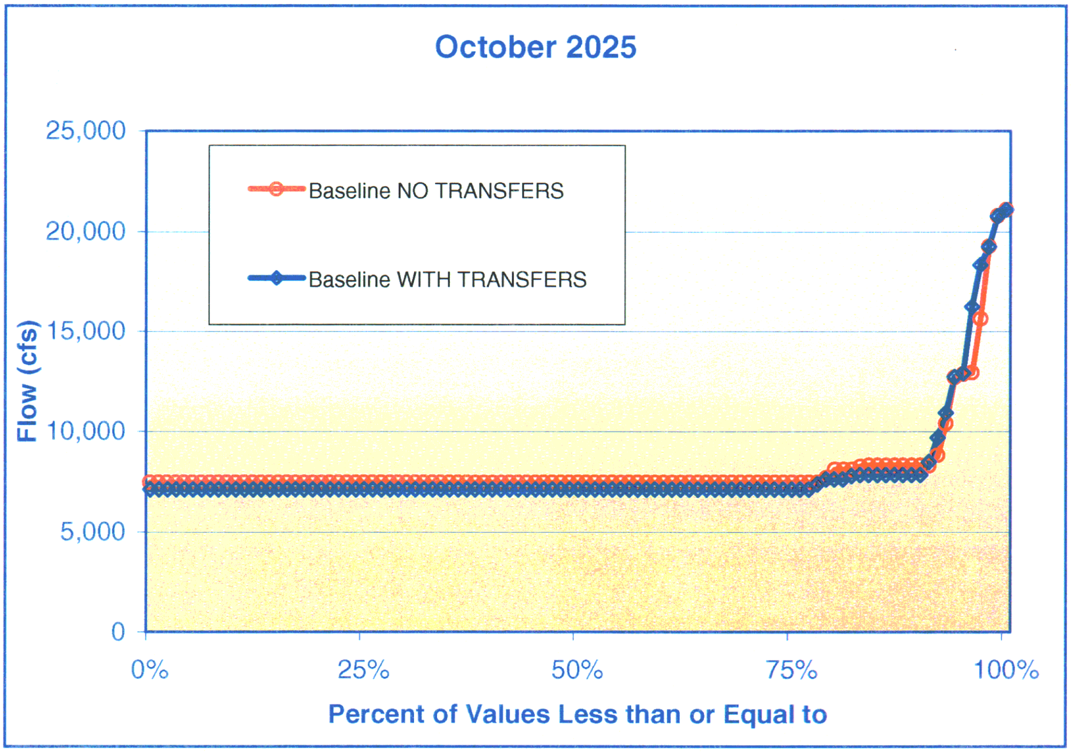
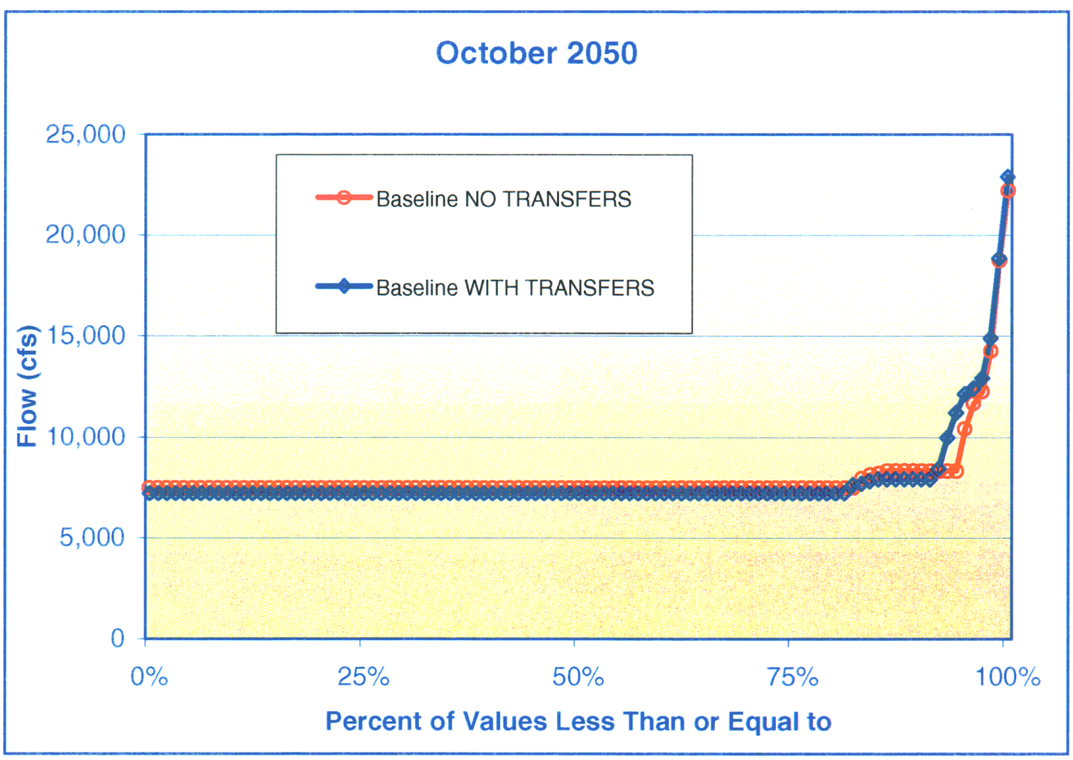


Figure L-16b
Sensitivity Analysis - California Intrastate Water Transfers
Colorado River Flow – Downstream of Palo Verde Diversion Dam
Fall Season Flows as Represented by October Flows
Years 2025 and 2050





ATTACHMENT M

Sensitivity Analysis of Modeled Lake Mead Water Level Protection Assumptions

This attachment illustrates the water surface elevations of Lake Mead and Lake Powell when modeled using a shortage assumption other than was used in the FEIS. In the modeling for the FEIS analysis, it was assumed that the Lake Mead water surface elevation of 1083 feet msl would be protected by determining the existence of a shortage declaration when the operation threatened to draw the water level below 1083. For the sensitivity analysis, the Lake Mead water surface elevation of 1050 feet msl was used as the alternate assumed water level to be protected. The results of the sensitivity analysis are shown by plots of reservoir water levels for Lake Mead and Lake Powell. These plots are to be compared with the plots on the corresponding figures in Section 3.3.

The plots for elevation 1050 protection were produced by the CRSS model configured in the same manner as for the analysis using the Lake Mead water level of 1083 feet msl as a protection level. In both cases an 80 percent probability of protecting the Lake Mead water level was programmed into the model.

Sensitivity Analysis of Shortage Protection Assumptions

Overview

This attachment to the Colorado River Interim Surplus Criteria FEIS presents the results of a sensitivity analysis conducted to assess the effects of using different Lake Mead shortage protection lines in the modeling of the baseline conditions and surplus alternatives. As discussed in Section 3.3.3.4, it was assumed that the Lake Mead water surface elevation of 1083 feet msl would be protected with a certain degree of confidence (approximately 80% of the time). Also, as discussed in Section 3.3.4.1, separate modeling studies were used to determine a "protection line" or trigger such that if Mead's elevation falls below that line, a Level 1 shortage is declared. The actual assurance achieved with respect to the protection of this level (water surface elevation 1083-foot msl) was about 73% through year 2040.

For the sensitivity analysis, the modeling assumptions included a lower protection line (one that would protect Lake Mead water surface elevation of 1050 feet msl approximately 80% of the time). The shortage protection triggers that were used for this purpose are presented graphically in Figure M-1. A graphical comparison of the probability of Lake Mead water surface elevations dropping below 1050 feet msl is presented in Figure M-2. This figure compares the water surface elevations observed under the baseline conditions to those observed under the surplus. As seen in Figure M-2, the level of protection achieved under the baseline conditions was approximately 75% through the year 2040 and then further decreased to 73 percent by 2050.

The sensitivity analysis evaluates the effect that a change to the shortage protection assumptions for the baseline conditions, the Basin States alternative, and the Shortage Protection Alternative would have on the water surface elevations of Lakes Powell and Mead. The relative differences in Lake Powell and Lake Mead water levels between the surplus alternatives and the baseline conditions using the 1050 feet msl Lake Mead water level protection criteria were determined to be similar to those observed under the 1083 feet msl Lake Mead water level protection criteria. There is also little to no difference in the observed Lake Powell water levels under the modeled conditions using the 1083 and 1050 feet msl shortage criteria. However, in general, the 1050 feet msl Lake Mead water level protection criteria provided lower Lake Mead water levels under the baseline conditions and the surplus alternatives.

Lake Mead Water Surface Elevations

Figure M-3 compares the 90^{th,} 50th and 10th Percentile Values of Lake Mead water surface elevations observed under the baseline conditions to that of the surplus alternatives, using the 1050 shortage protection triggers. This figure can be compared to Figure 3.3-13 in Volume I of the FEIS that reflects the same information using the 1083 feet protection criteria. In Figure M-4, a direct comparison of the 90th, 50th, and 10th percentile values of the observed Lake Mead elevations for each shortage assumption is shown for baseline conditions. Figures M-5 and M-6 show the same comparison for the Shortage Protection and Basin States Alternatives, respectively. As noted in these three figures, the 90th percentile values for the three modeled conditions are similar. There are some differences between the 50th percentile values and the 10th percentile values of the three modeled conditions. Generally, the 50th and 10th percentile values are similar during the initial years and then depart. Departures are observed much earlier in time for the Shortage Protection Alternative (Figure M-6), then the Basin States Alternative (Figure M-5) and finally the baseline conditions (Figure M-4). Lower lake water levels are observed for the modeled conditions that use the 1050 feet msl shortage protection criteria. This is attributable to the more liberal modeled criteria that allows the lake to be drawn down to lower levels before the shortage triggers kick-in and water delivery reductions begin.

Summaries of the observed differences in Lake Mead water levels are presented in Tables M-1, M-2 and M-3.

Table M-1
Lake Mead Water Surface Elevations
90th, 50th and 10th Percentile Values for Baseline Conditions
Comparison of Lake Mead Shortage Protection Criteria (1083 to 1050)

	Departures (49-year Period)		
	90th Percentile Values	50th Percentile Values	10th Percentile Values
Maximum Departure	1.65	14.73	12.80
Minimum Departure	-0.62	0.00	0.00
Average Departure	0.06	5.45	4.60

Table M-2
Lake Mead Water Surface Elevations
90th, 50th and 10th Percentile Values for Basin States Alternative
Comparison of Lake Mead Shortage Protection Criteria (1083 to 1050)

	Departures (49-year Period)		
	90th Percentile Values	50th Percentile Values	10th Percentile Values
Maximum Departure	1.62	14.84	12.96
Minimum Departure	-0.64	0.00	0.00
Average Departure	0.10	5.92	5.15

Table M-3 Lake Mead Water Surface Elevations 90th, 50th and 10th Percentile Values for Shortage Protection Alternative Comparison of Lake Mead Shortage Protection Criteria (1083 to 1050)			
	Departures (49-year Period)		
	90th Percentile Values	50th Percentile Values	10th Percentile Values
Maximum Departure	3.36	23.56	26.22
Minimum Departure	-1.84	0.00	0.00
Average Departure	0.23	9.21	9.72

Lake Powell Water Surface Elevations

Figure M-7 compares the 90th, 50th and 10th percentile Lake Powell water surface elevations observed under the baseline conditions and all of the surplus alternatives, using the 1050 shortage protection triggers. This figure can be compared to Figure 3.3-6 in Volume I of the FEIS that reflects the same information using the 1083 feet protection criteria. In Figure M-8, a direct comparison of the 90th, 50th, and 10th percentile Lake Powell elevations for each shortage protection assumption is shown for baseline conditions. Figures M-9 and M-10 show the same comparison for the Shortage Protection and Basin States Alternatives respectively. As shown in Figures M-8, M-9 and M-10, differences observed under the baseline, Basin States Alternative and Shortage Protection Alternative are minimum and considered to be insignificant. This indicates that the use of different Lake Mead shortage protection criteria has very little to no impact on Lake Powell water surface elevations.

Summaries of the observed differences in Lake Powell water levels are presented in Tables M-4, M-5 and M-6.

Table M-4 Lake Powell Water Surface Elevations 90th, 50th and 10th Percentile Values for Baseline Conditions Comparison of Lake Mead Shortage Protection Criteria (1083 to 1050)			
	Departures (49-year Period)		
	90th Percentile Values	50th Percentile Values	10th Percentile Values
Maximum Departure	0.48	0.00	0.00
Minimum Departure	-0.13	0.00	0.00
Average Departure	0.02	0.00	0.00

Table M-5 Lake Powell Water Surface Elevations 90th, 50th and 10th Percentile Values for Basin States Alternative Comparison of Lake Mead Shortage Protection Criteria (1083 to 1050)			
	Departures (49-year Period)		
	90th Percentile Values	50th Percentile Values	10th Percentile Values
Maximum Departure	0.20	0.00	0.00
Minimum Departure	-0.13	0.00	0.00
Average Departure	0.01	0.00	0.00

Table M-6 Lake Powell Water Surface Elevations 90th, 50th and 10th Percentile Values for Shortage Protection Alternative Comparison of Lake Mead Shortage Protection Criteria (1083 to 1050)			
	Departures (49-year Period)		
	90th Percentile Values	50th Percentile Values	10th Percentile Values
Maximum Departure	0.25	2.78	5.37
Minimum Departure	-0.02	0.00	0.00
Average Departure	0.03	0.33	1.68

List of Figures	
M-1	Lake Mead Level 1 Shortage Triggers
M-2	Lake Mead Water Surface Elevations Comparison of Surplus Alternatives to Baseline Percent of Values Greater Than or Equal to 1050 feet (80P-1050)
M-3	Lake Mead End-of-December Water Elevations Comparison of Surplus Alternatives to Baseline for 1050 Shortage Protection 90th, 50th, and 10th Percentile Values
M-4	Lake Mead End-of-December Water Elevations Comparison of Shortage Assumptions for Baseline Conditions 90th, 50th, and 10th Percentile Values
M-5	Lake Mead End-of-December Water Elevations Comparison of Shortage Assumptions for Basin States Alternative 90th, 50th, and 10th Percentile Values
M-6	Lake Mead End-of-December Water Elevations Comparison of Shortage Assumptions for Shortage Protection Alternative 90th, 50th, and 10th Percentile Values
M-7	Lake Powell End-of-July Water Elevations Comparison of Surplus Alternatives and Baseline for 1050 Shortage Protection
M-8	Lake Powell End-of-July Water Elevations Comparison of Shortage Assumptions for Baseline Conditions 90th, 50th, and 10th Percentile Values
M-9	Lake Powell End-of-July Water Elevations Comparison of Shortage Assumptions for Basin States Alternative 90th, 50th, and 10th Percentile Values
M-10	Lake Powell End-of-July Water Elevations Comparison of Shortage Assumptions for Shortage Protection Alternative 90th, 50th, and 10th Percentile Values

Figure M-1
Lake Mead Level 1 Shortage Triggers Assumed for Modeling

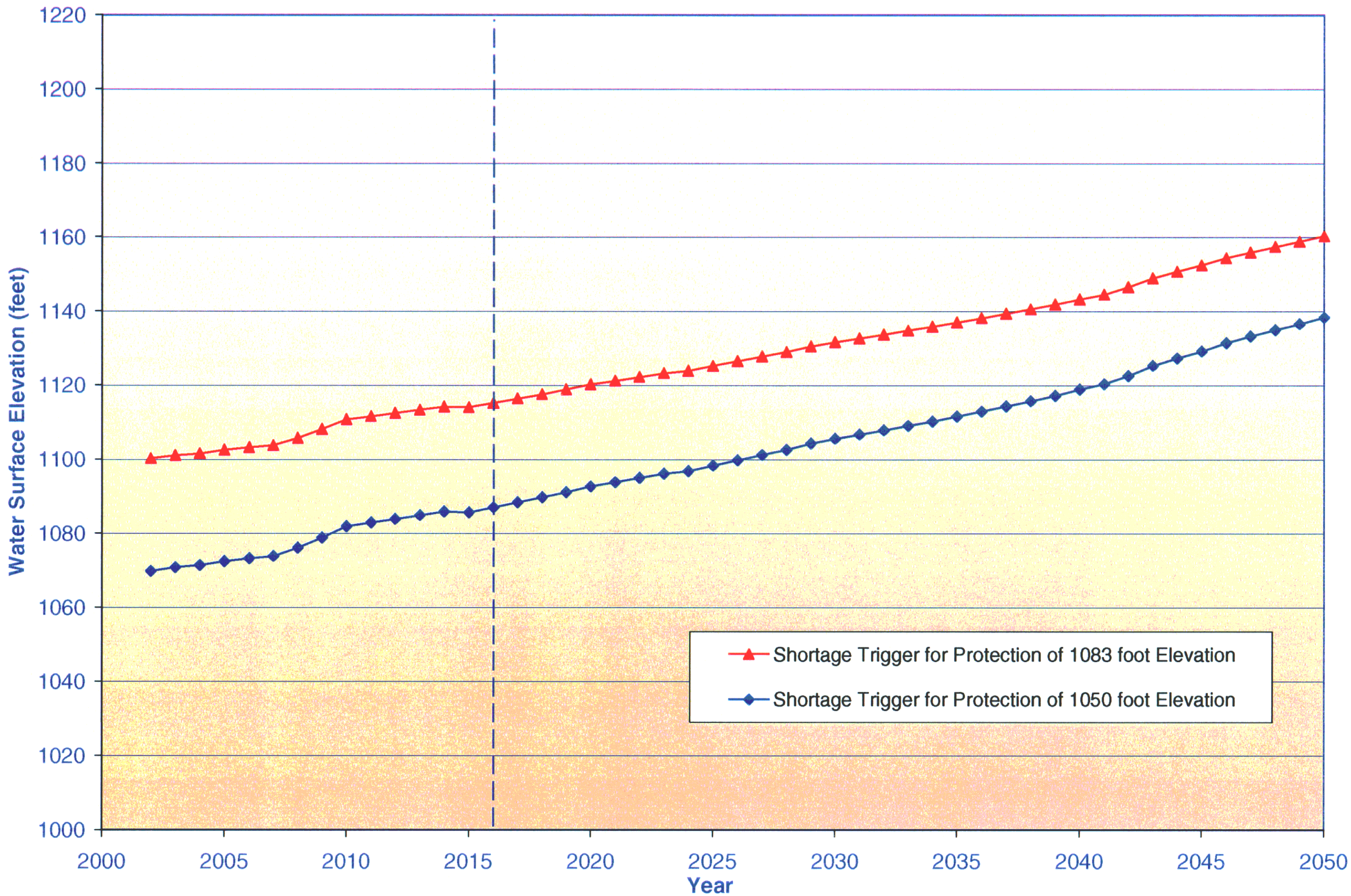


Figure M-2
Lake Mead Water Surface Elevations
Comparison of Surplus Alternatives to Baseline
Percent of Values Greater than or Equal to 1050 (80P-1050)

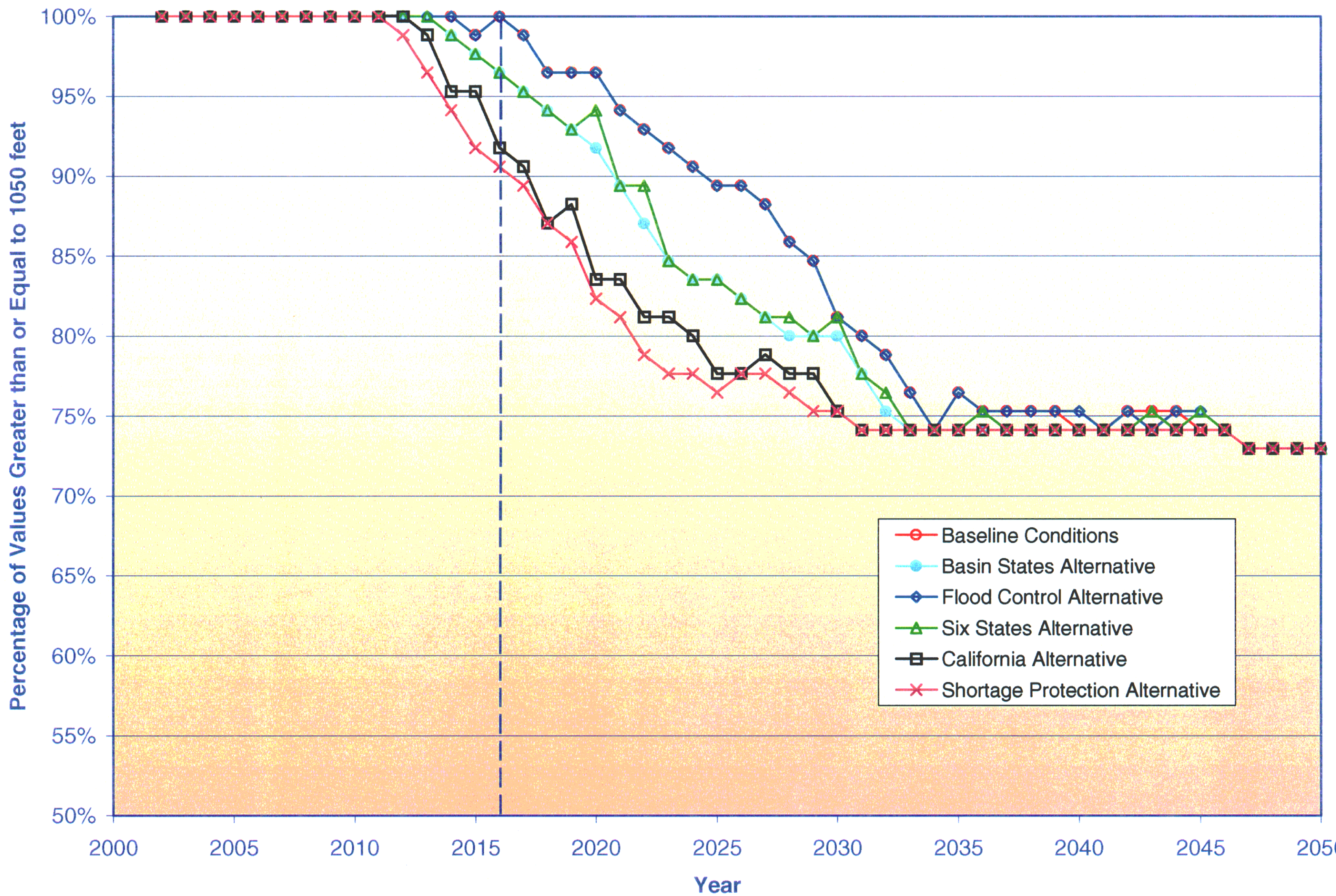


Figure M-3
Lake Mead End-of-December Water Elevations
Comparison of Surplus Alternatives to Baseline for 1050 Shortage Protection
90th, 50th, and 10th Percentile Values

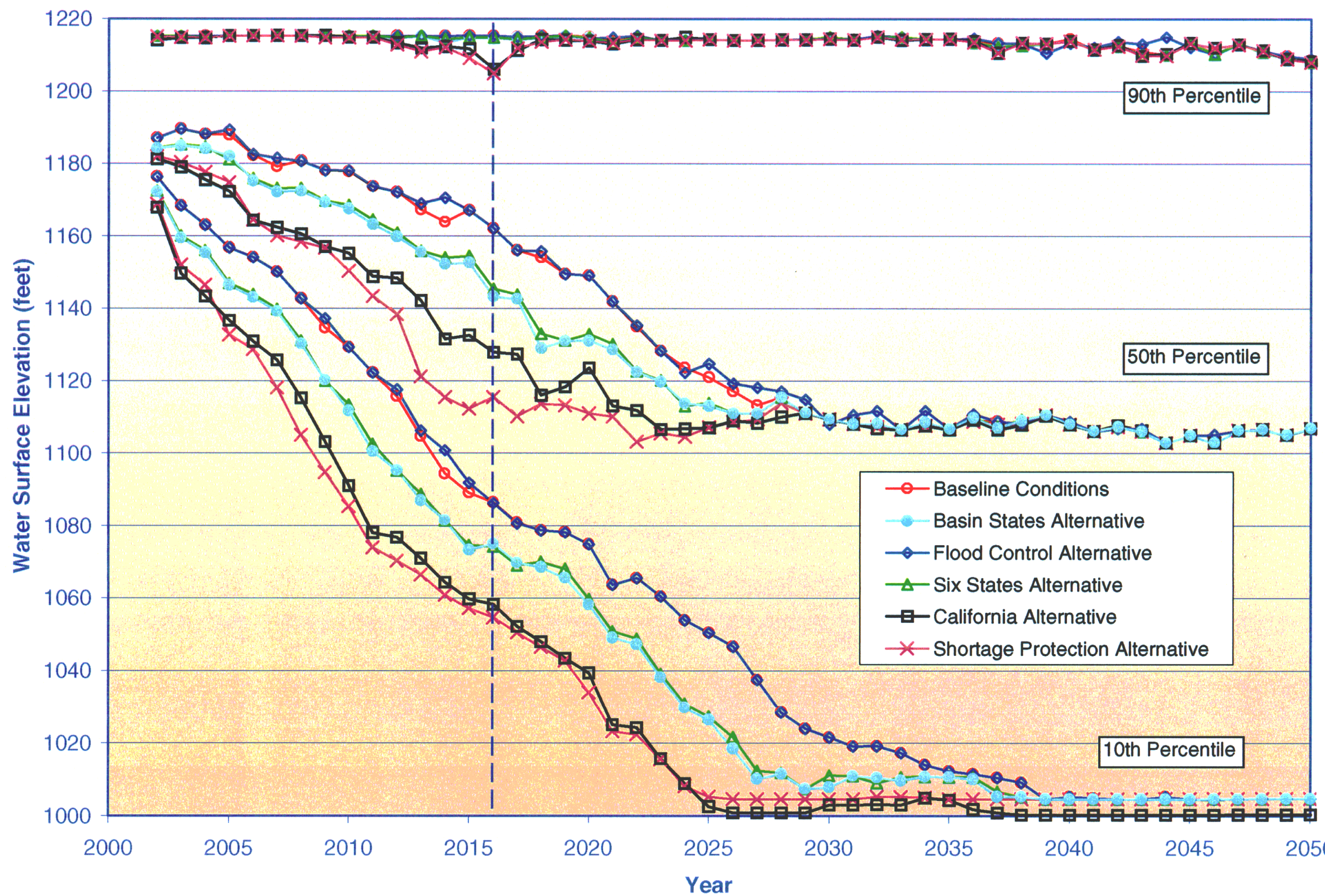


Figure M-4
Lake Mead End-of-December Water Elevations
Comparison of Shortage Assumptions for Baseline Conditions
90th, 50th, and 10th Percentile Values

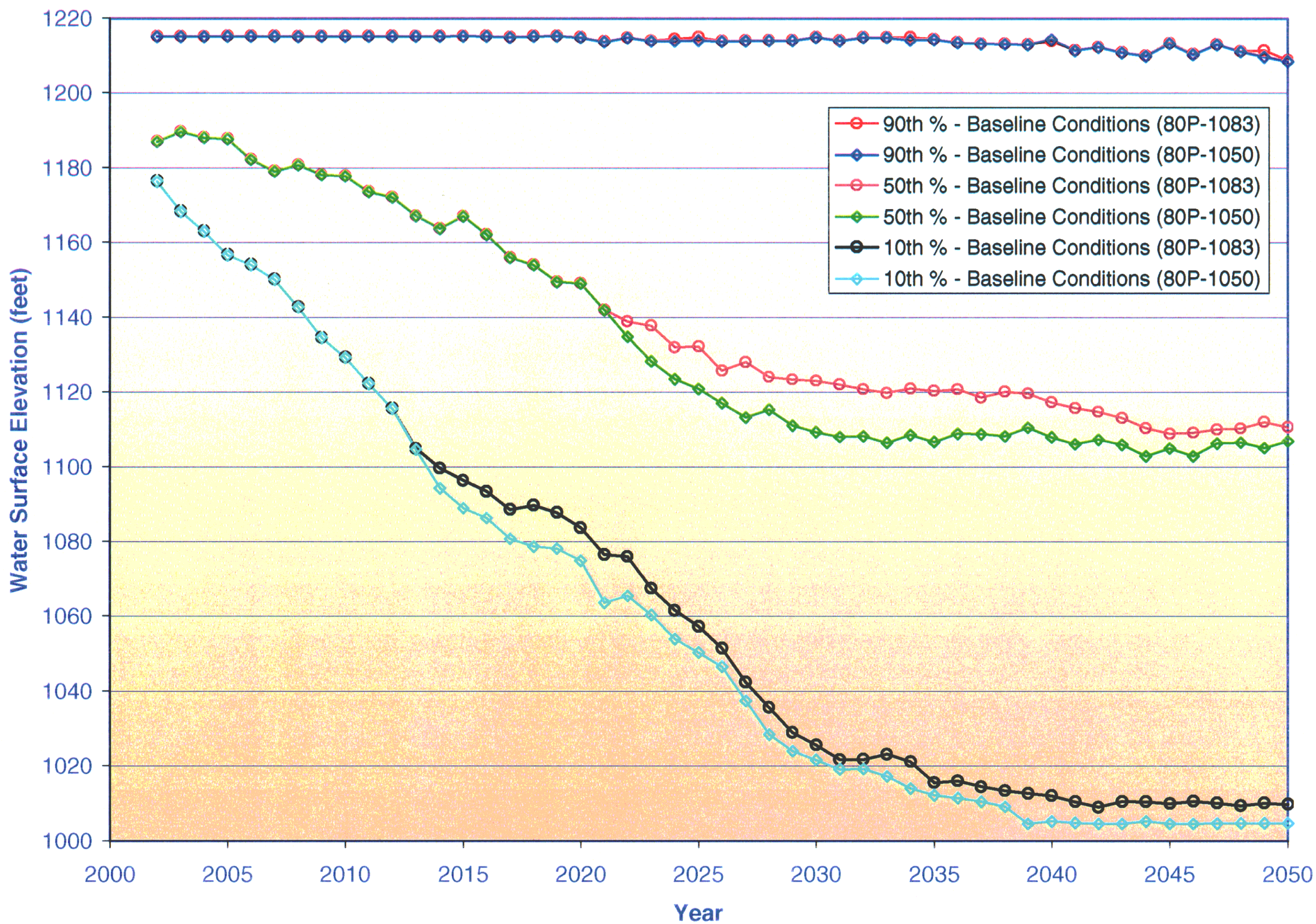


Figure M-5
Lake Mead End-of-December Water Elevations
Comparison of Shortage Assumptions for Basin States Alternative
90th, 50th, and 10th Percentile Values

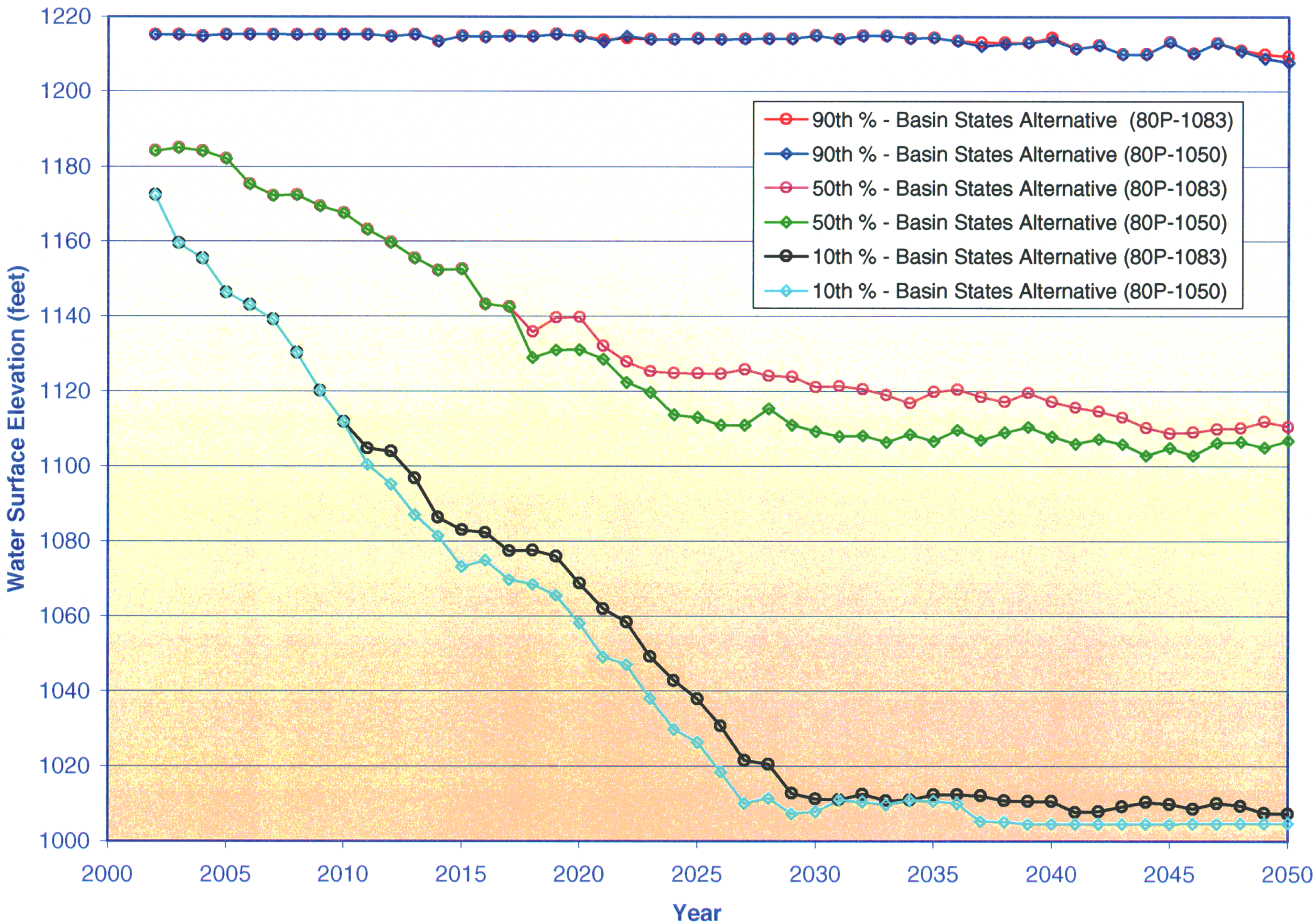


Figure M-6
Lake Mead End-of-December Water Elevations
Comparison of Shortage Assumptions for Shortage Protection Alternative
90th, 50th, and 10th Percentile Values

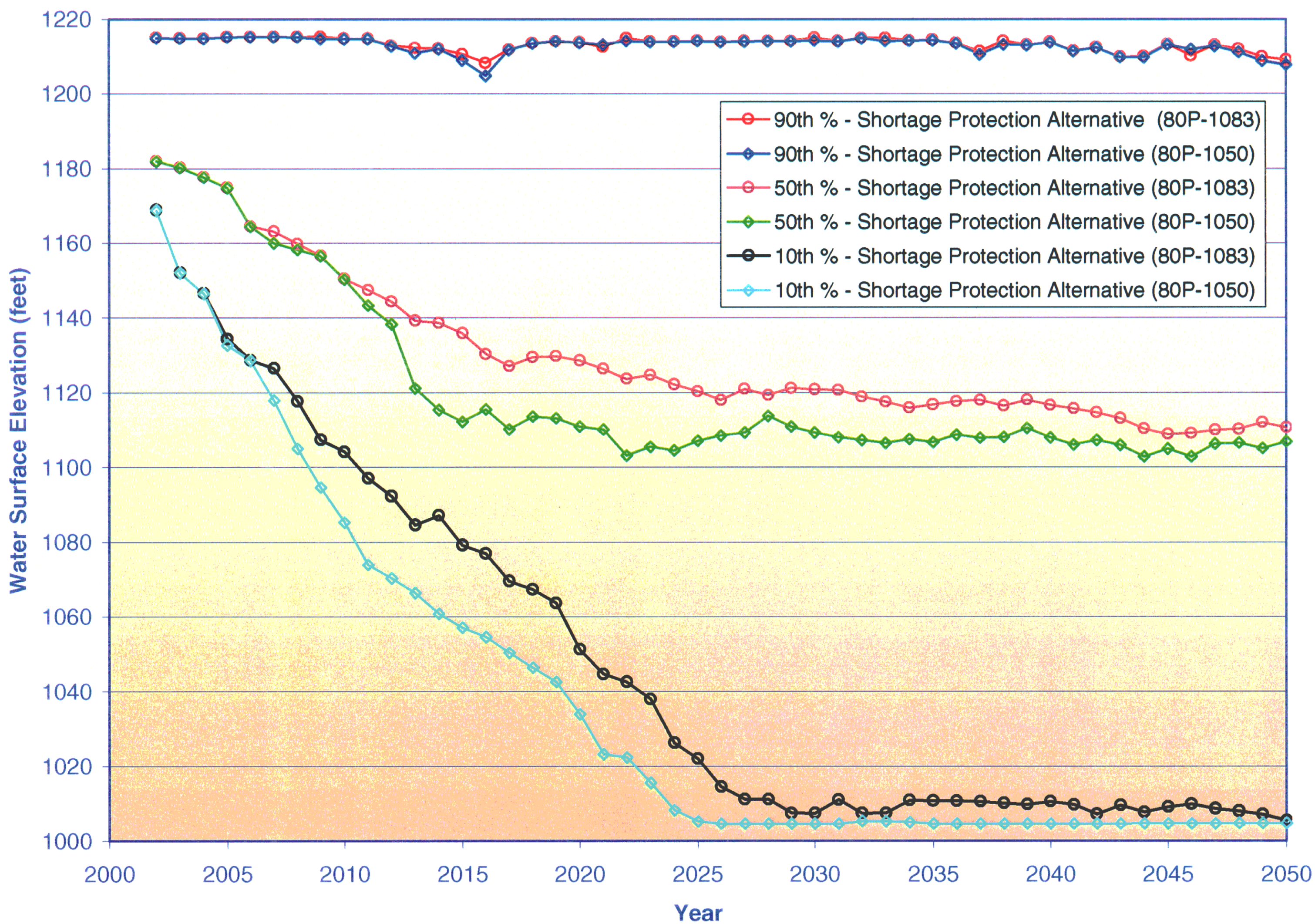


Figure M-7
Lake Powell End-of-July Water Elevations
Comparison of Surplus Alternatives and Baseline for 1050 Shortage Protection
90th, 50th, and 10th Percentile Values

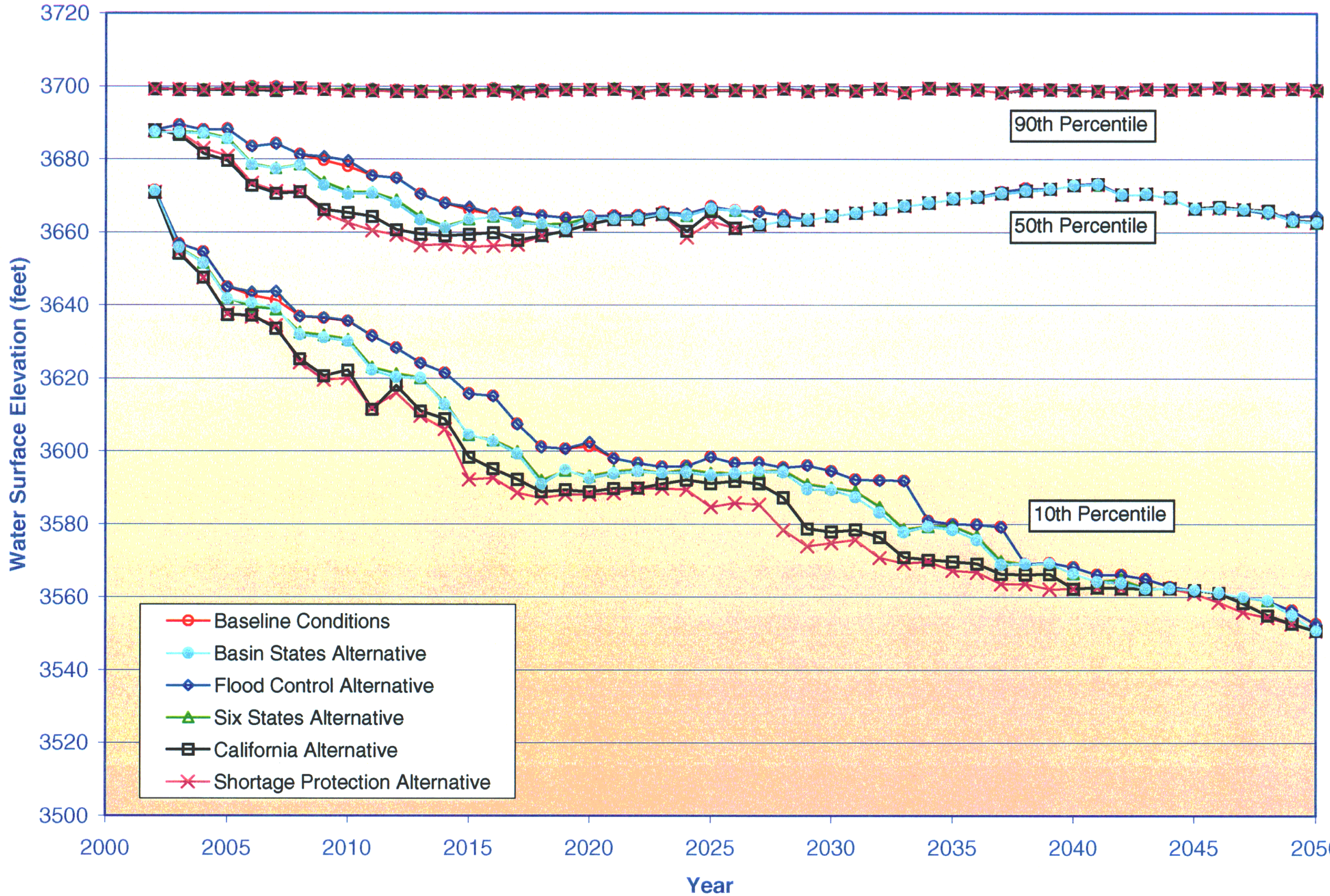


Figure M-8
Lake Powell End-of-July Water Elevations
Comparison of Shortage Assumptions for Baseline Conditions
90th, 50th, and 10th Percentile Values

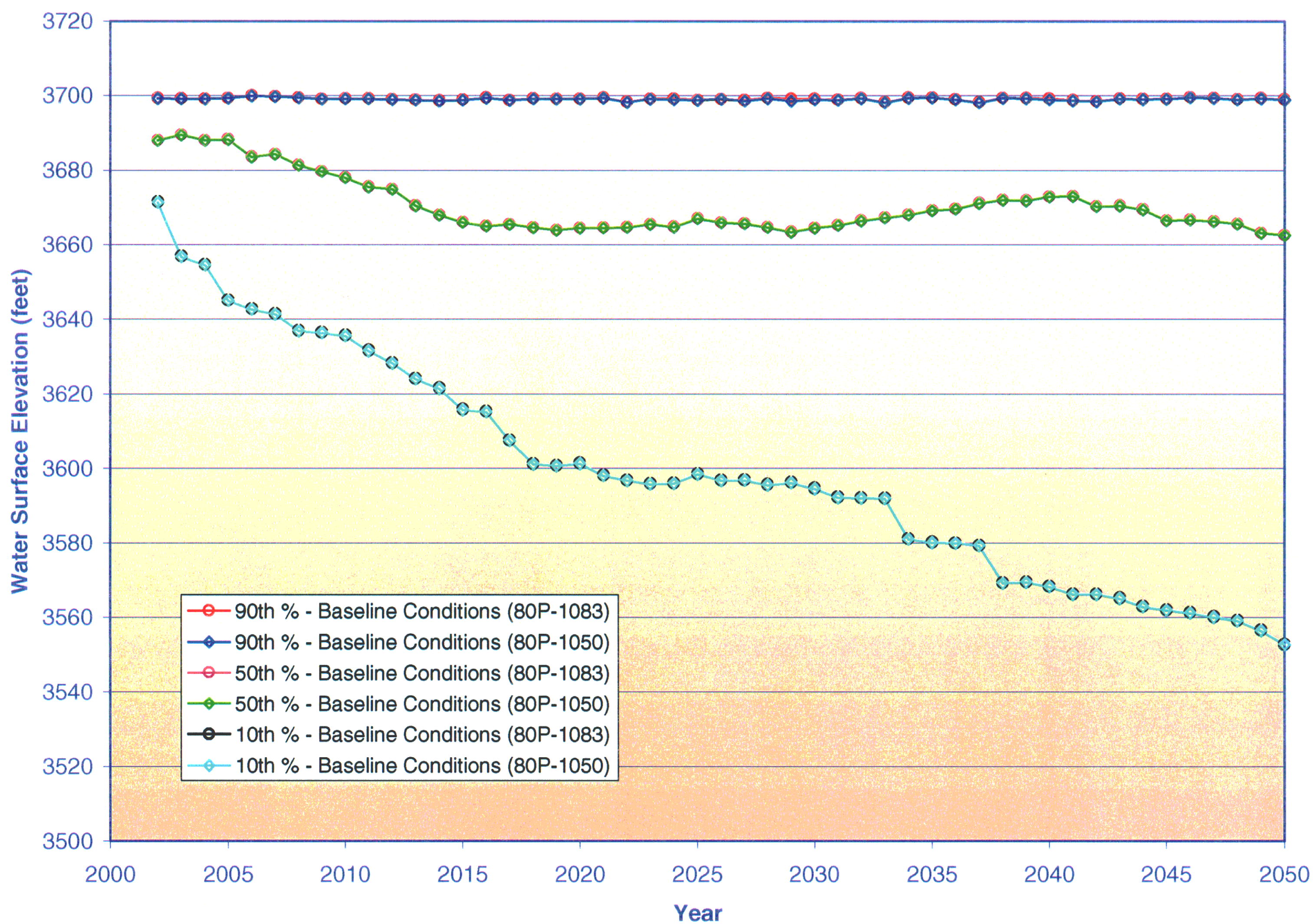


Figure M-9
Lake Powell End-of-July Water Elevations
Comparison of Shortage Assumptions for Basin States Alternative
90^{th}, 50^{th}, and 10^{th} Percentile Values

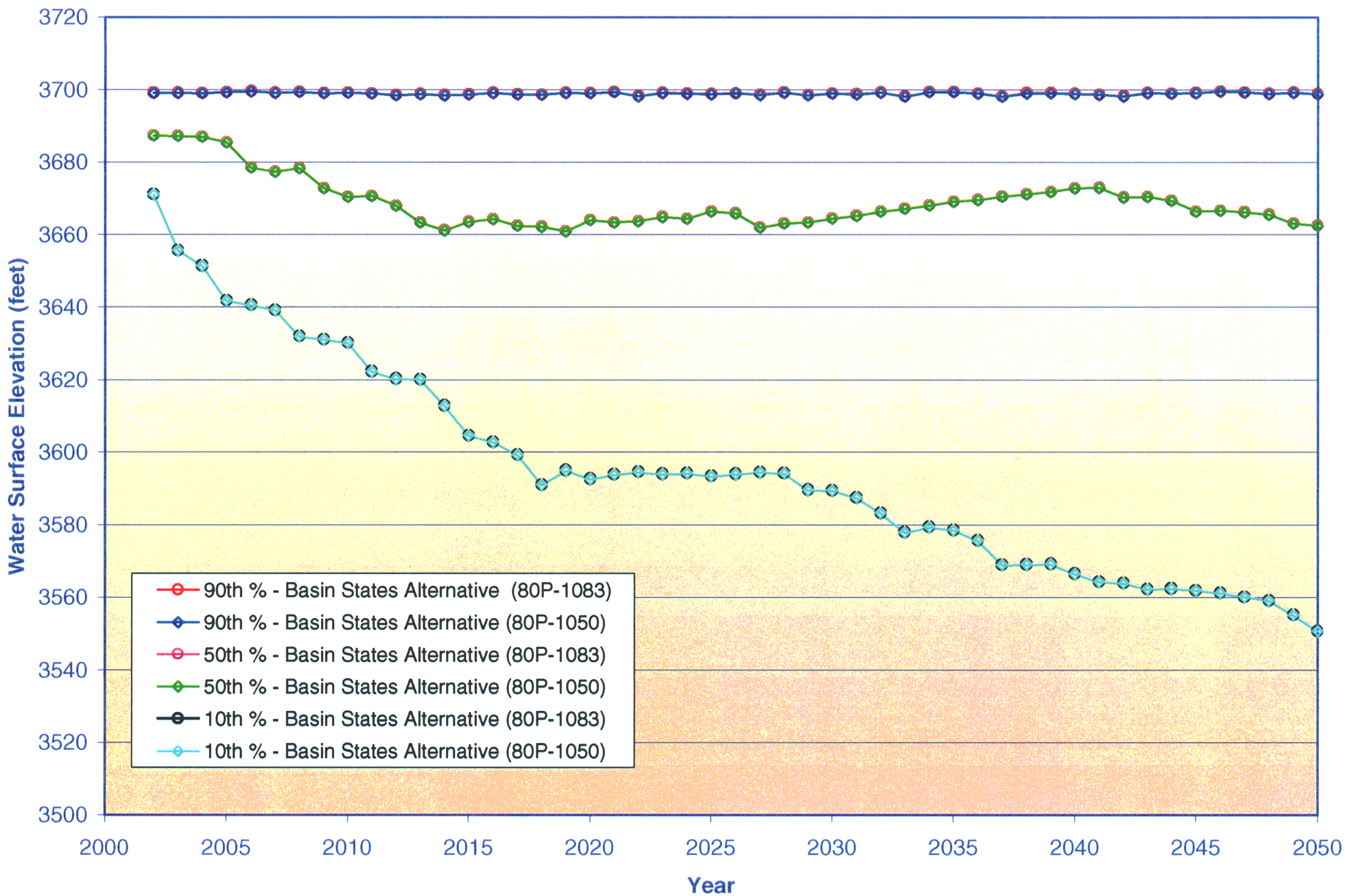
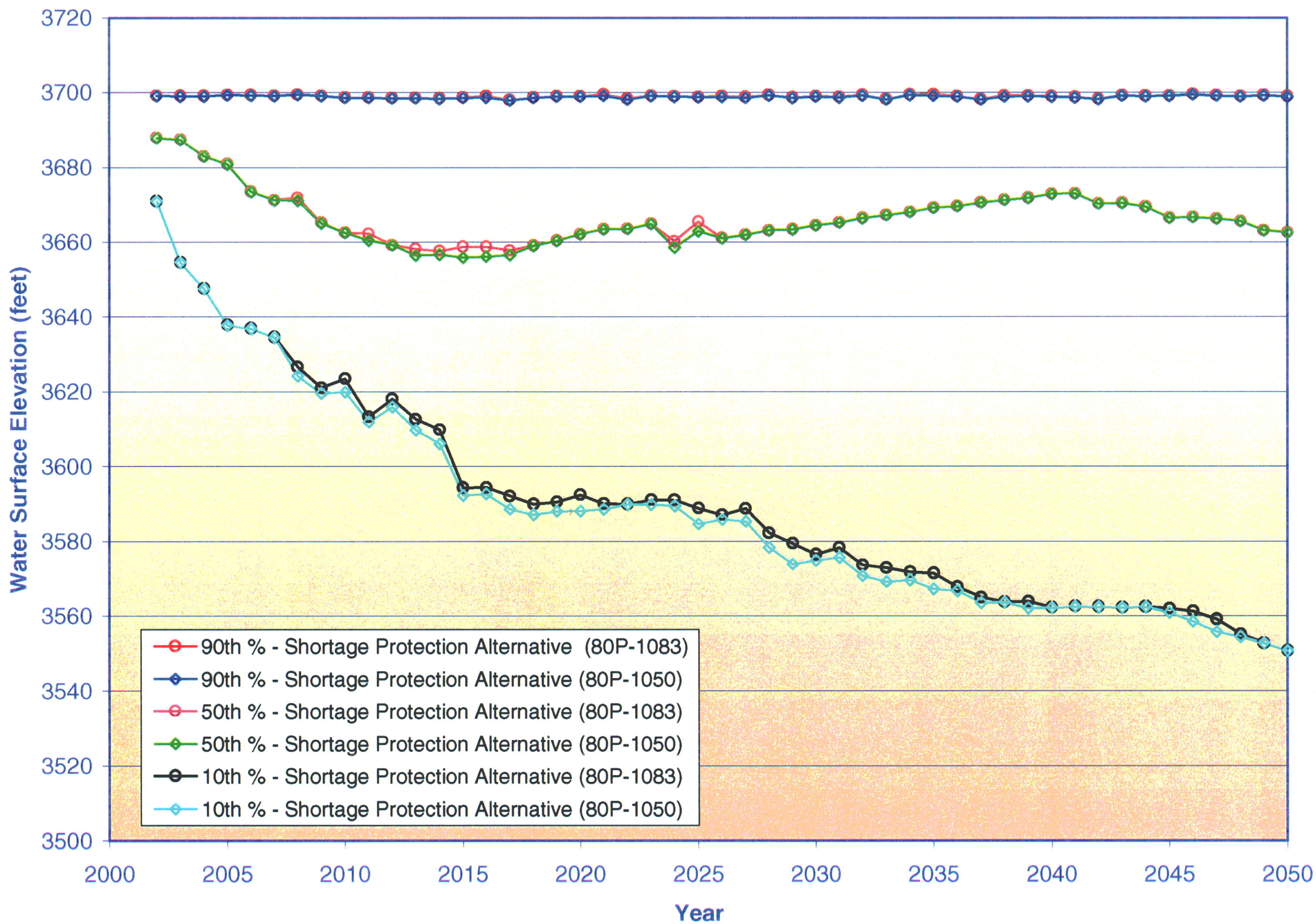


Figure M-10
Lake Powell End-of-July Water Elevations
Comparison of Shortage Assumptions for Shortage Protection Alternative
90th, 50th, and 10th Percentile Values



ATTACHMENT N

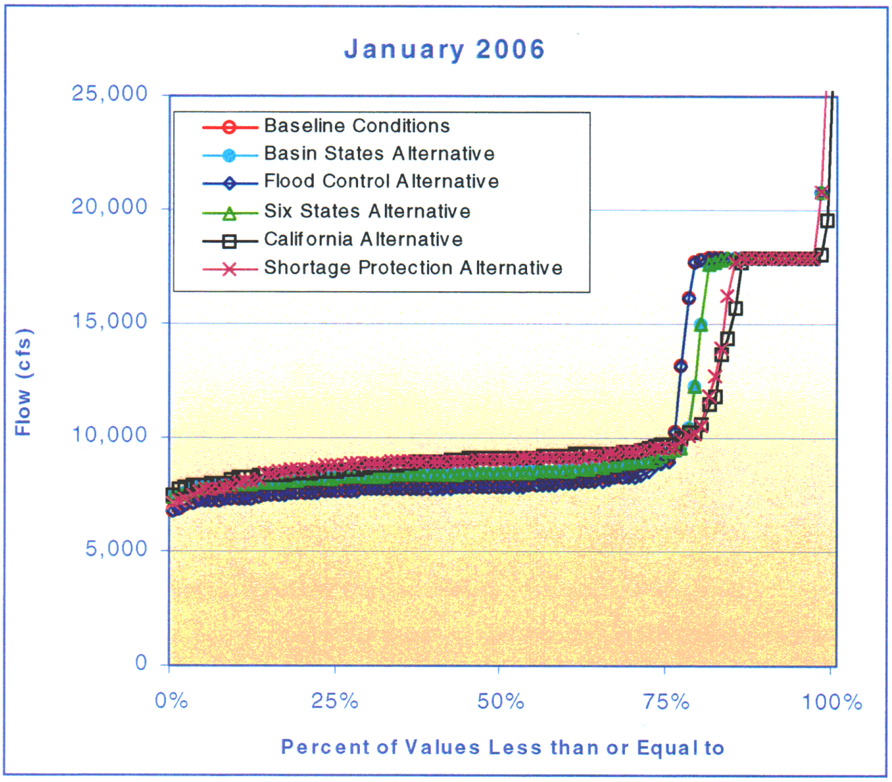
Comparison of Colorado River Flows

This attachment presents a comparison of seasonal Colorado River flows between the baseline conditions and the alternatives. The comparison is made by means of a group of plots for each of four stations along the river. Each group corresponds to a single modeled flow measurement location on the river and each figure within a group corresponds to one of the four seasons. Each of the seasonal figures is further divided into four sub-figures. Each sub-figure deals with a separate modeled year. Data describing Colorado River flow is presented in this manner for the following locations: downstream of the Havasu National Wildlife Refuge diversion; upstream of the Colorado River Indian Reservation diversion; downstream of the Palo Verde Irrigation District diversion; and below Mexico's diversion at Morelos Dam.

Index of Flow Data Plots

Figures	Station
N-1a through N-4b	Havasu NWR
N-5a through N-8b	Colorado River Indian Reservation
N-9a through N-12b	Palo Verde Diversion Dam
N-13a through N-16b	Mexico Diversion at Morelos Dam

Figure N-1a
Colorado River Seasonal Flows Downstream of Havasu NWR
Comparison of Surplus Alternatives to Baseline Conditions for
Modeled Years 2006 and 2016



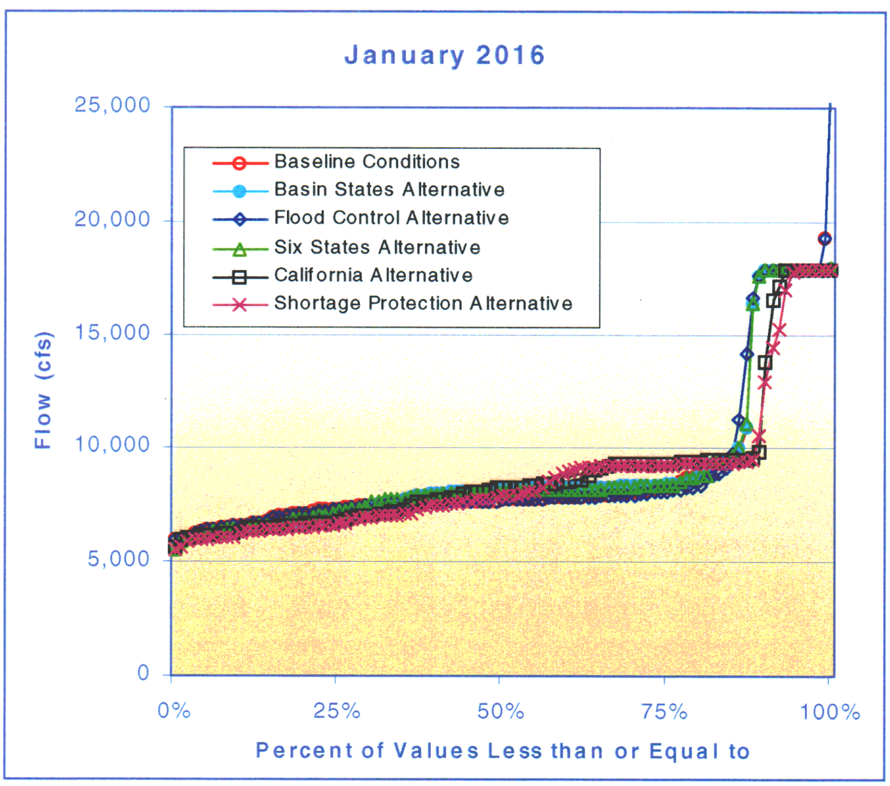
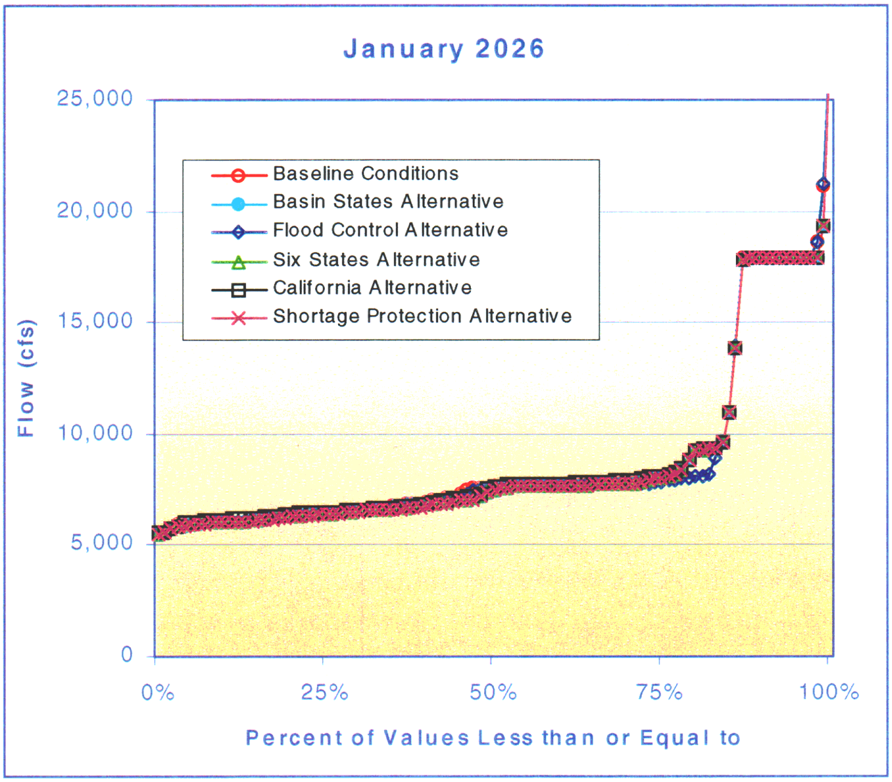


Figure N-1b
Colorado River Seasonal Flows Downstream of Havasu NWR
Comparison of Surplus Alternatives to Baseline Conditions for
Modeled Years 2026 and 2050



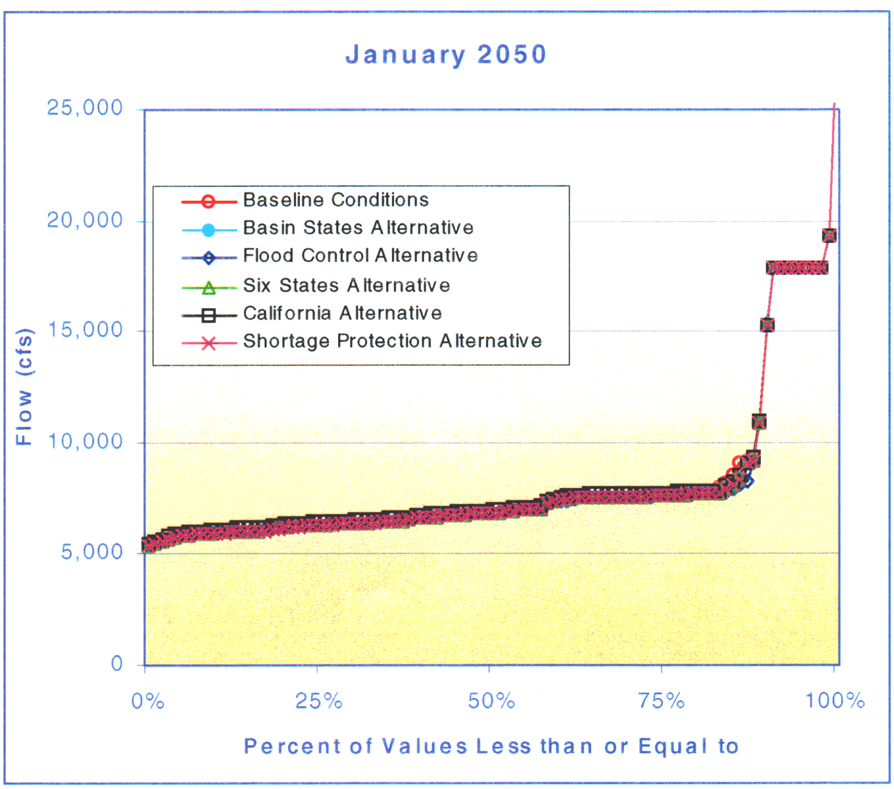
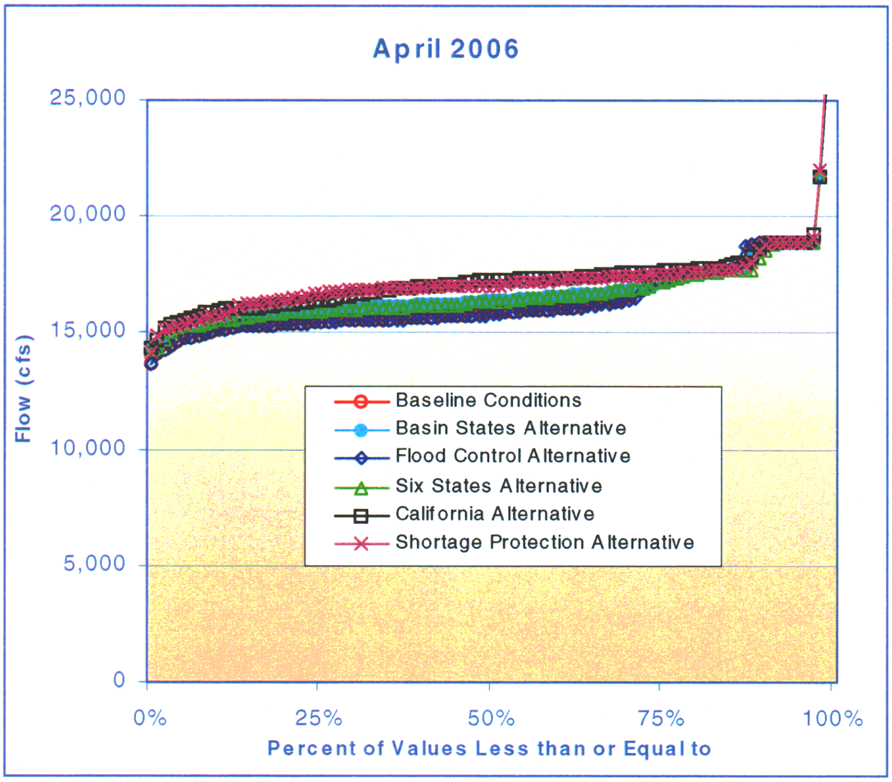


Figure N-2a
Colorado River Seasonal Flows Downstream of Havasu NWR
Comparison of Surplus Alternatives to Baseline Conditions for
Modeled Years 2006 and 2016



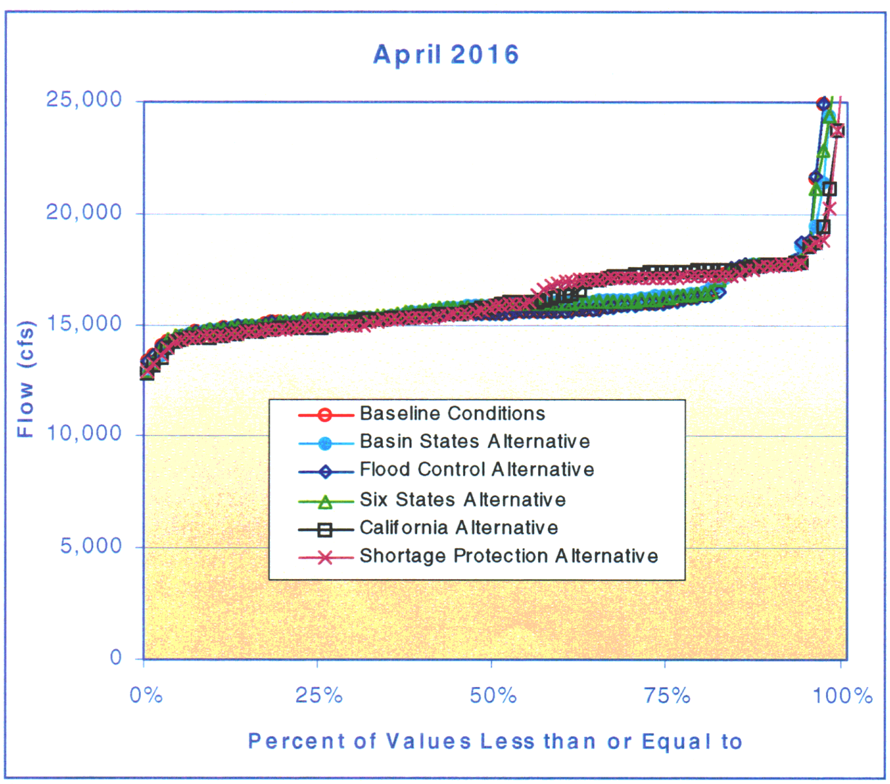
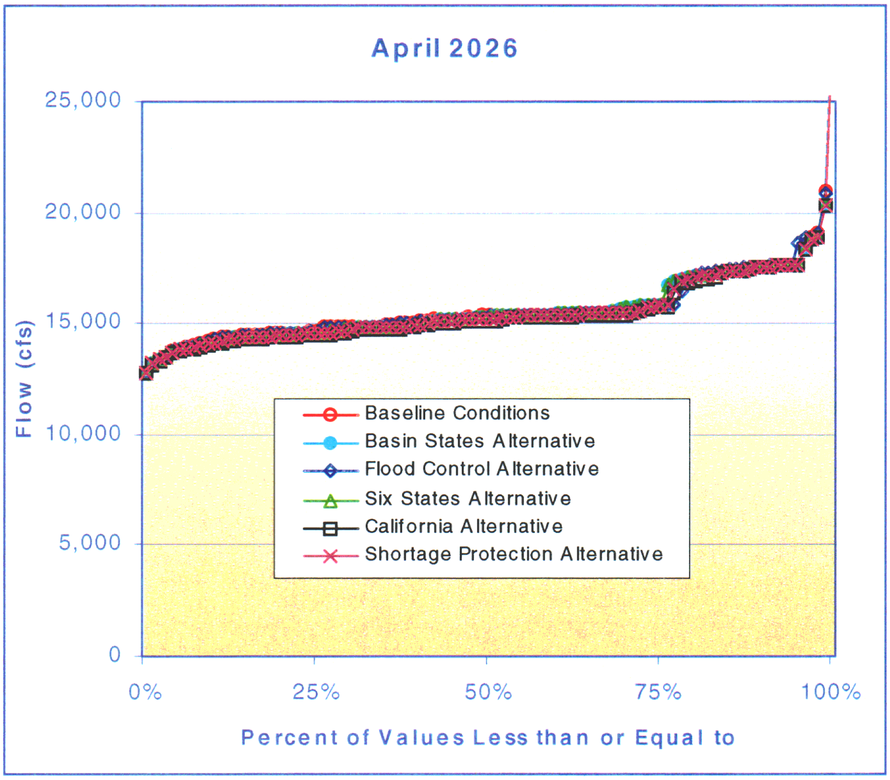


Figure N-2b
Colorado River Seasonal Flows Downstream of Havasu NWR
Comparison of Surplus Alternatives to Baseline Conditions for
Modeled Years 2026 and 2050



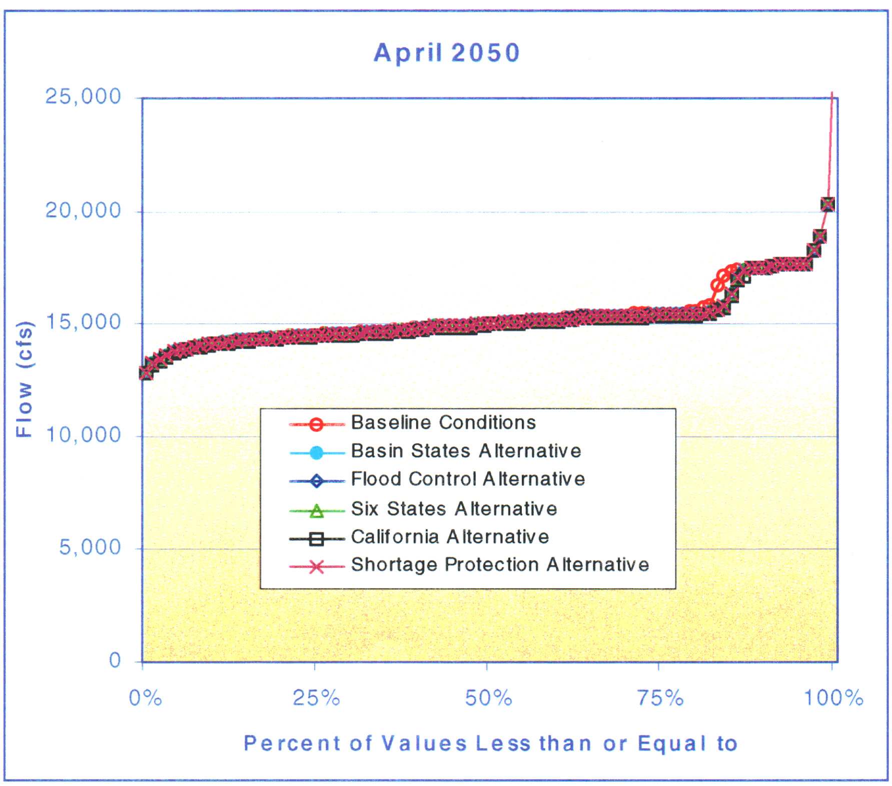
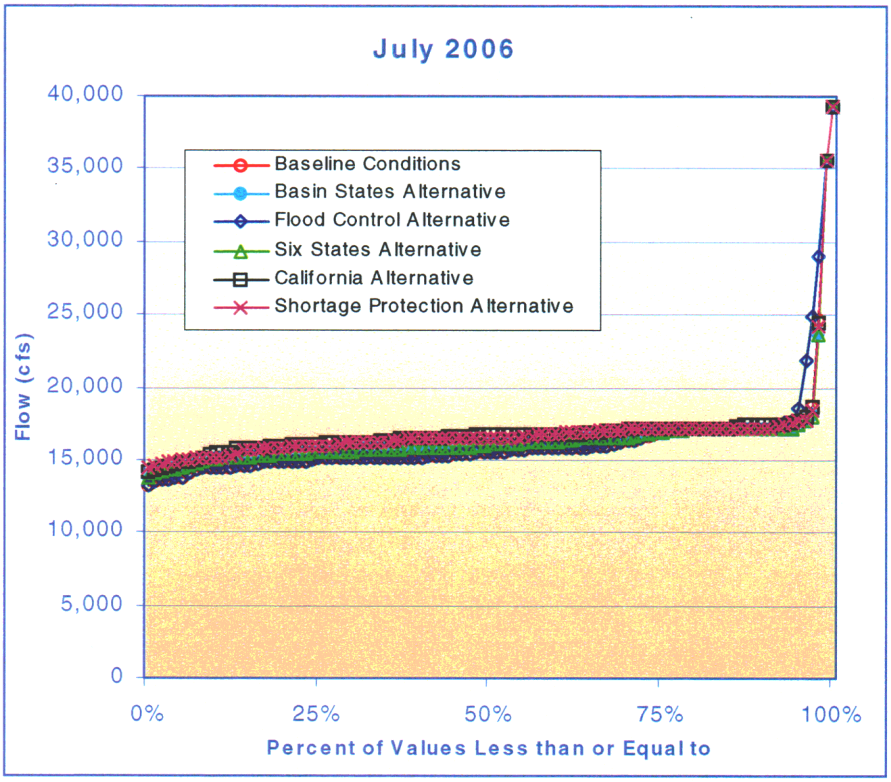


Figure N-3a
Colorado River Seasonal Flows Downstream of Havasu NWR
Comparison of Surplus Alternatives to Baseline Conditions for
Modeled Years 2006 and 2016



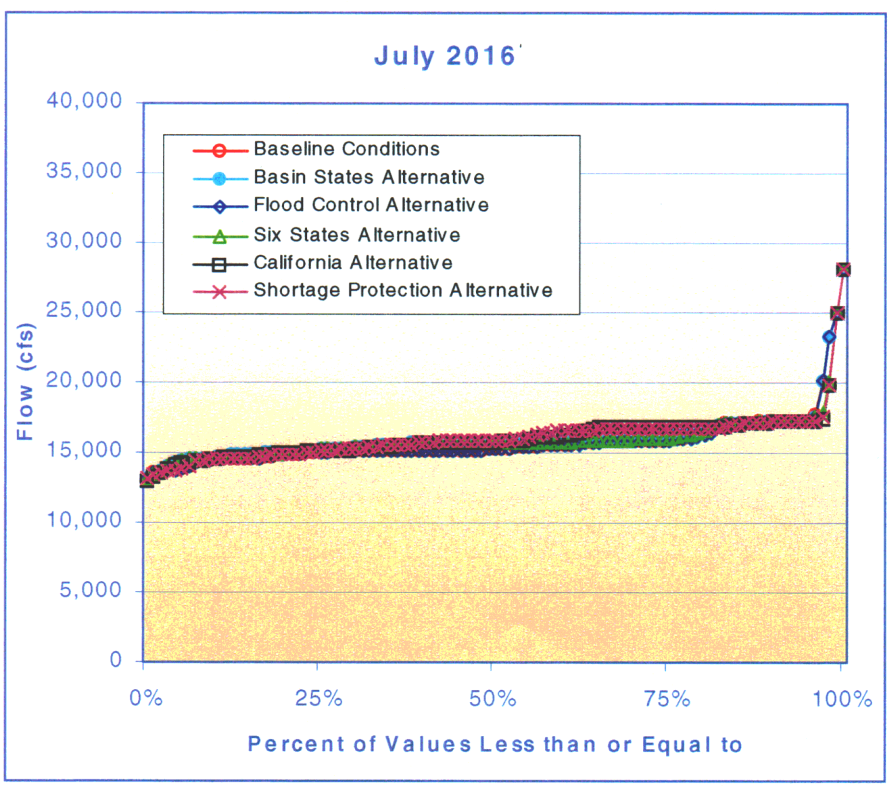
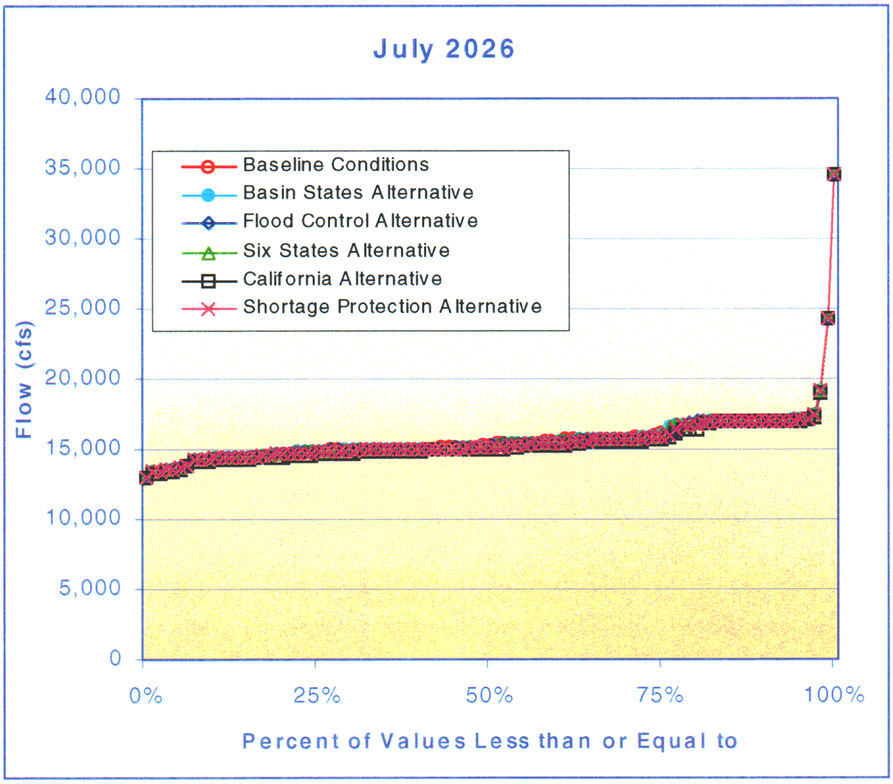


Figure N-3b
Colorado River Seasonal Flows Downstream of Havasu NWR
Comparison of Surplus Alternatives to Baseline Conditions for Modeled Years 2026 and 2050



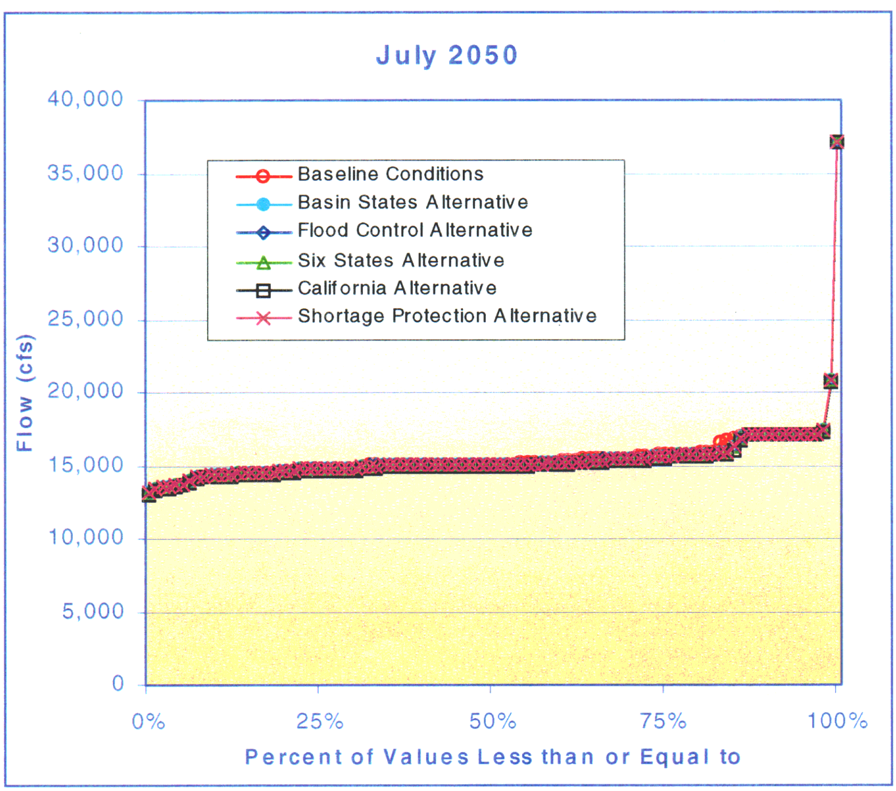
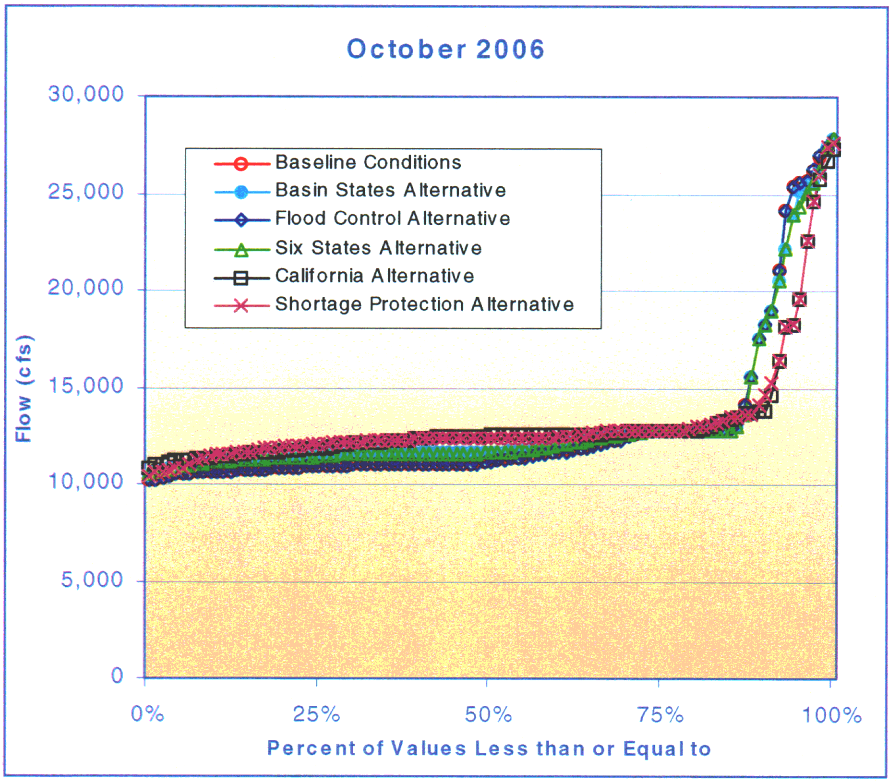


Figure N-4a
Colorado River Seasonal Flows Upstream of Colorado River Indian Reservation
Comparison of Surplus Alternatives to Baseline Conditions for
Modeled Years 2006 and 2016



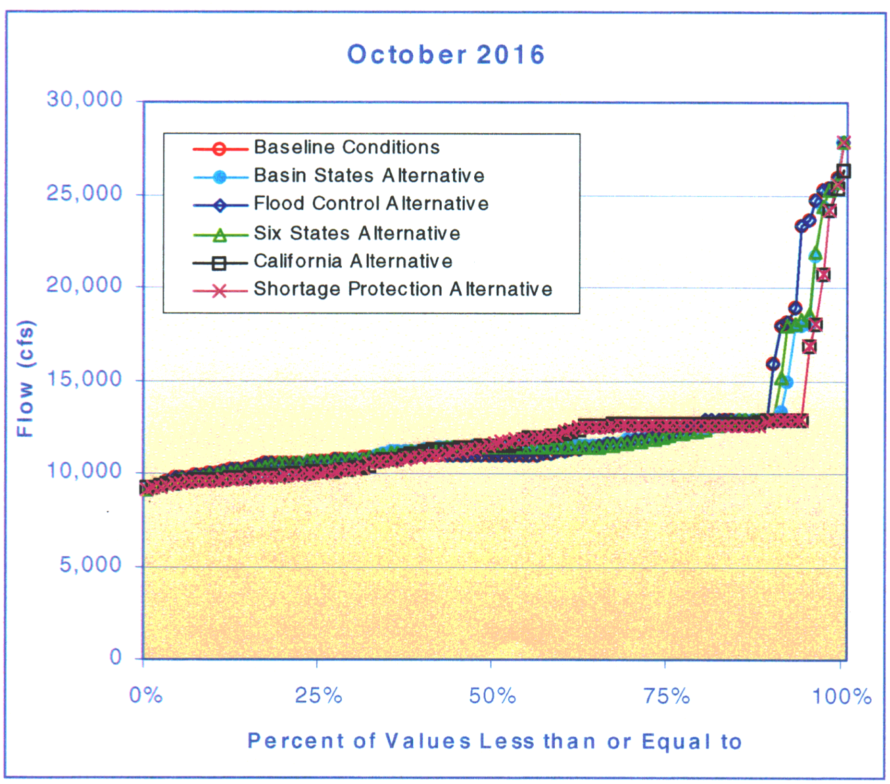
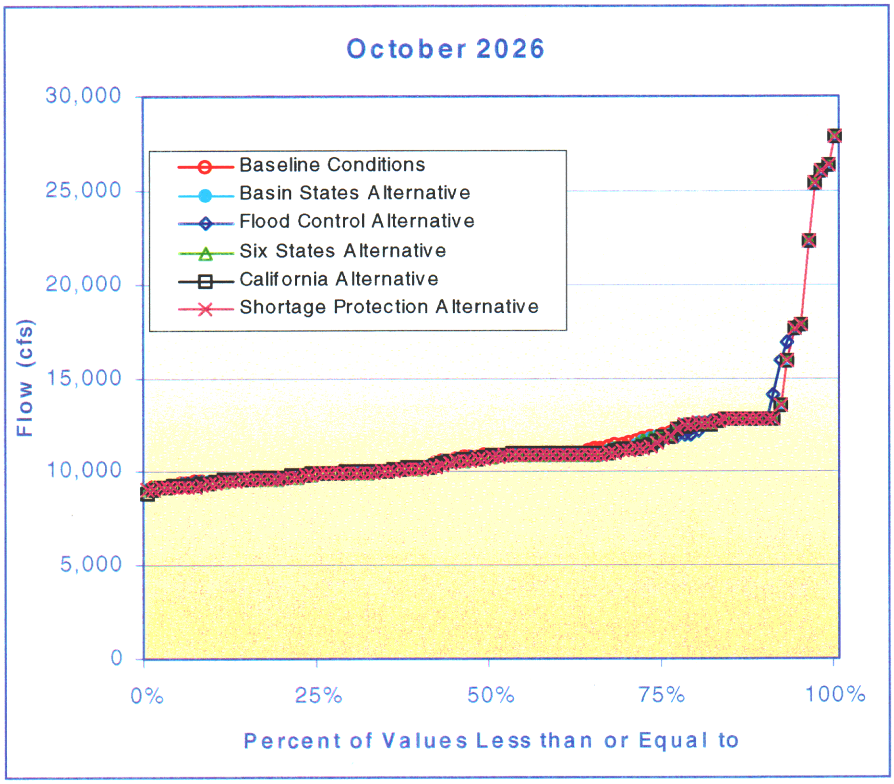


Figure N-4b
Colorado River Seasonal Flows Upstream of Colorado River Indian Reservation Comparison of Surplus Alternatives to Baseline Conditions for Modeled Years 2026 and 2050



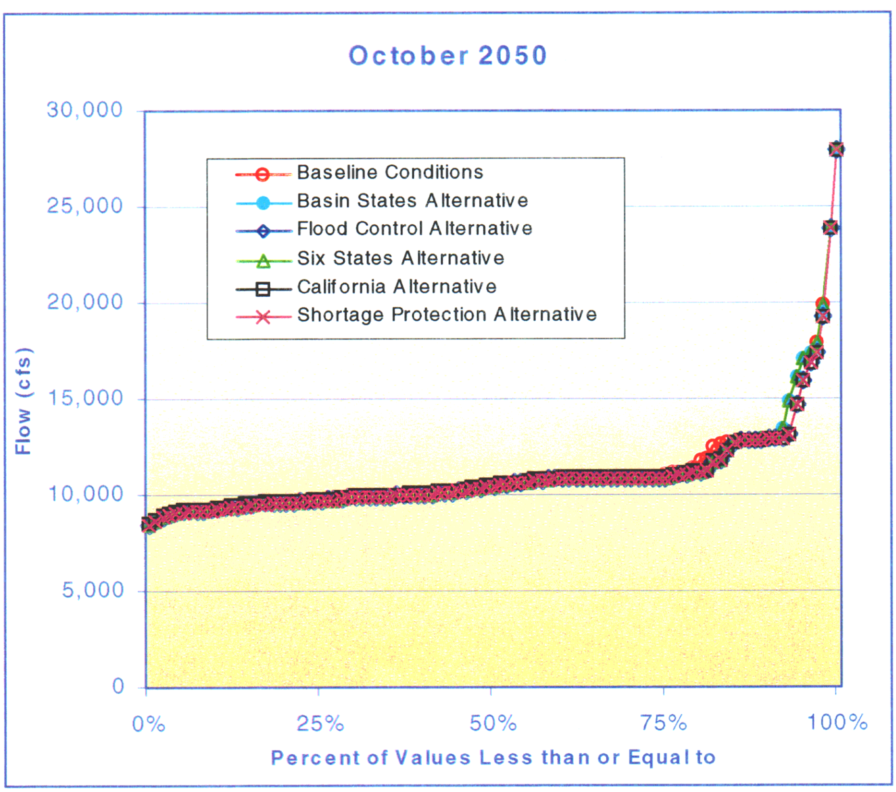
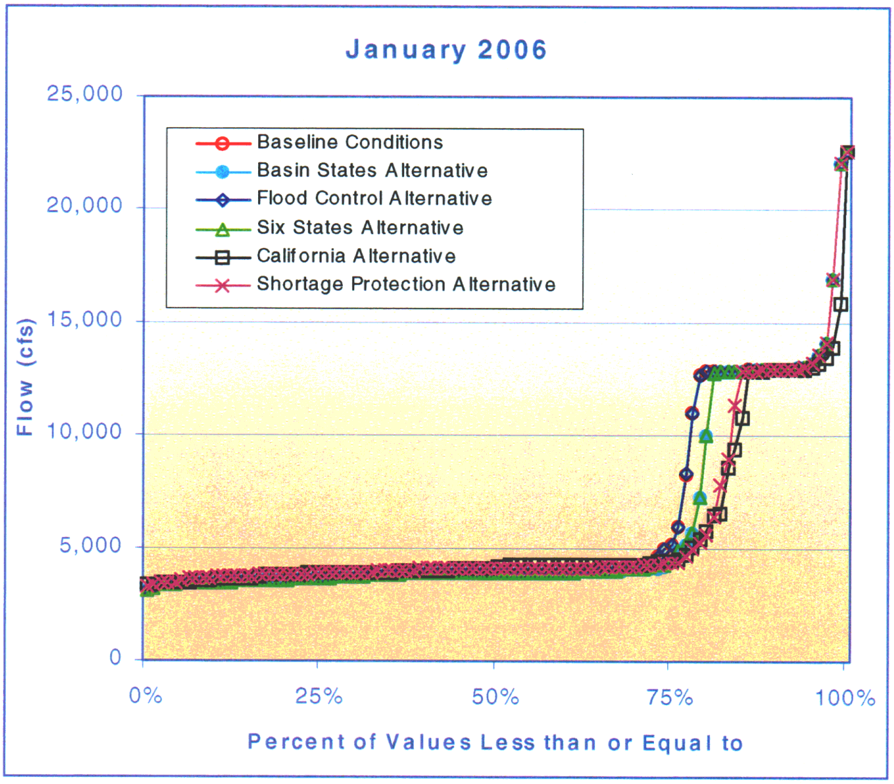


Figure N-5a
Colorado River Seasonal Flows Upstream of Colorado River Indian Reservation
Comparison of Surplus Alternatives to Baseline Conditions for
Modeled Years 2006 and 2016



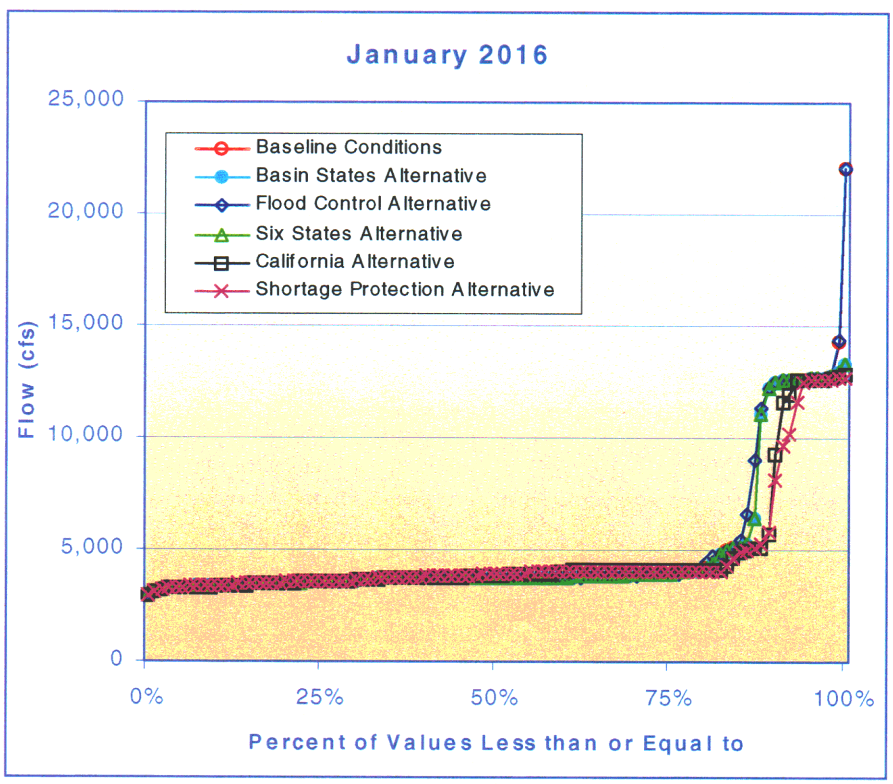
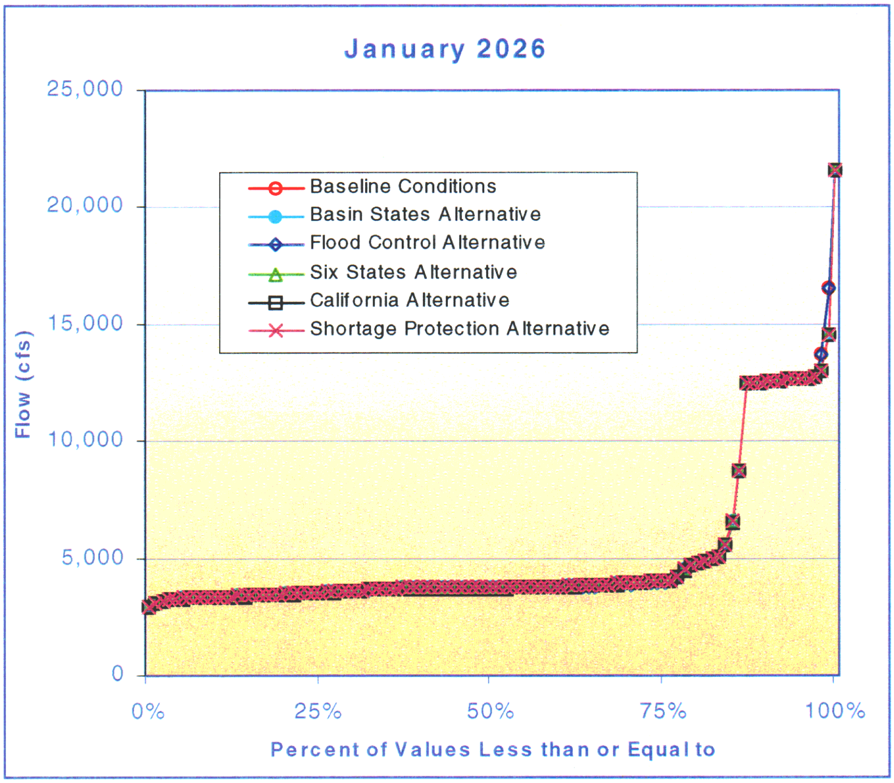


Figure N-5b
Colorado River Seasonal Flows Upstream of Colorado River Indian Reservation
Comparison of Surplus Alternatives to Baseline Conditions for
Modeled Years 2026 and 2050



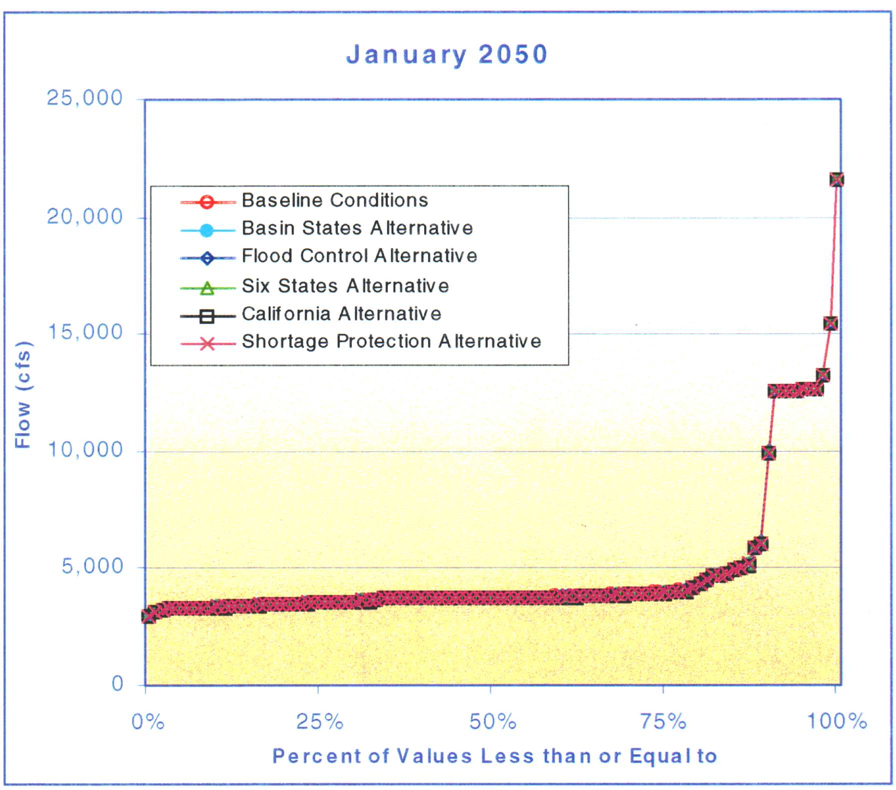
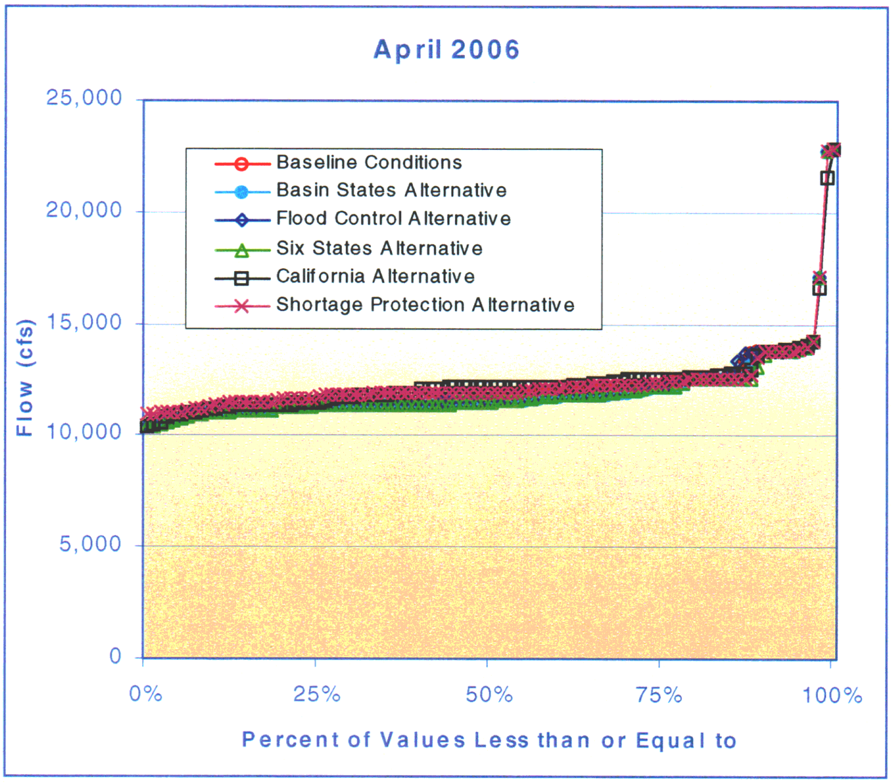


Figure N-6a
Colorado River Seasonal Flows Upstream of Colorado River Indian Reservation Comparison of Surplus Alternatives to Baseline Conditions for Modeled Years 2006 and 2016



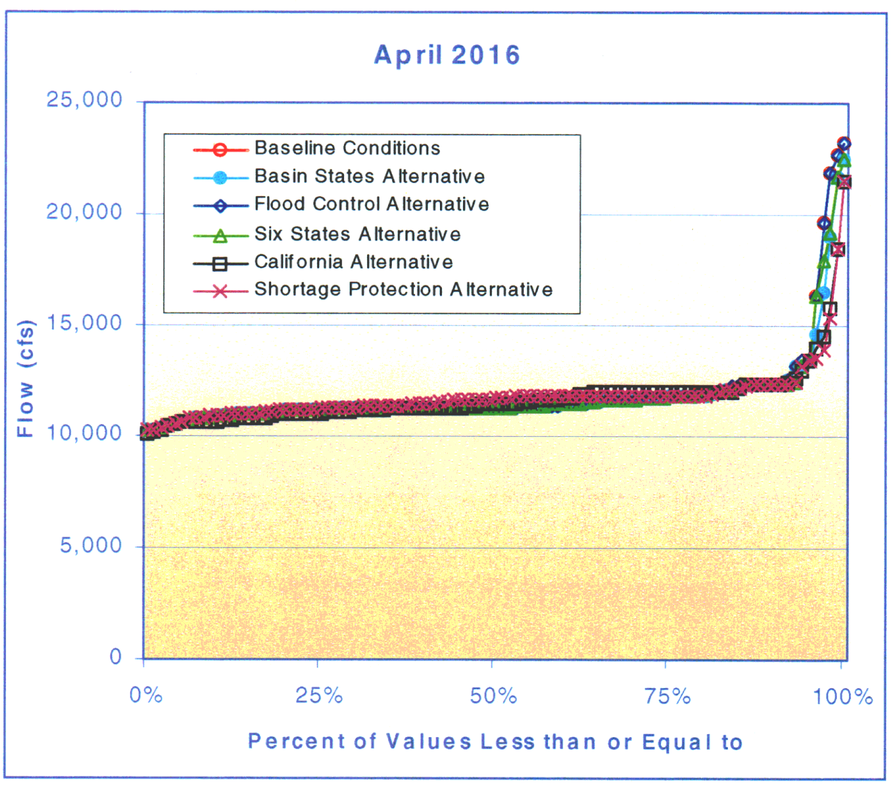
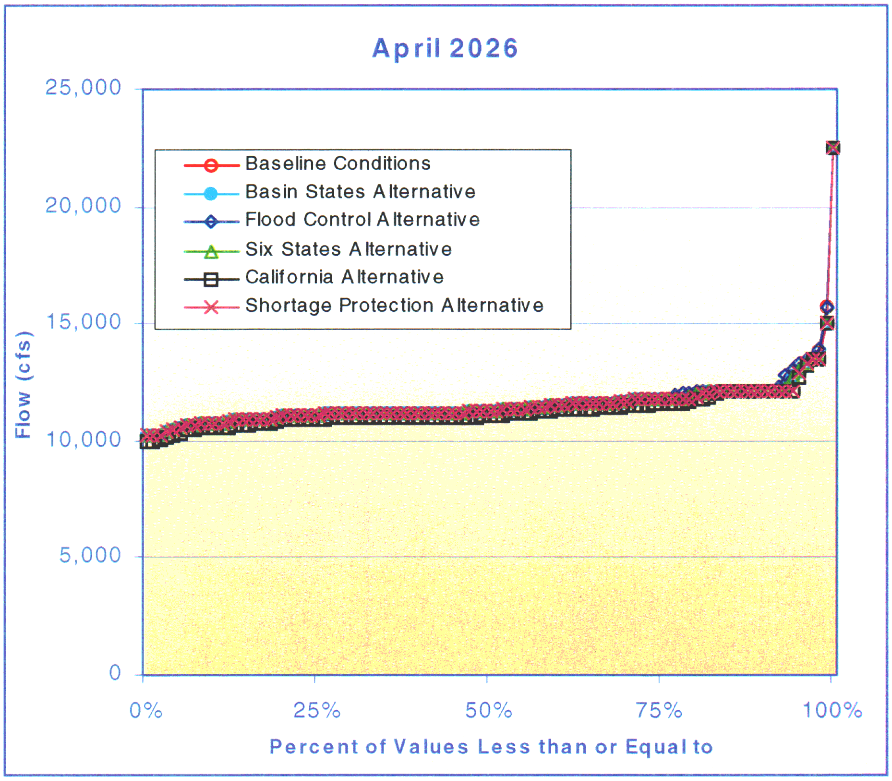


Figure N-6b
Colorado River Seasonal Flows Upstream of Colorado River Indian Reservation
Comparison of Surplus Alternatives to Baseline Conditions for
Modeled Years 2026 and 2050



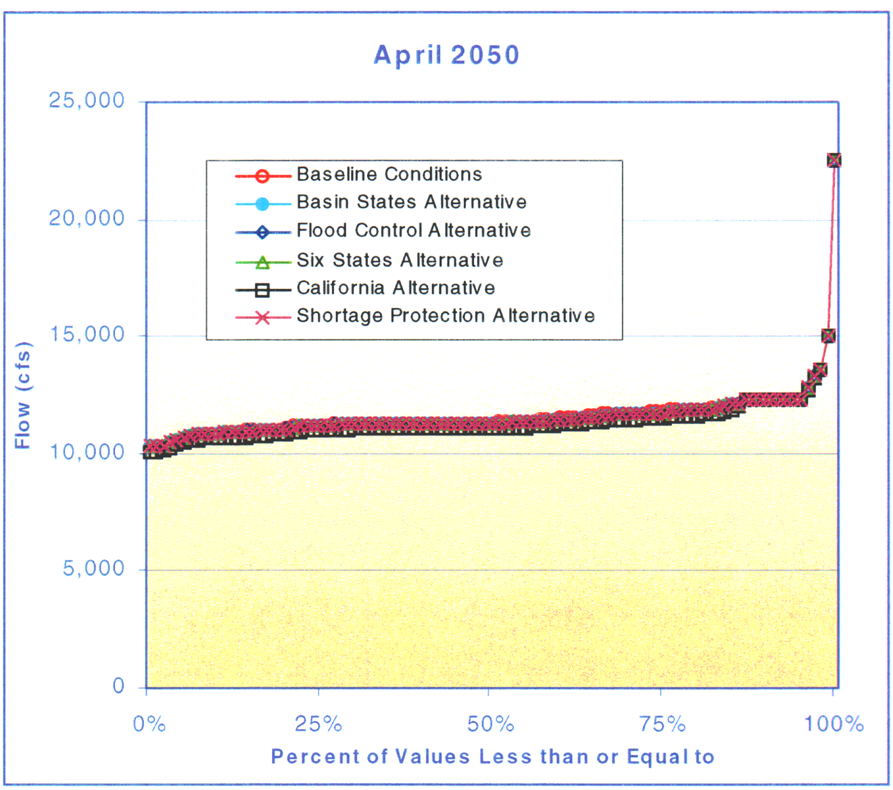
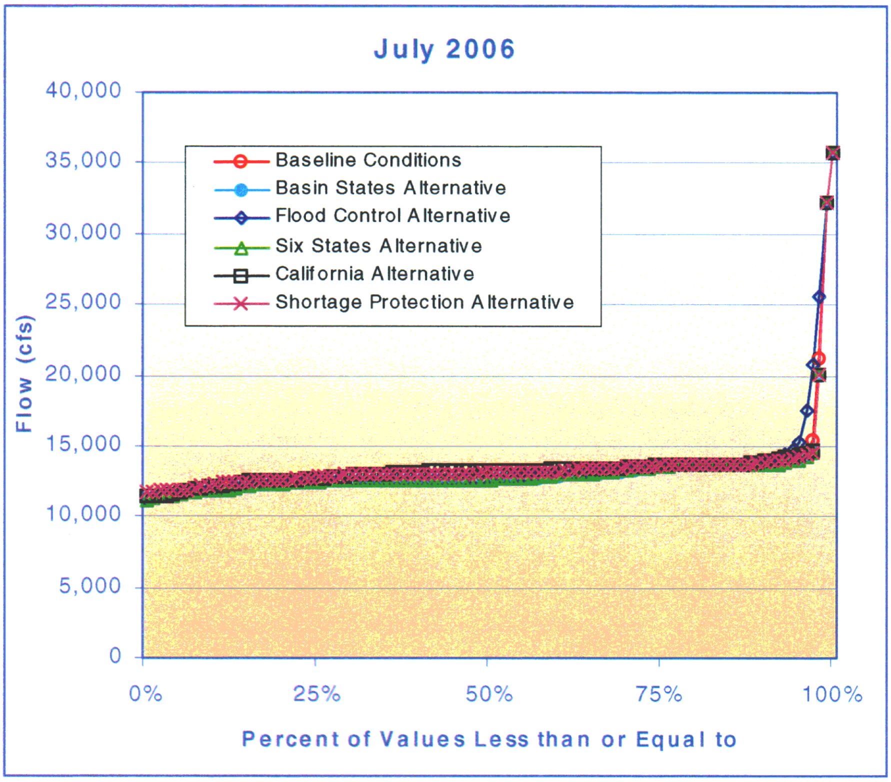


Figure N-7a
Colorado River Seasonal Flows Upstream of Colorado River Indian Reservation
Comparison of Surplus Alternatives to Baseline Conditions for
Modeled Years 2006 and 2016



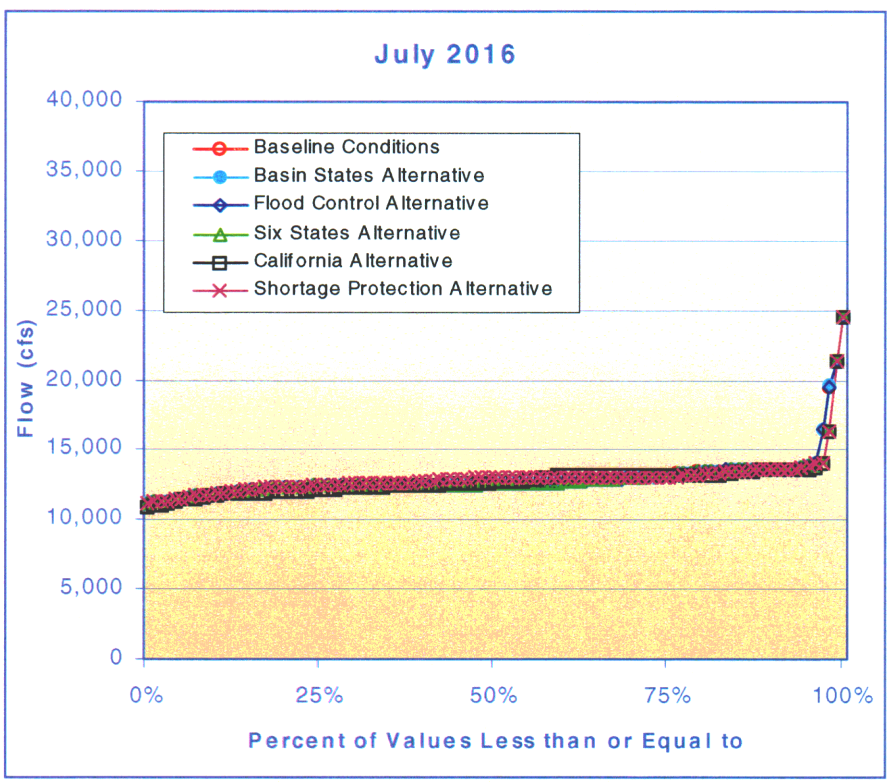
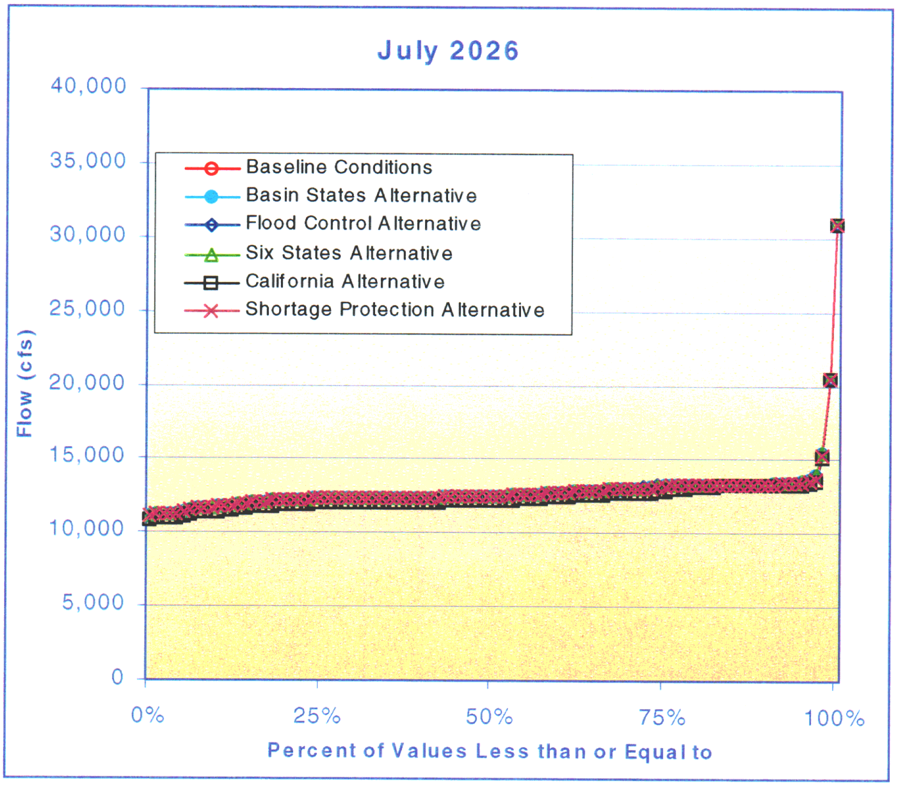


Figure N-7b
Colorado River Seasonal Flows Upstream of Colorado River Indian Reservation
Comparison of Surplus Alternatives to Baseline Conditions for
Modeled Years 2026 and 2050



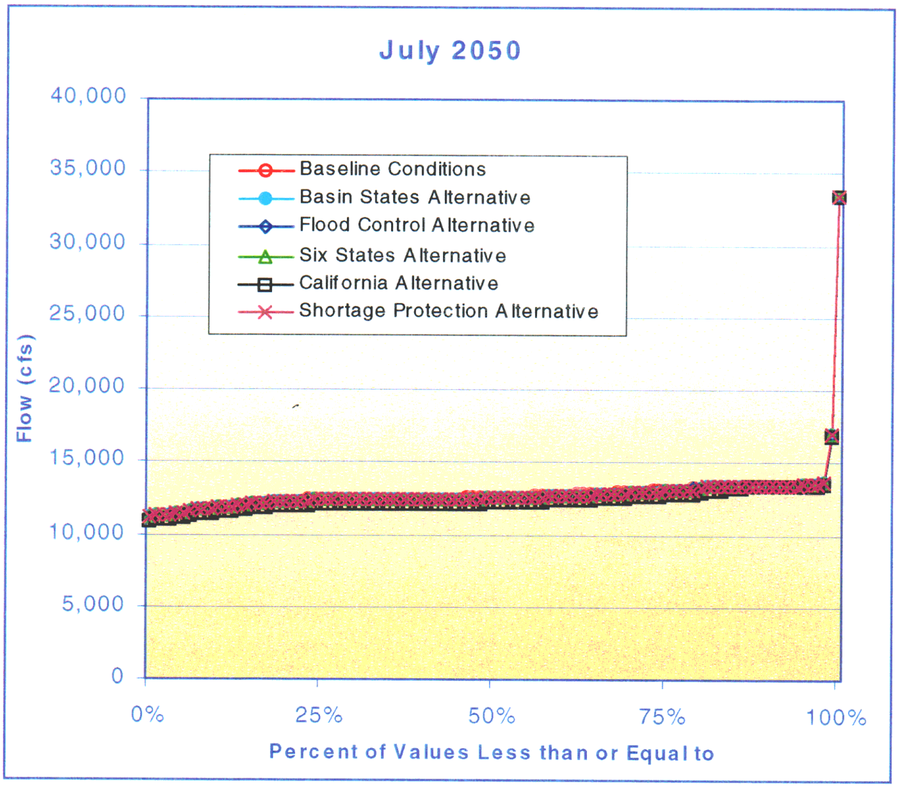
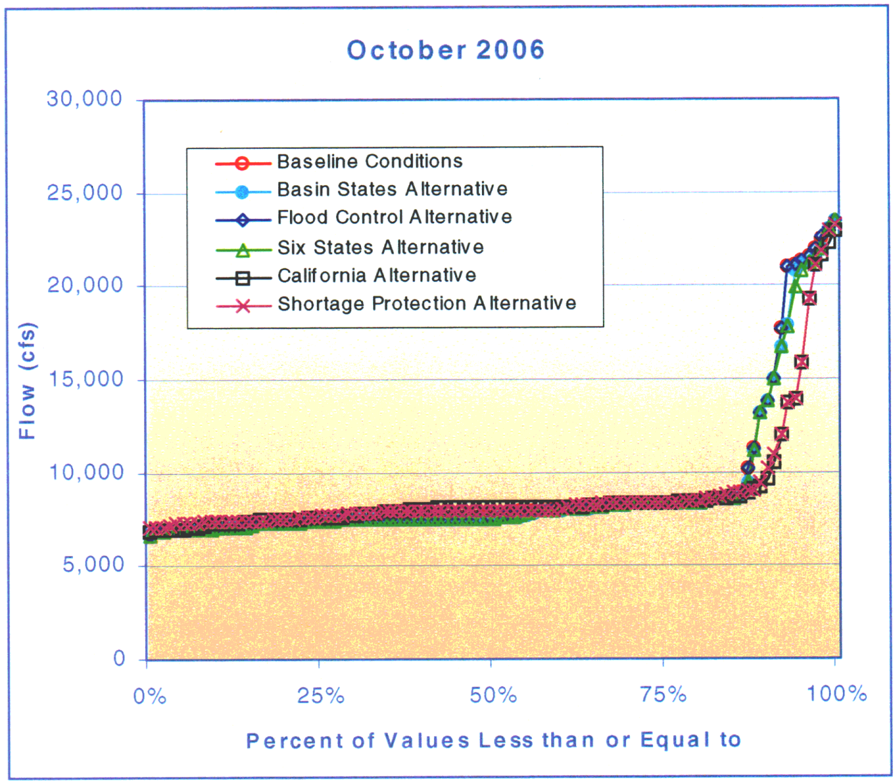


Figure N-8a
Colorado River Seasonal Flows Upstream of Colorado River Indian Reservation
Comparison of Surplus Alternatives to Baseline Conditions for
Modeled Years 2006 and 2016



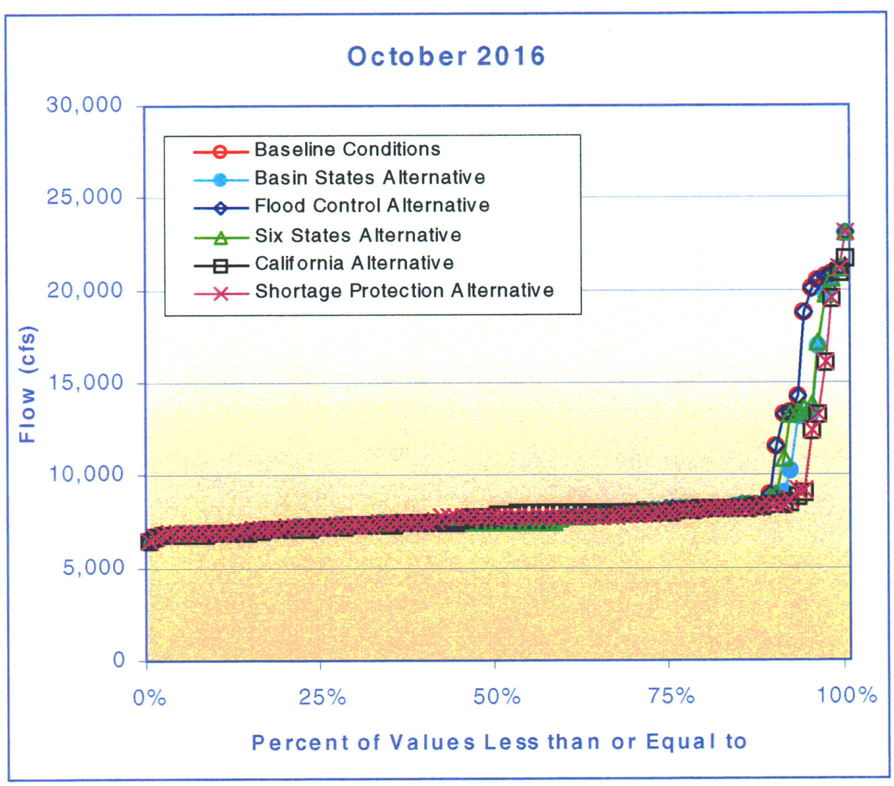
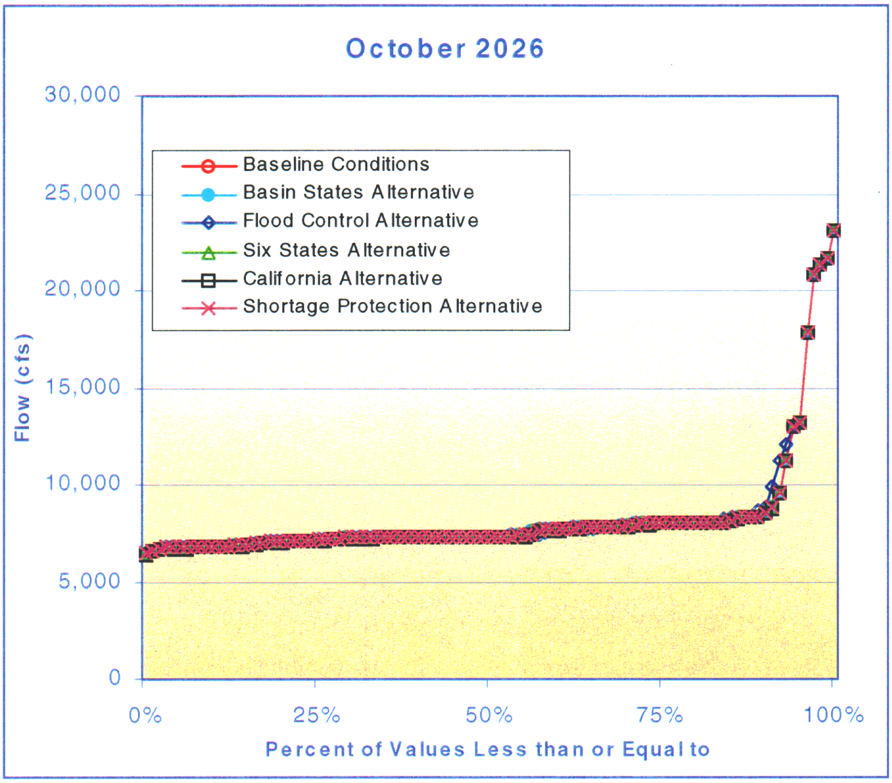


Figure N-8b
Colorado River Seasonal Flows Upstream of Colorado River Indian Reservation
Comparison of Surplus Alternatives to Baseline Conditions for
Modeled Years 2026 and 2050



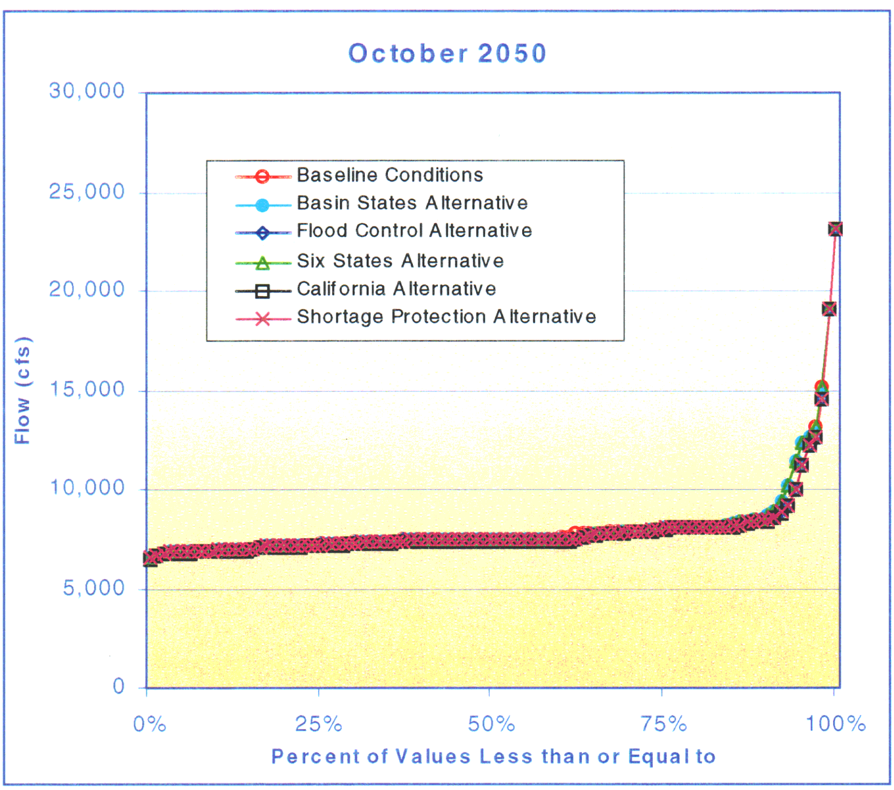
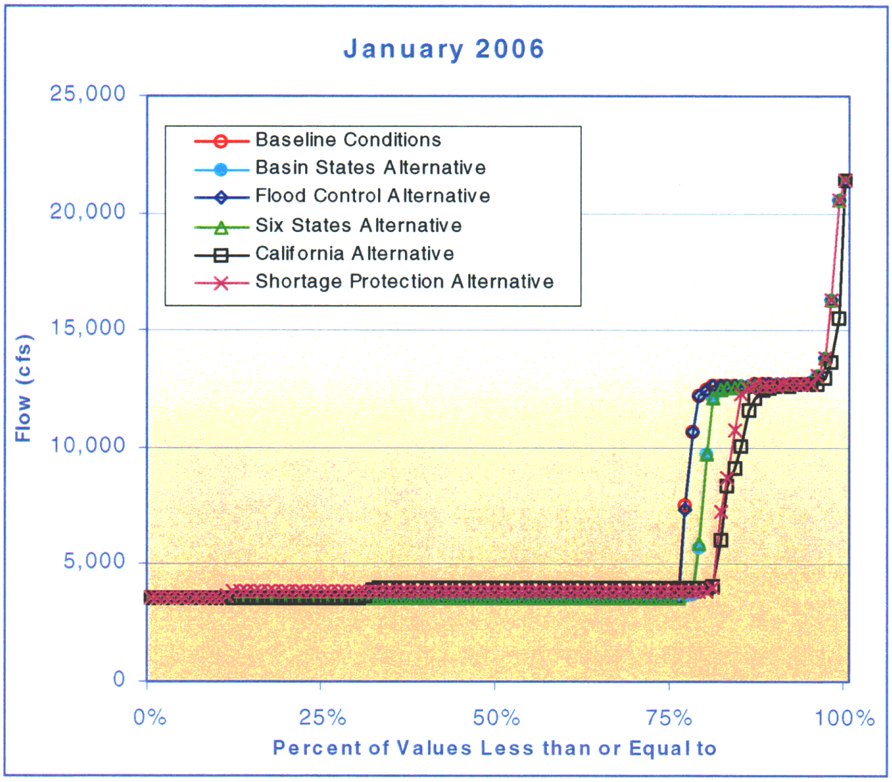


Figure N-9a
Colorado River Seasonal Flows Downstream of Palo Verde Diversion Dam
Comparison of Surplus Alternatives to Baseline Conditions for
Modeled Years 2006 and 2016



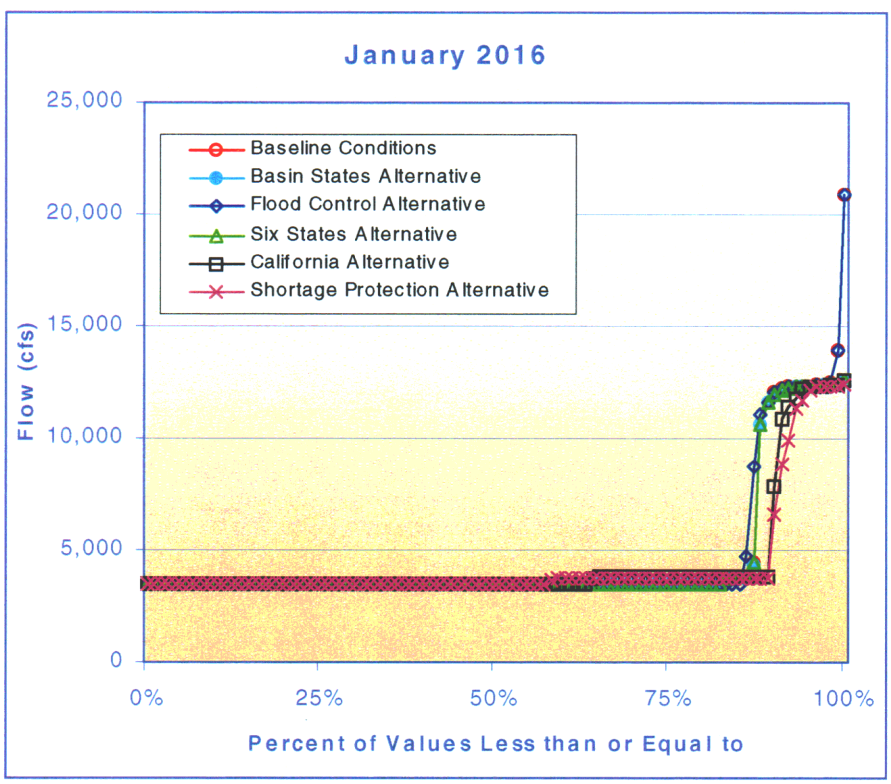
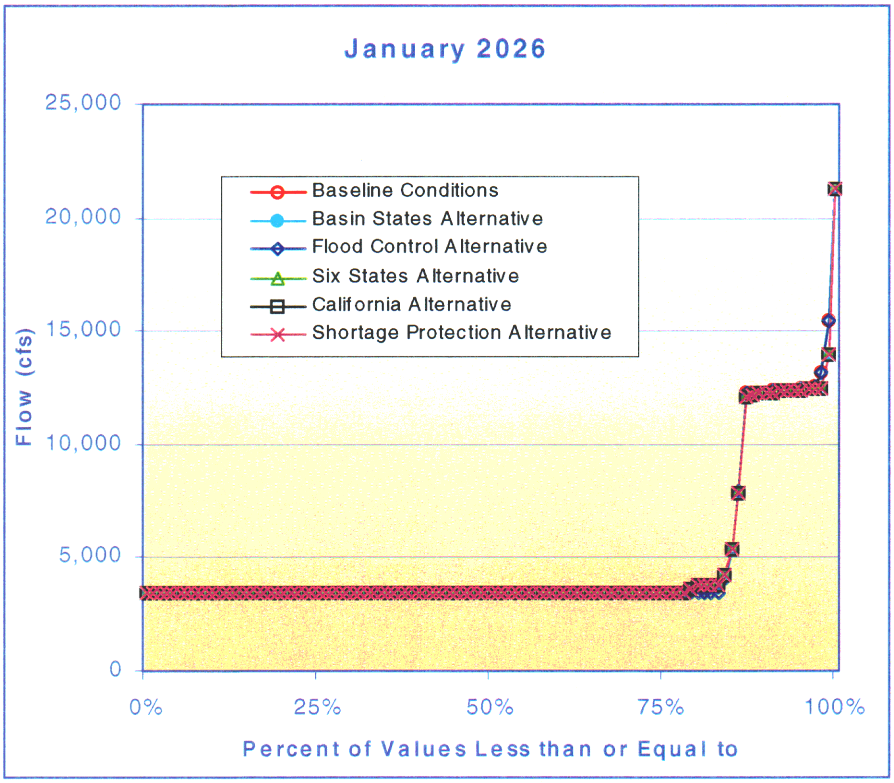


Figure N-9b
Colorado River Seasonal Flows Downstream of Palo Verde Diversion Dam
Comparison of Surplus Alternatives to Baseline Conditions for
Modeled Years 2026 and 2050



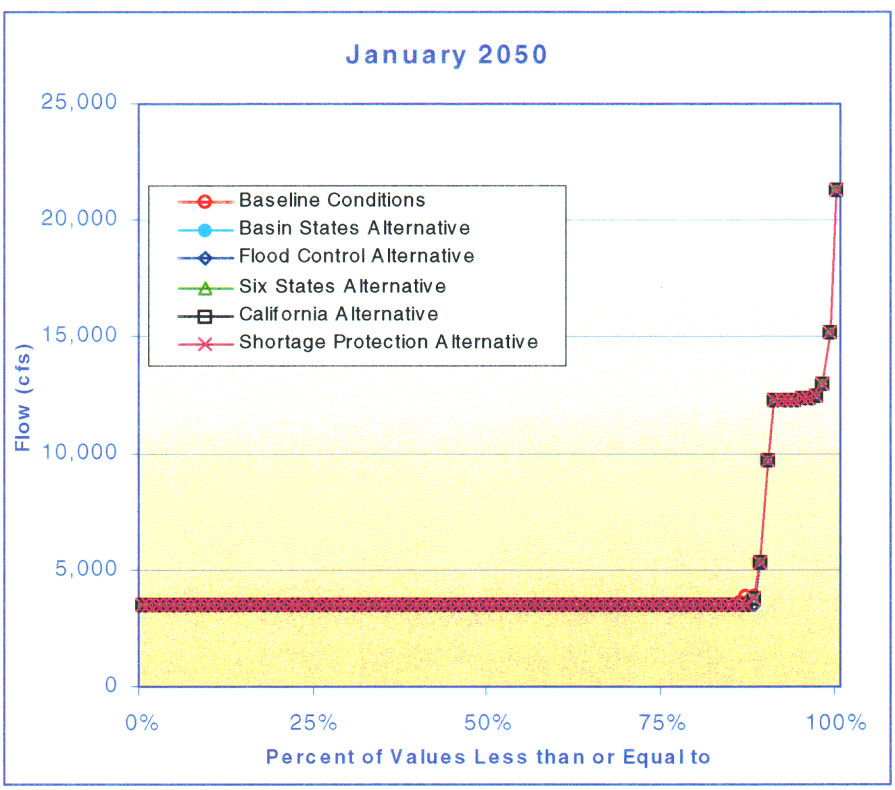
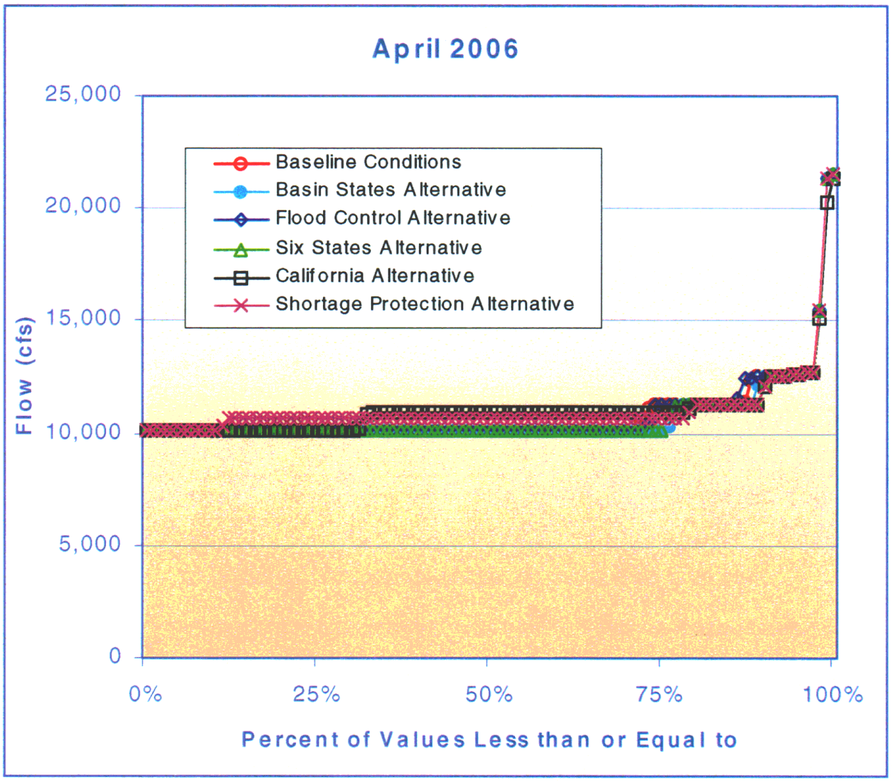


Figure N-10a
Colorado River Seasonal Flows Downstream of Diversion Dam
Comparison of Surplus Alternatives to Baseline Conditions for Modeled Years 2006 and 2016



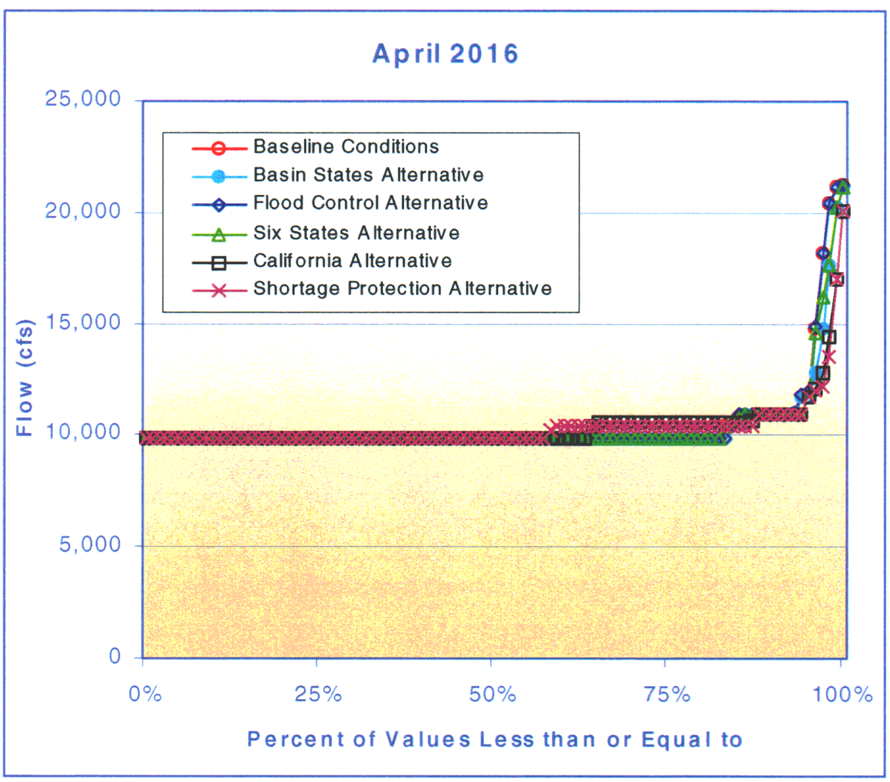
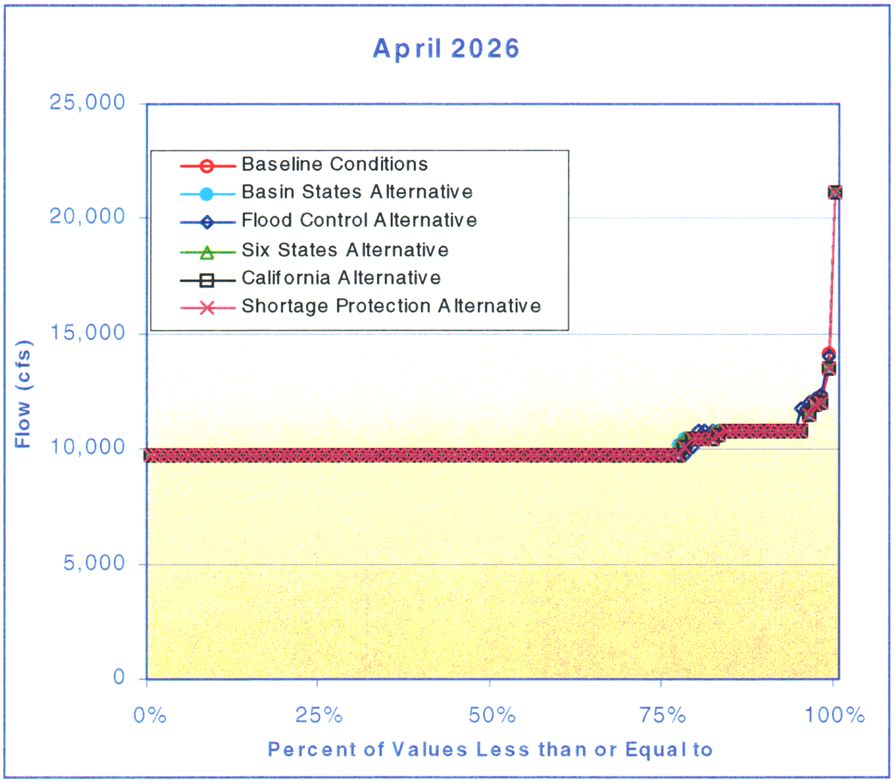


Figure N-10b
Colorado River Seasonal Flows Downstream of Palo Verde Diversion Dam
Comparison of Surplus Alternatives to Baseline Conditions for
Modeled Years 2026 and 2050



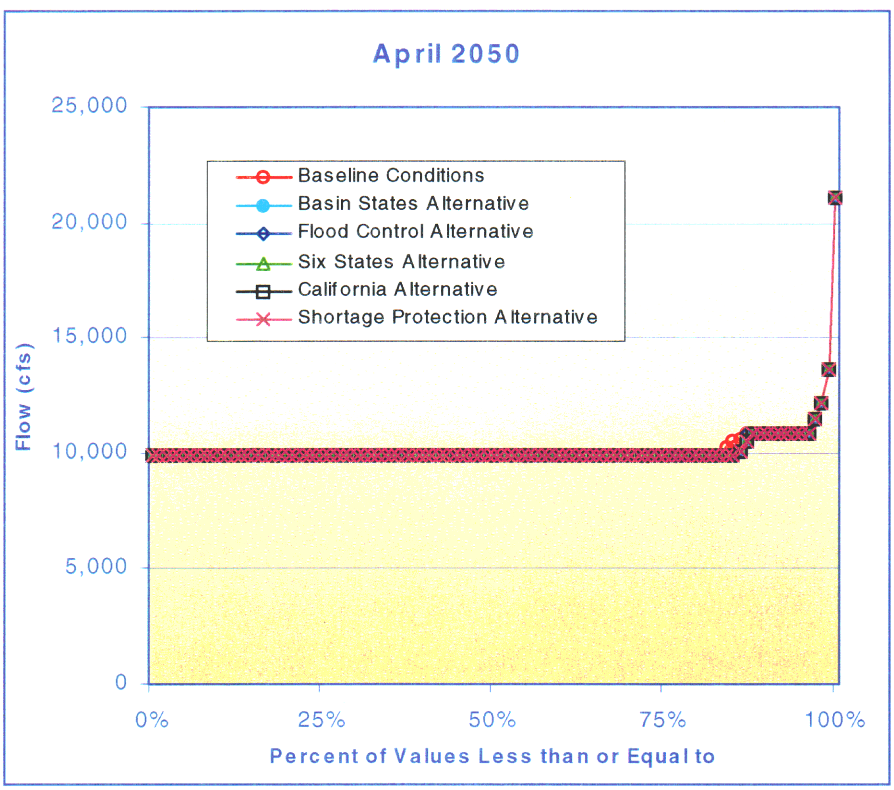
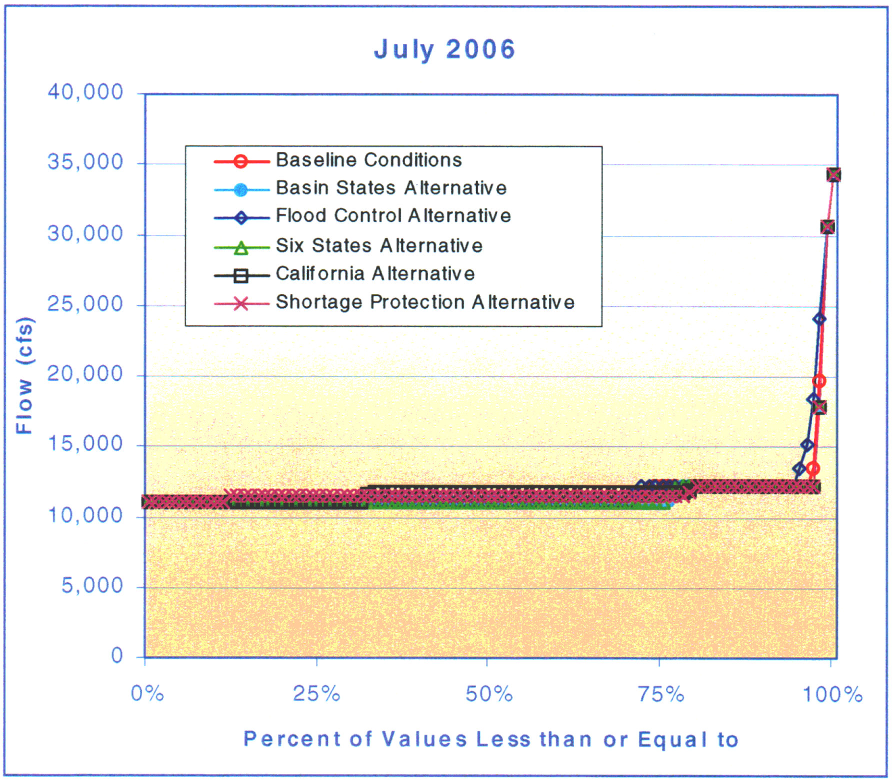


Figure N-11a
Colorado River Seasonal Flows Downstream of Palo Verde Diversion Dam
Comparison of Surplus Alternatives to Baseline Conditions for
Modeled Years 2006 and 2016



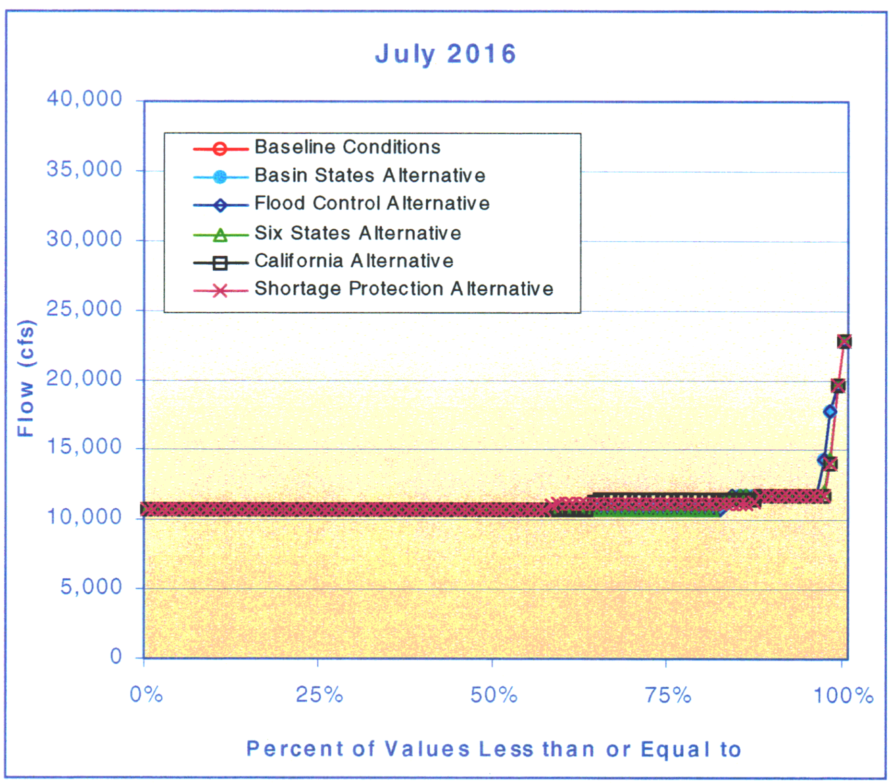
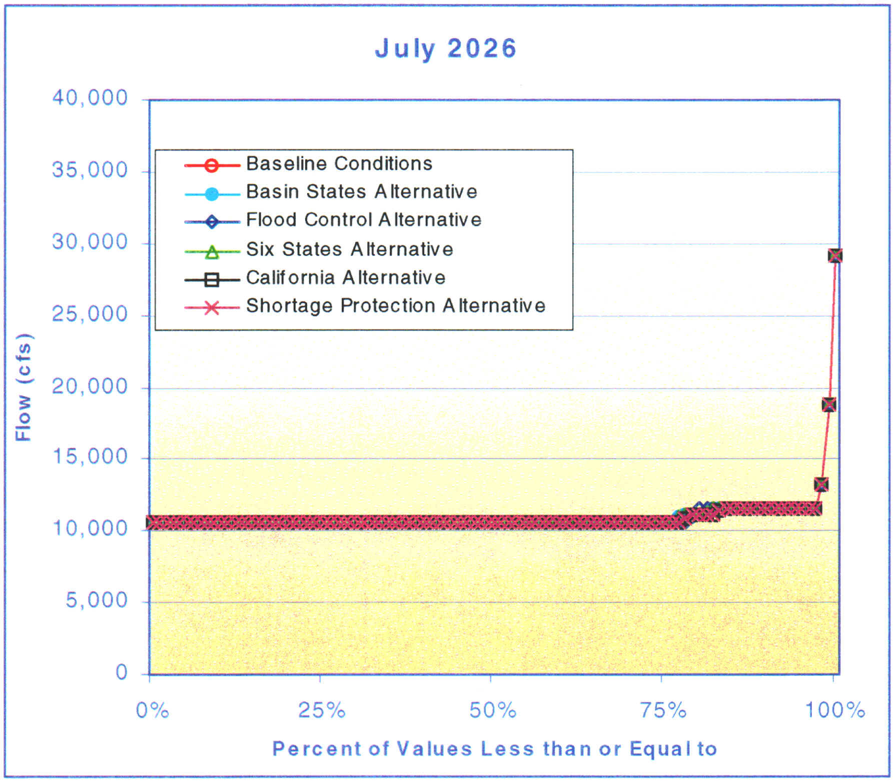


Figure N-11b
Colorado River Seasonal Flows Downstream of Palo Verde Diversion Dam
Comparison of Surplus Alternatives to Baseline Conditions for
Modeled Years 2026 and 2050



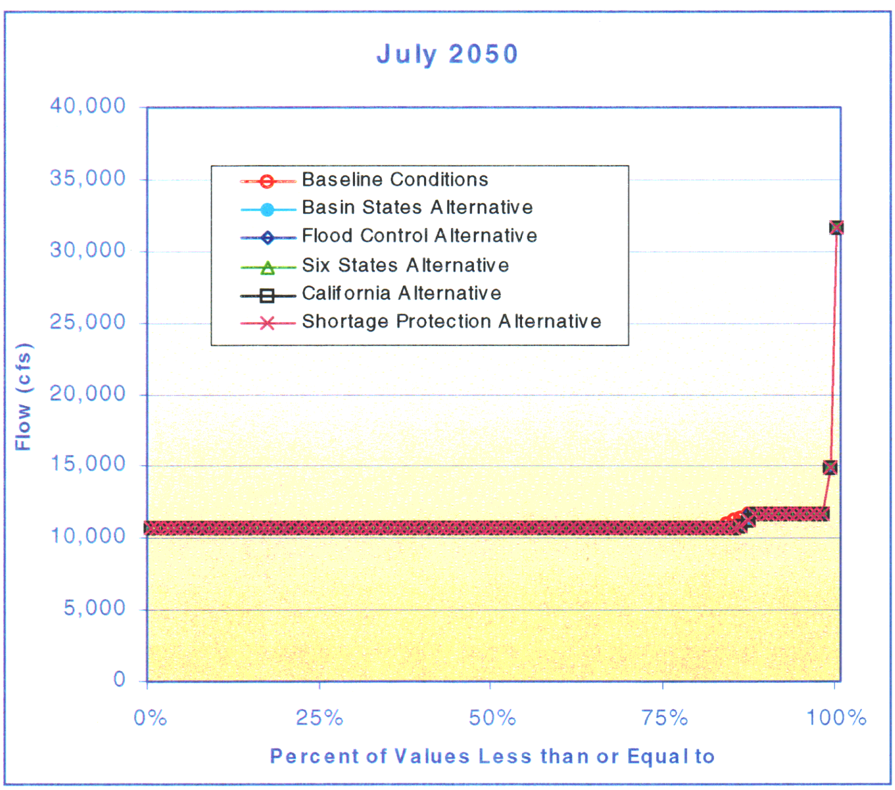


Figure N-12a
Colorado River Seasonal Flows Downstream of Palo Verde Diversion Dam
Comparison of Surplus Alternatives to Baseline Conditions for
Modeled Years 2006 and 2016

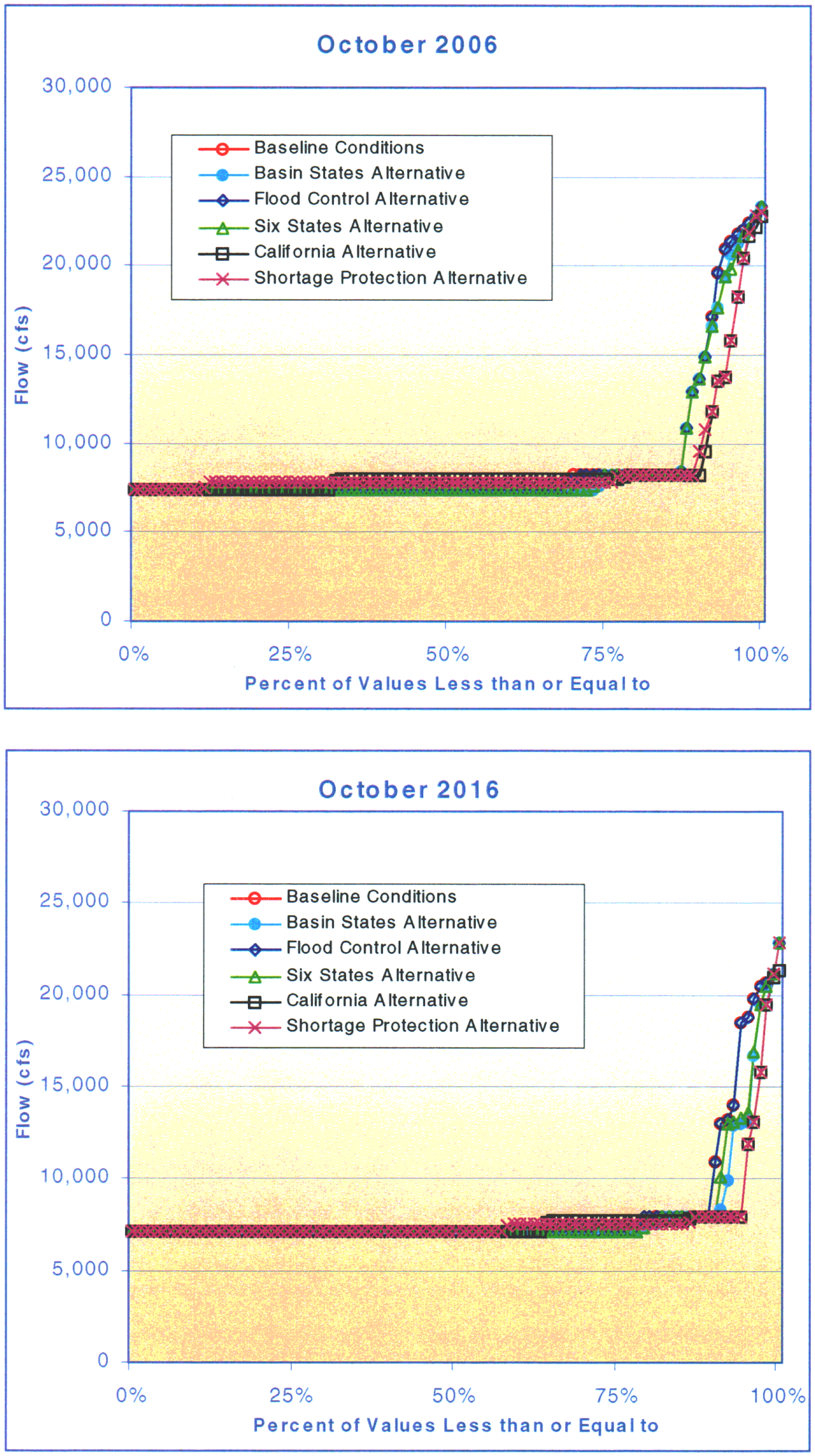
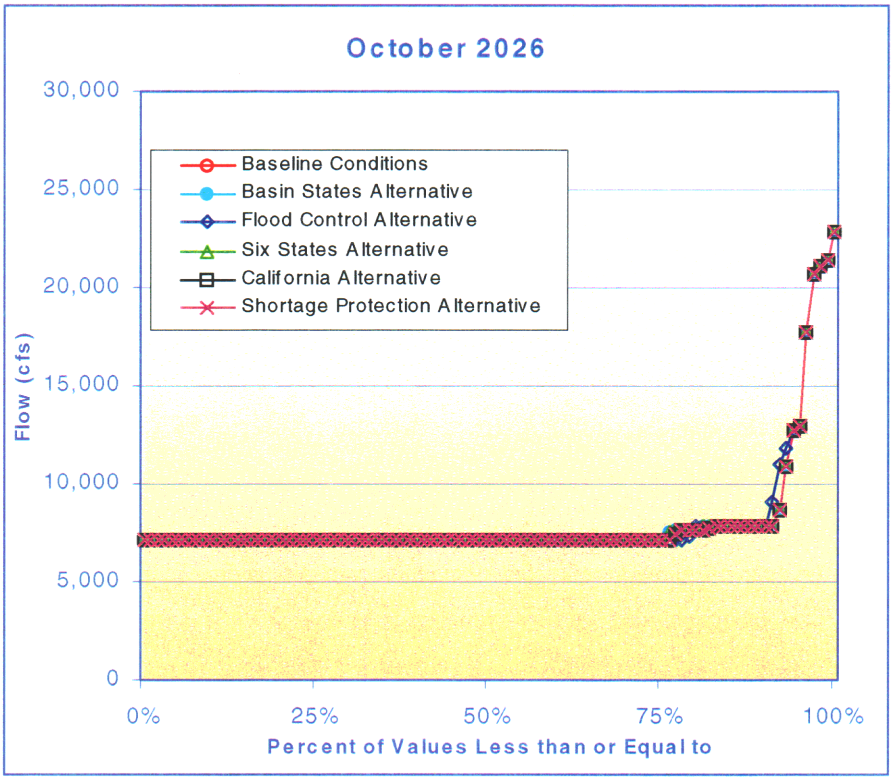


Figure N-12b
Colorado River Seasonal Flows Downstream of Palo Verde Diversion Dam
Comparison of Surplus Alternatives to Baseline Conditions for
Modeled Years 2026 and 2050



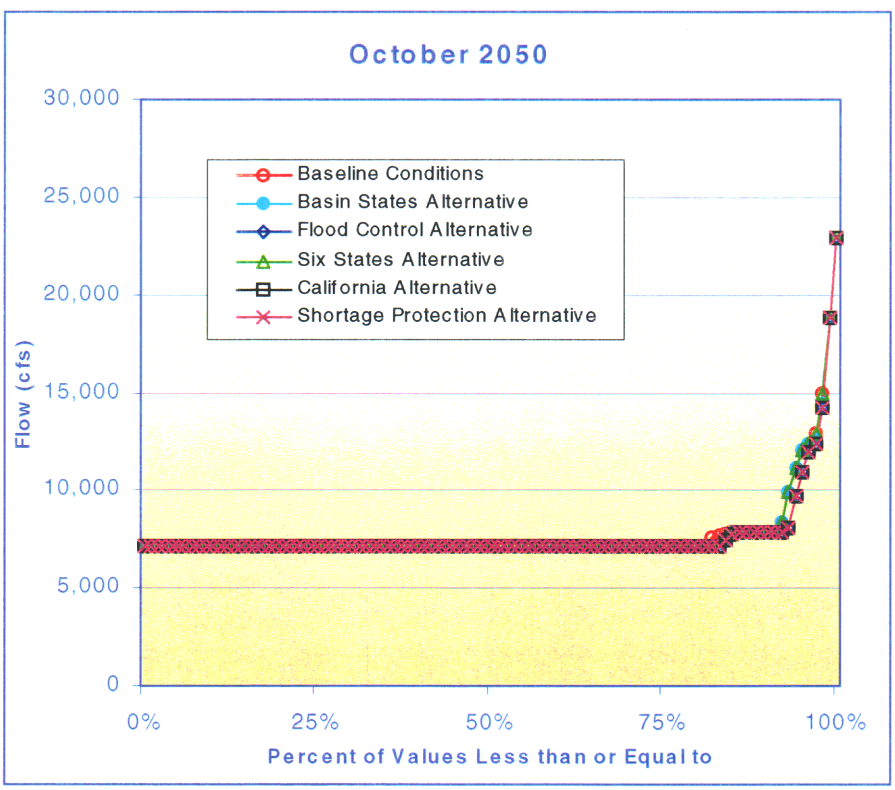
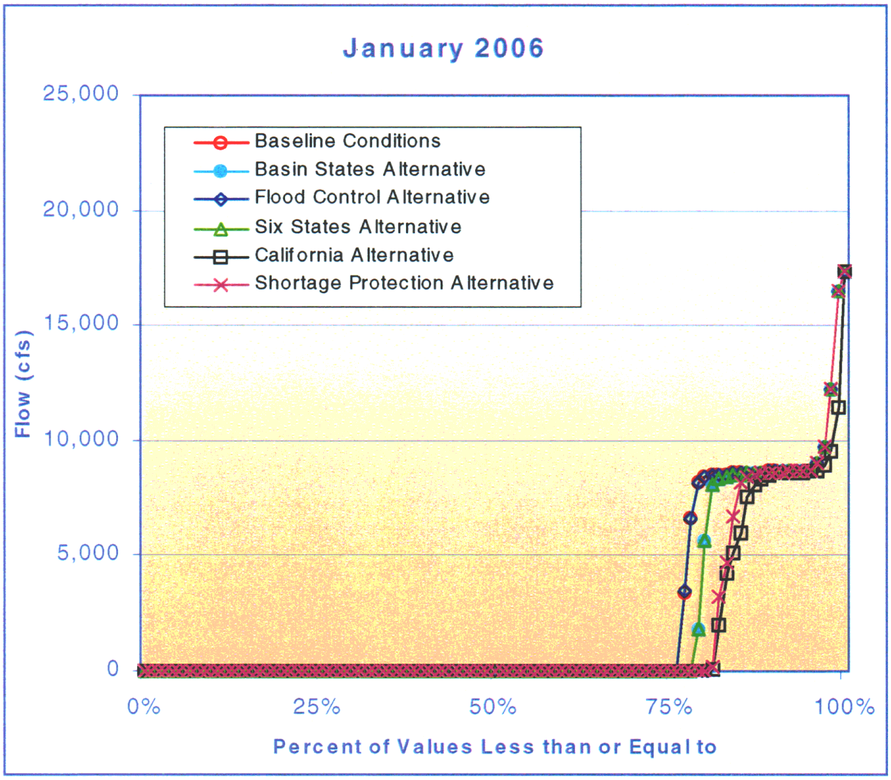


Figure N-13a
Colorado River Seasonal Flows Below Mexico Diversion at Morelos Dam
Comparison of Surplus Alternatives to Baseline Conditions for
Modeled Years 2006 and 2016



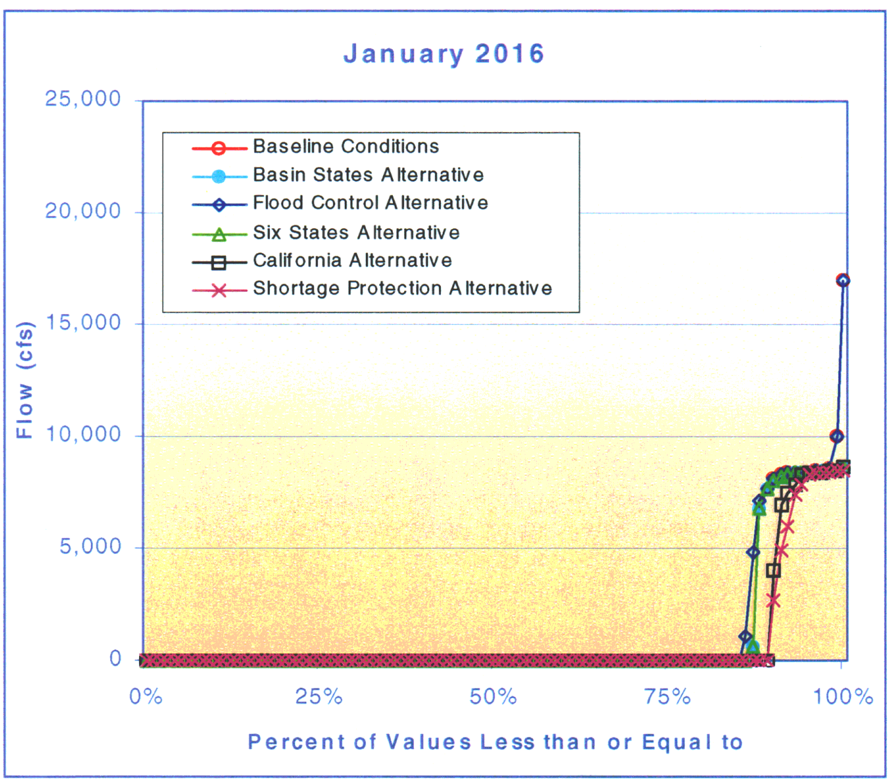
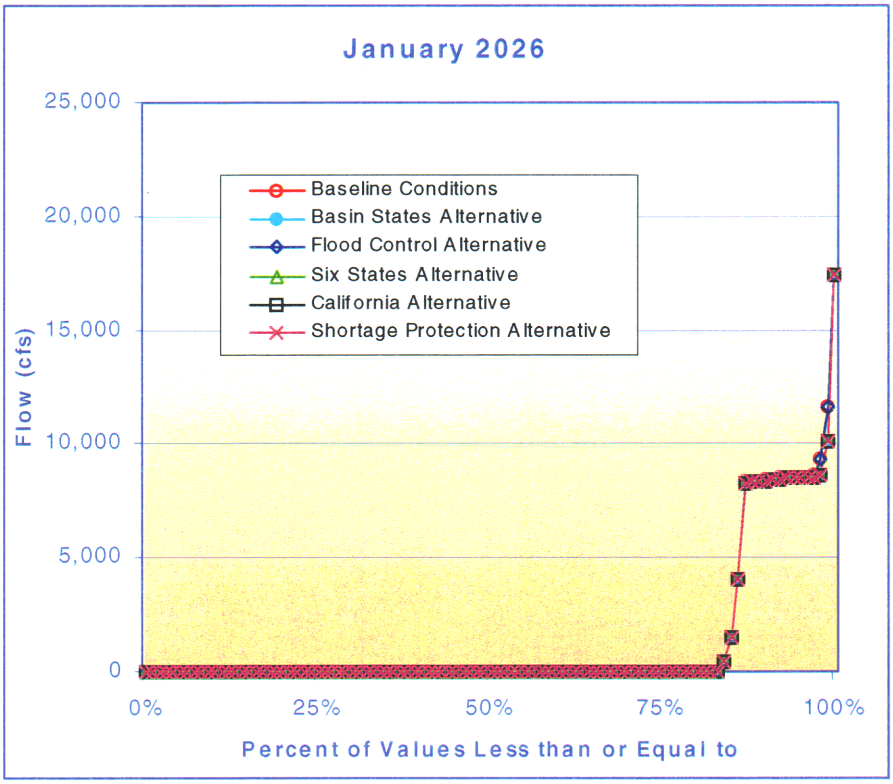


Figure N-13b
Colorado River Seasonal Flows Below Mexico Diversion at Morelos Dam
Comparison of Surplus Alternatives to Baseline Conditions for
Modeled Years 2026 and 2050



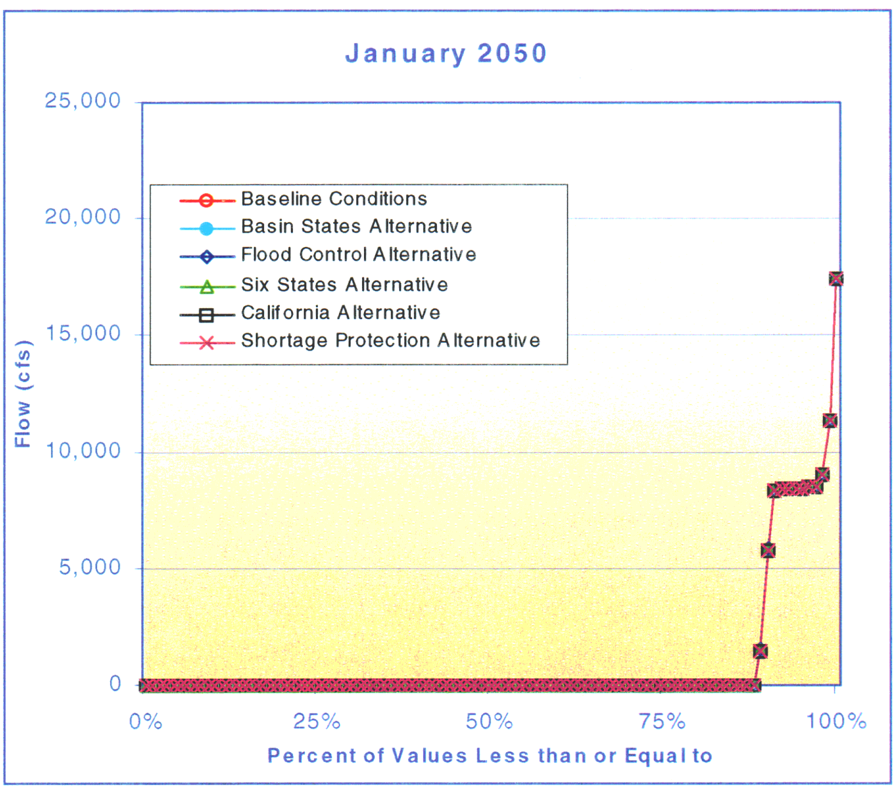
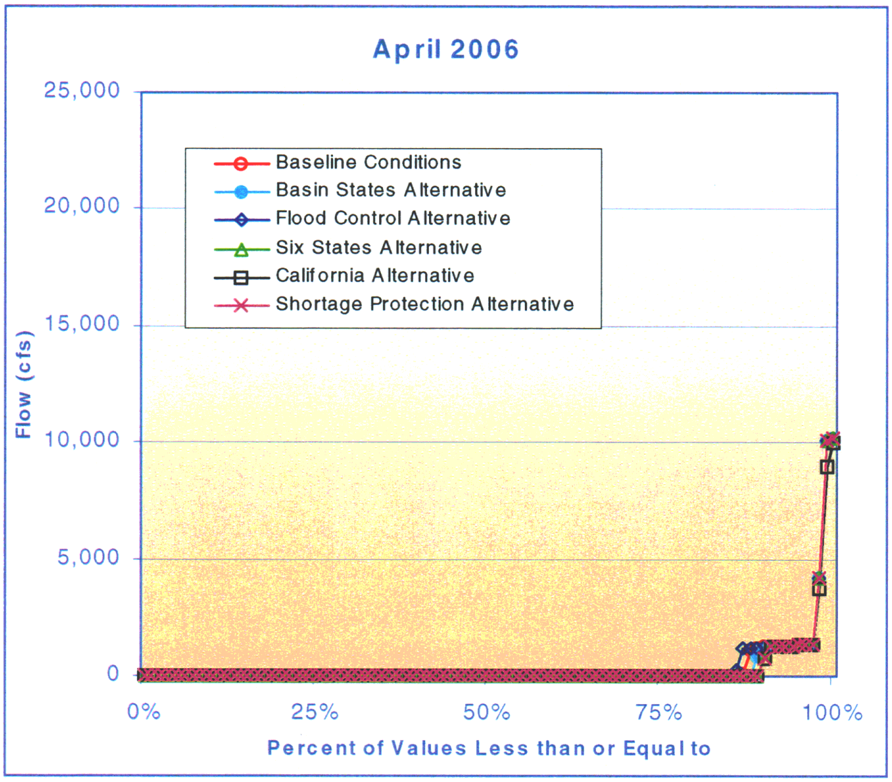


Figure N-14a
Colorado River Seasonal Flows Below Mexico Diversion at Morelos Dam
Comparison of Surplus Alternatives to Baseline Conditions for
Modeled Years 2006 and 2016



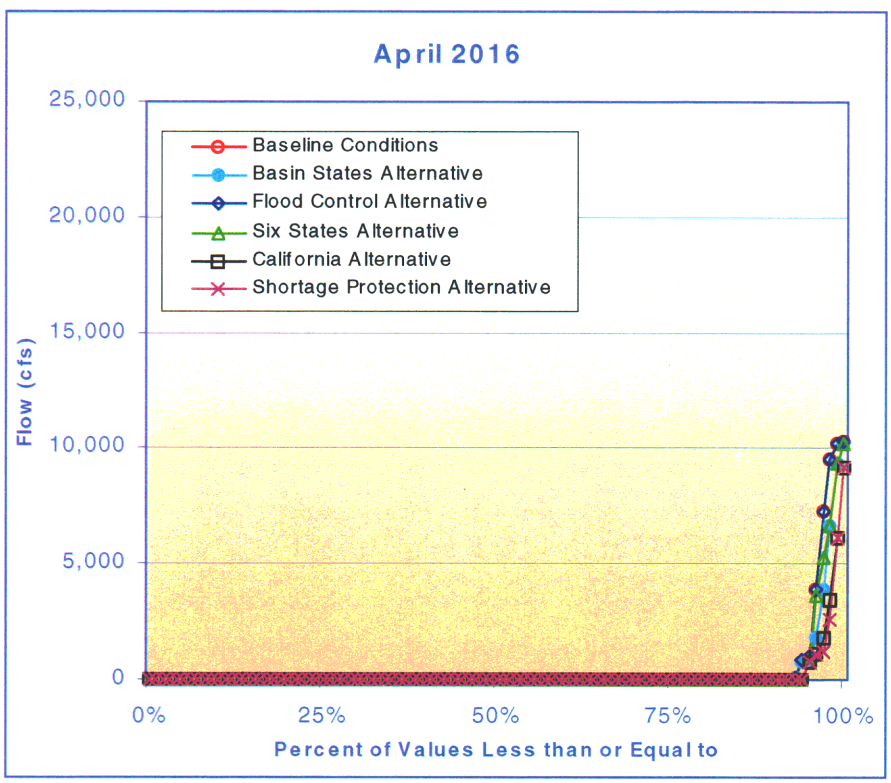
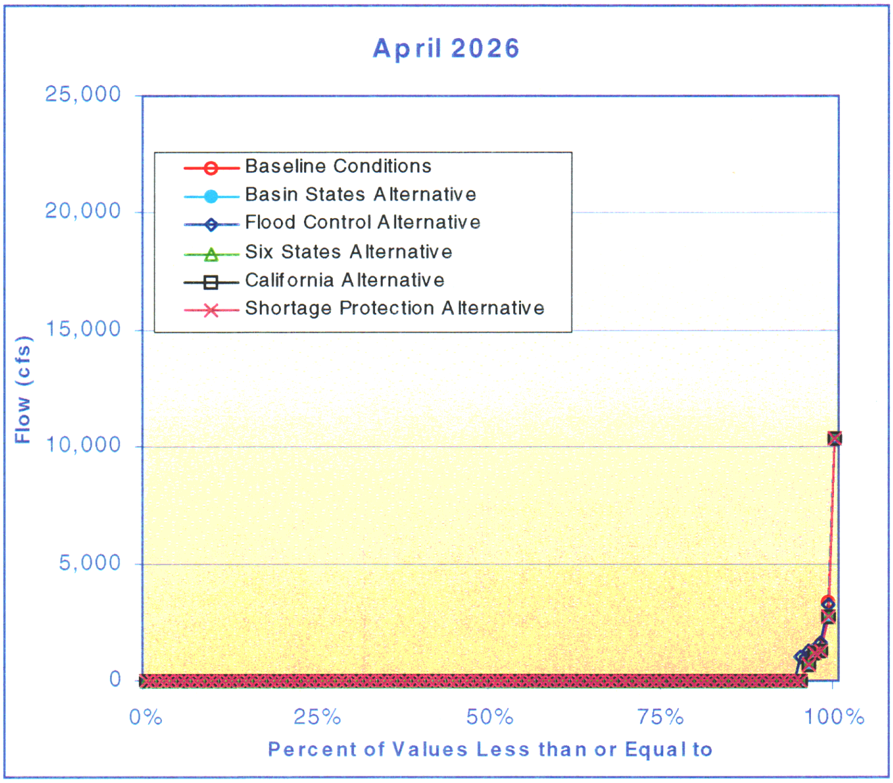


Figure N-14b
Colorado River Seasonal Flows Below Mexico Diversion at Morelos Dam
Comparison of Surplus Alternatives to Baseline Conditions for
Modeled Years 2026 and 2050



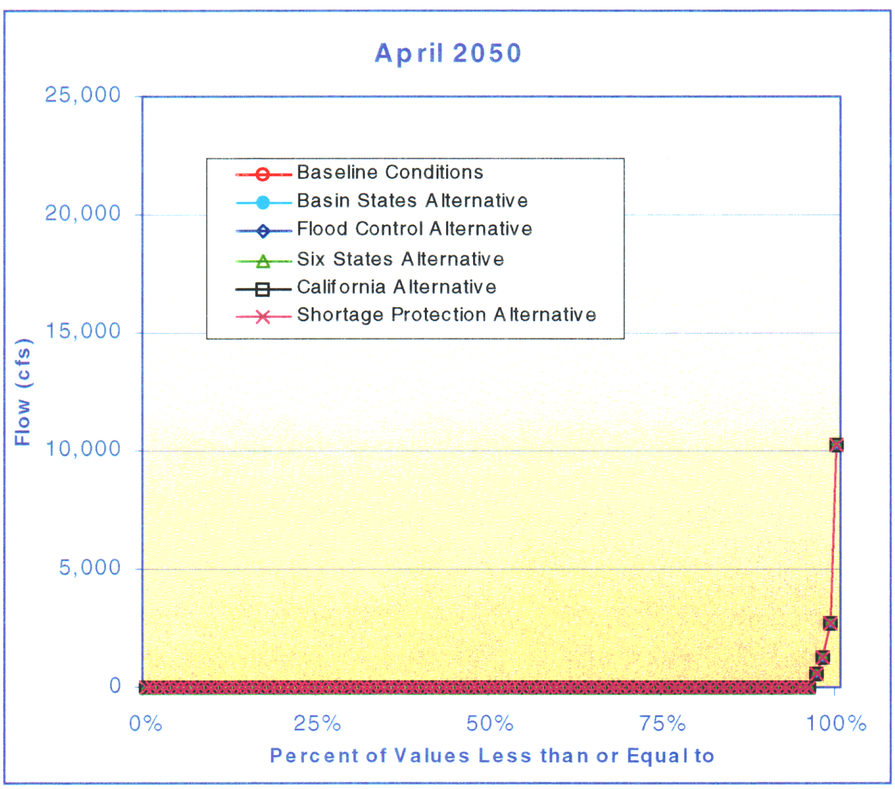
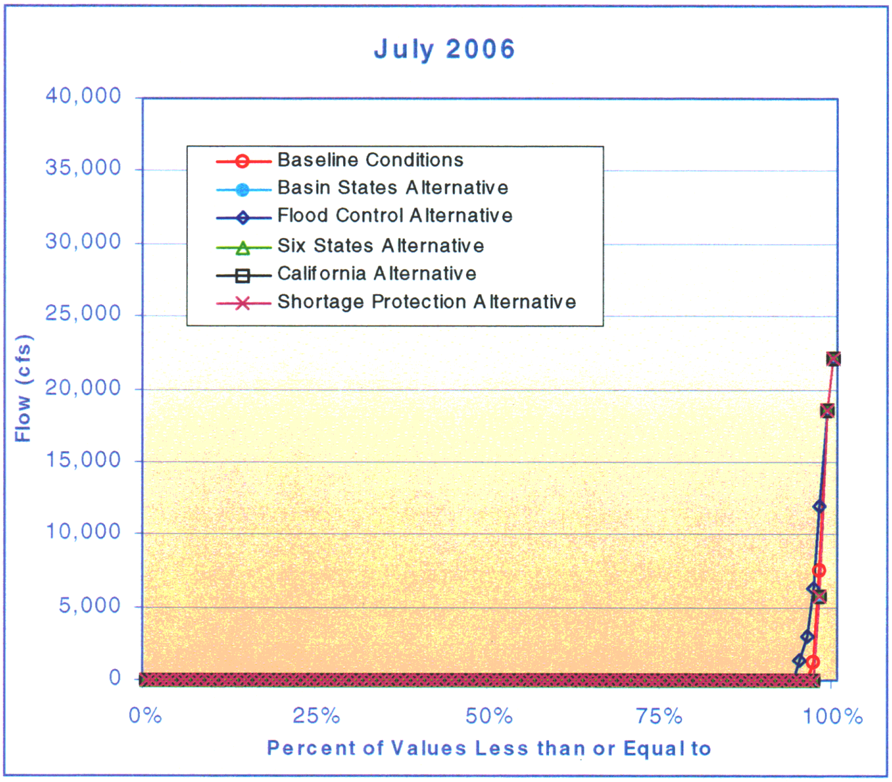


Figure N-15a
Colorado River Seasonal Flows Below Mexico Diversion at Morelos Dam
Comparison of Surplus Alternatives to Baseline Conditions for
Modeled Years 2006 and 2016



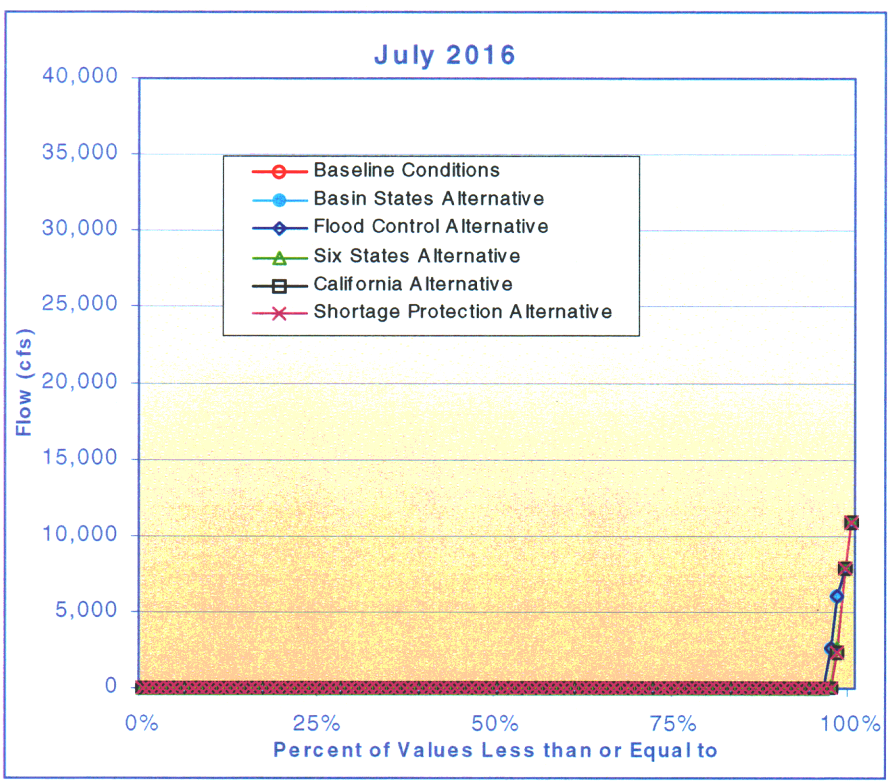
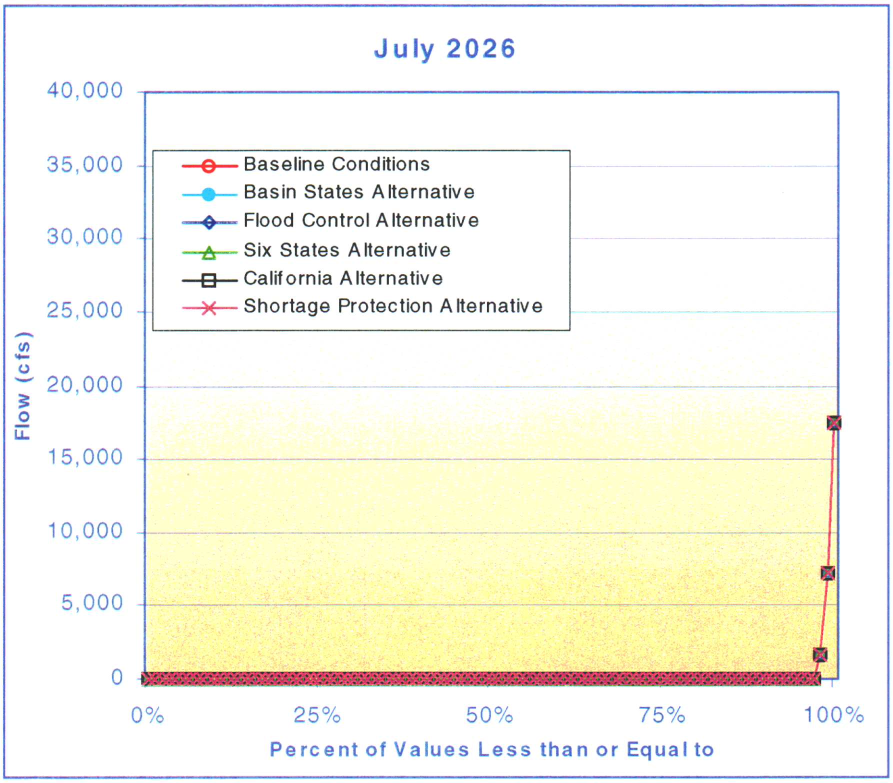


Figure N-15b
Colorado River Seasonal Flows Below Mexico Diversion at Morelos Dam
Comparison of Surplus Alternatives to Baseline Conditions for
Modeled Years 2026 and 2050



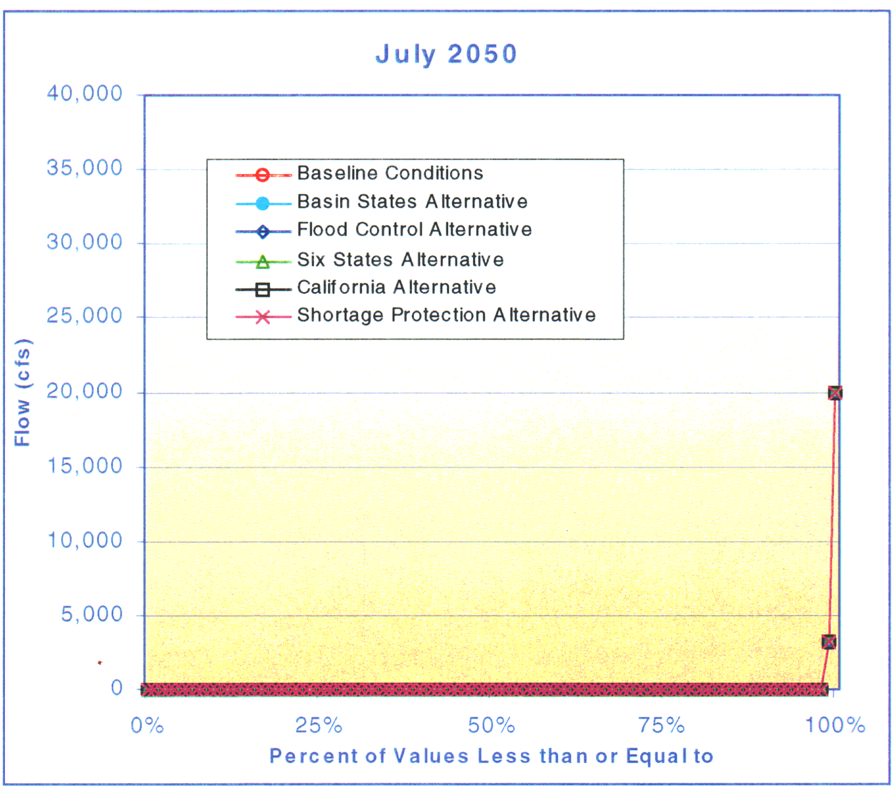


Figure N-16a
Colorado River Seasonal Flows Below Mexico Diversion at Morelos Dam
Comparison of Surplus Alternatives to Baseline Conditions for
Modeled Years 2006 and 2016

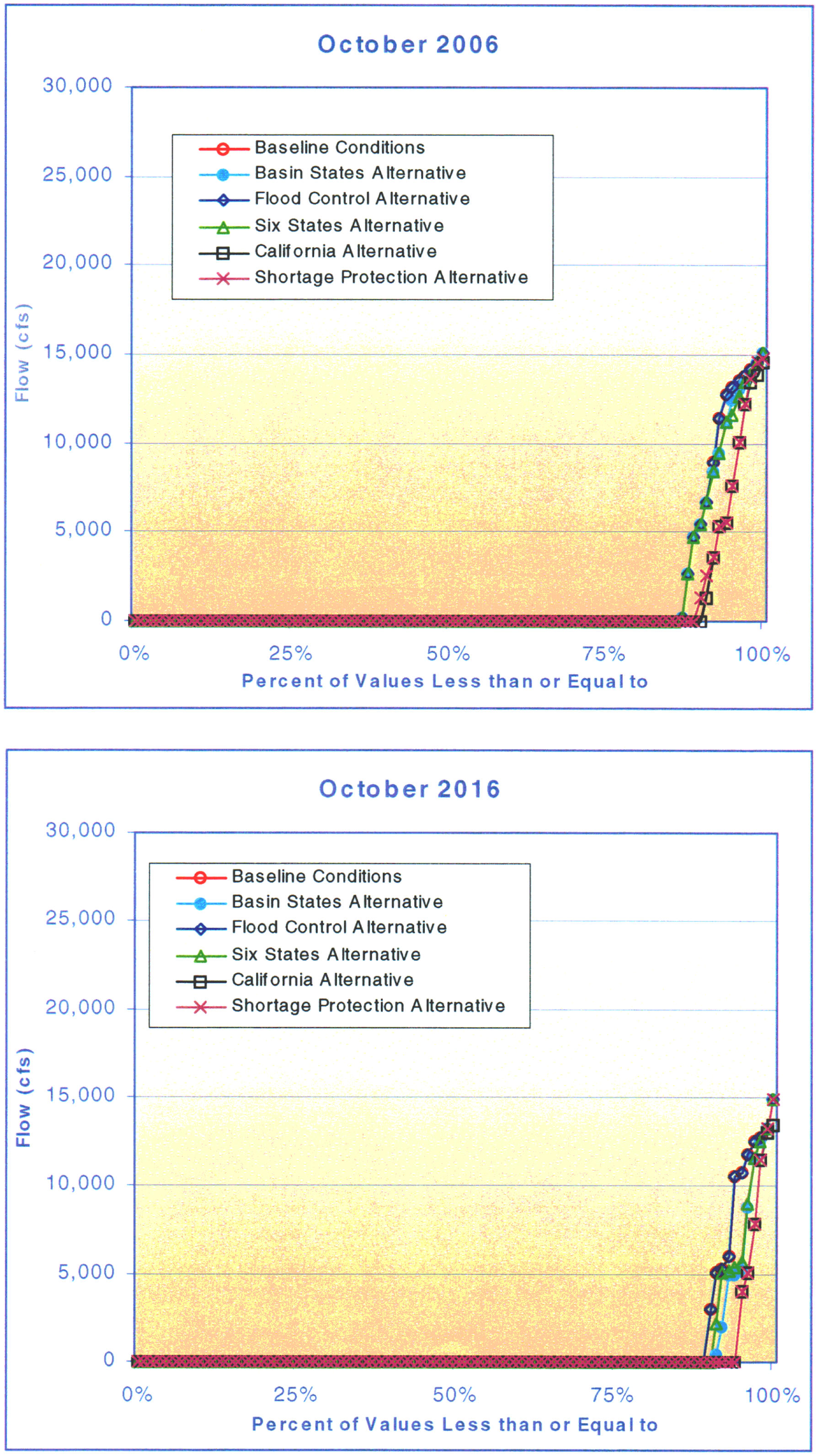
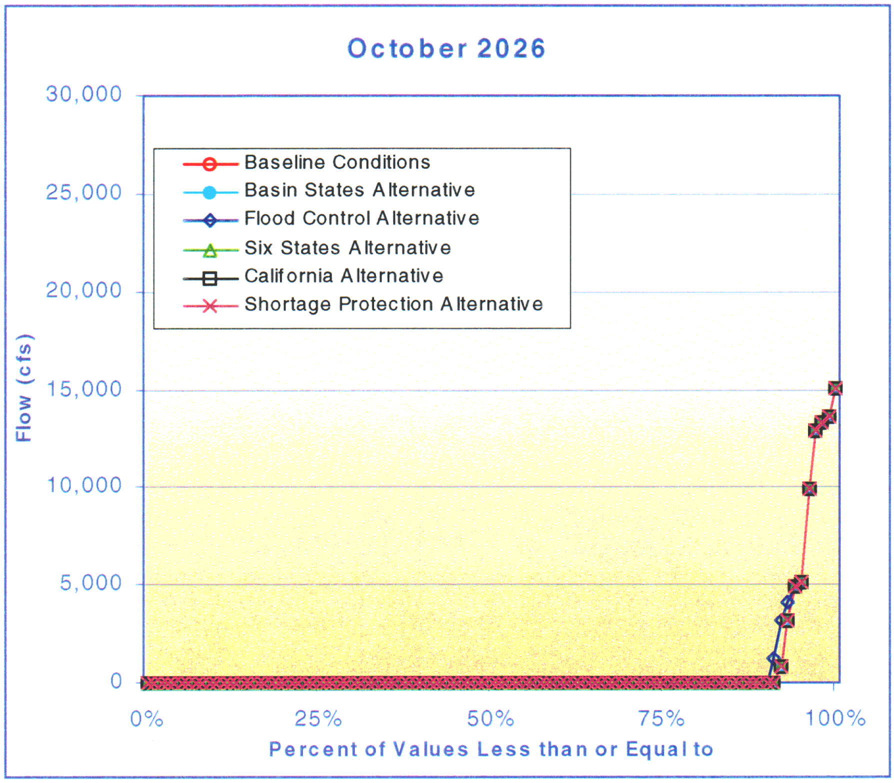
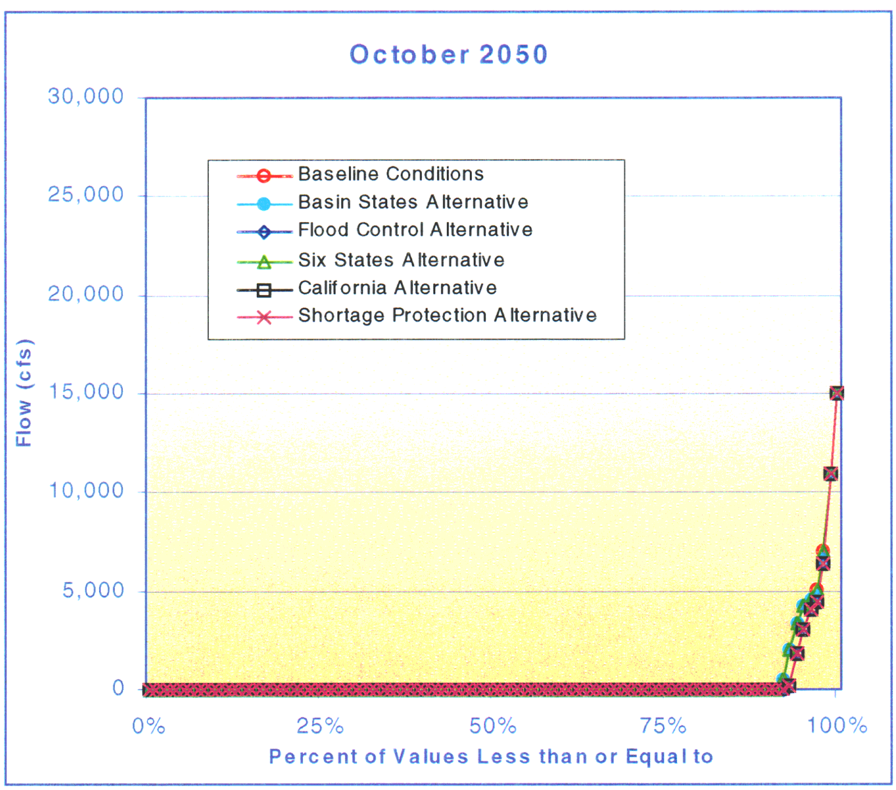


Figure N-16b
Colorado River Seasonal Flows Below Mexico Diversion at Morelos Dam
Comparison of Surplus Alternatives to Baseline Conditions for
Modeled Years 2026 and 2050





ATTACHMENT O

Water Supply for Lower Division States

This attachment presents additional plots of the projected amounts of water that would be available to each Lower Division state under baseline conditions and the interim surplus criteria alternatives. The plots show, for each year, the annual amount available (depletions) under the maximum; 90th, 50th, and 10th percentiles; and minimum values as discussed in Section 3.4, Water Supply.

Index of State Depletion Plots	
Figure	**Title**
O-1	Arizona Modeled Annual Depletions Under Baseline Conditions
O-2	Arizona Modeled Annual Depletions Under Basin States Alternative
O-3	Arizona Modeled Annual Depletions Under Flood Control Alternative
O-4	Arizona Modeled Annual Depletions Under Six States Alternative
O-5	Arizona Modeled Annual Depletions Under California Alternative
O-6	Arizona Modeled Annual Depletions Under Shortage Protection Alternative
O-7	California Modeled Annual Depletions Under Baseline Conditions
O-8	California Modeled Annual Depletions Under Basin States Alternative
O-9	California Modeled Annual Depletions Under Flood Control Alternative
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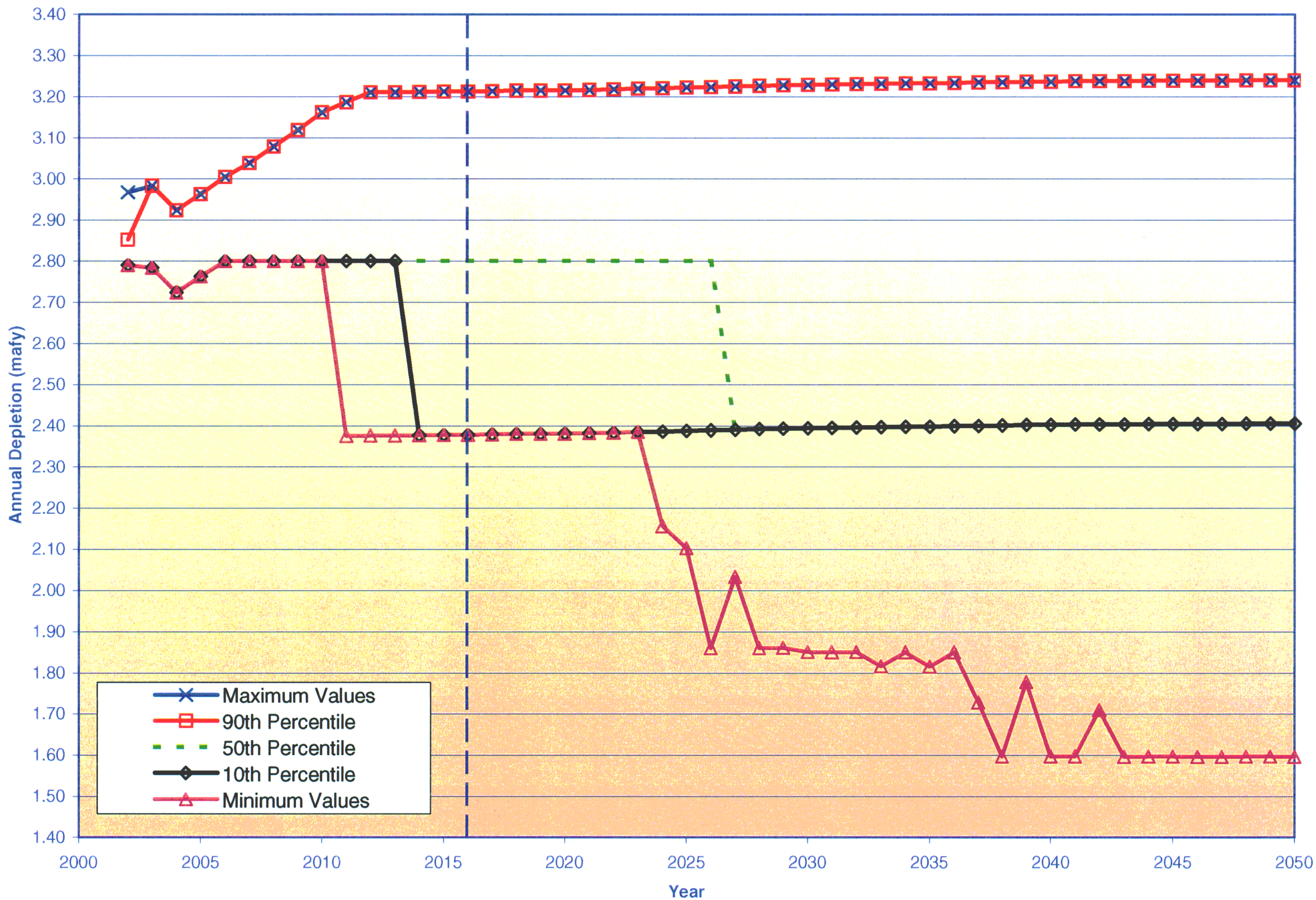
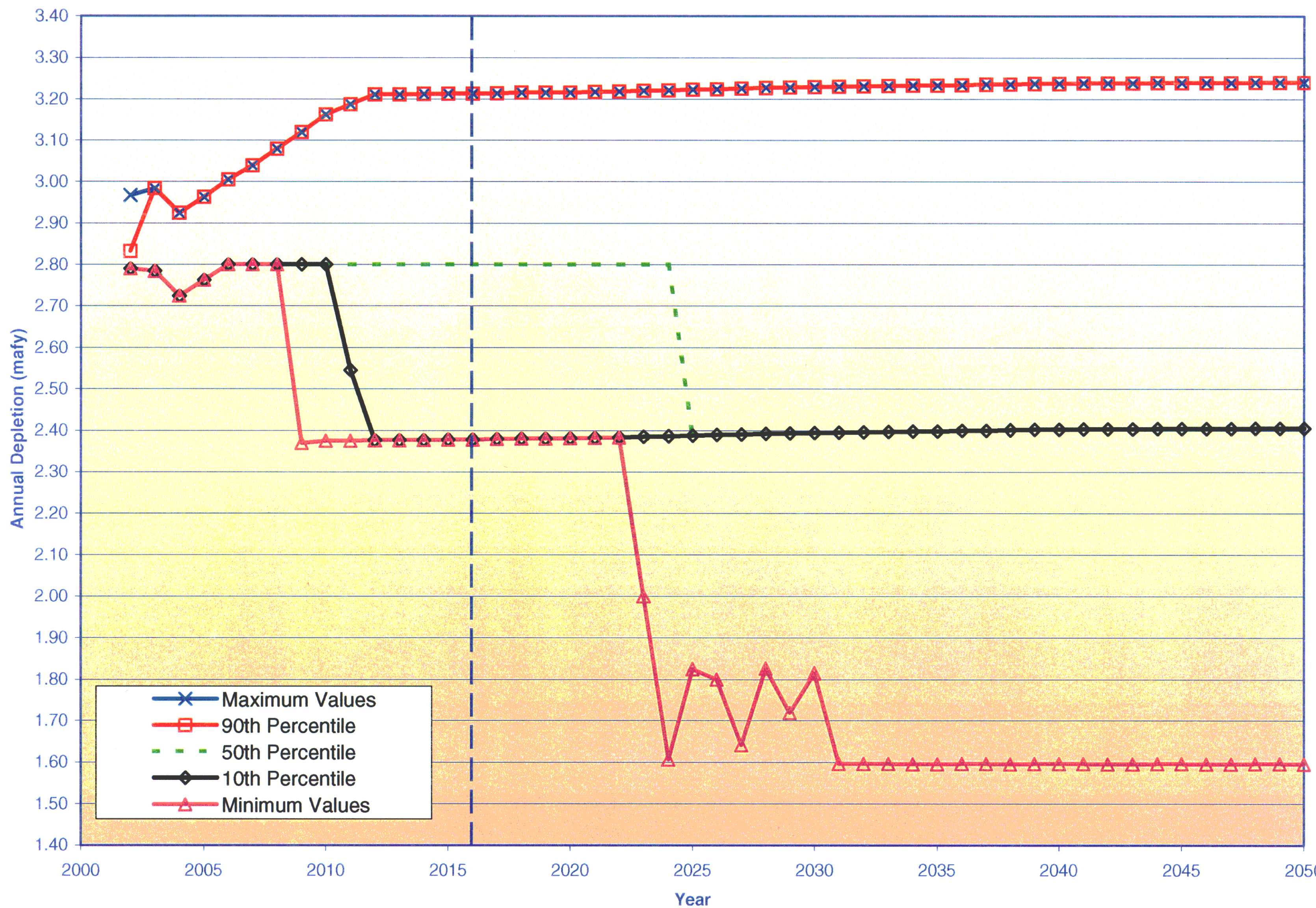
O-11	California Modeled Annual Depletions Under California Alternative
O-12	California Modeled Annual Depletions Under Shortage Protection Alternative
O-13	Nevada Modeled Annual Depletions Under Baseline Conditions
O-14	Nevada Modeled Annual Depletions Under Basin States Alternative
O-15	Nevada Modeled Annual Depletions Under Flood Control Alternative
O-16	Nevada Modeled Annual Depletions Under Six States Alternative
O-17	Nevada Modeled Annual Depletions Under California Alternative
O-18	Nevada Modeled Annual Depletions Under Shortage Protection Alternative

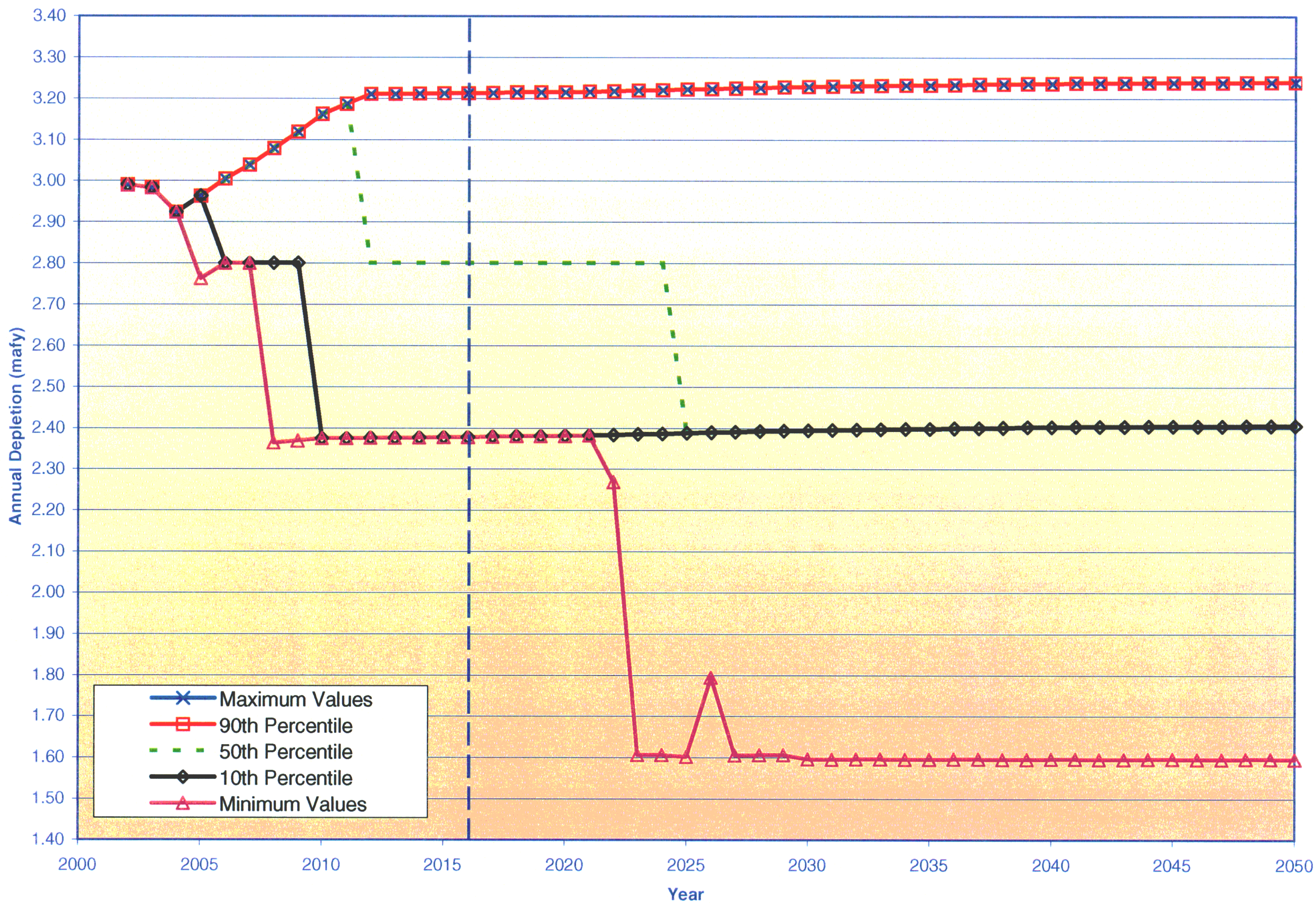
Attachment O-1
Arizona Modeled Annual Depletions Under Baseline Conditions
Maximum; 90th, 50th, and 10th Percentile; Minimum Values



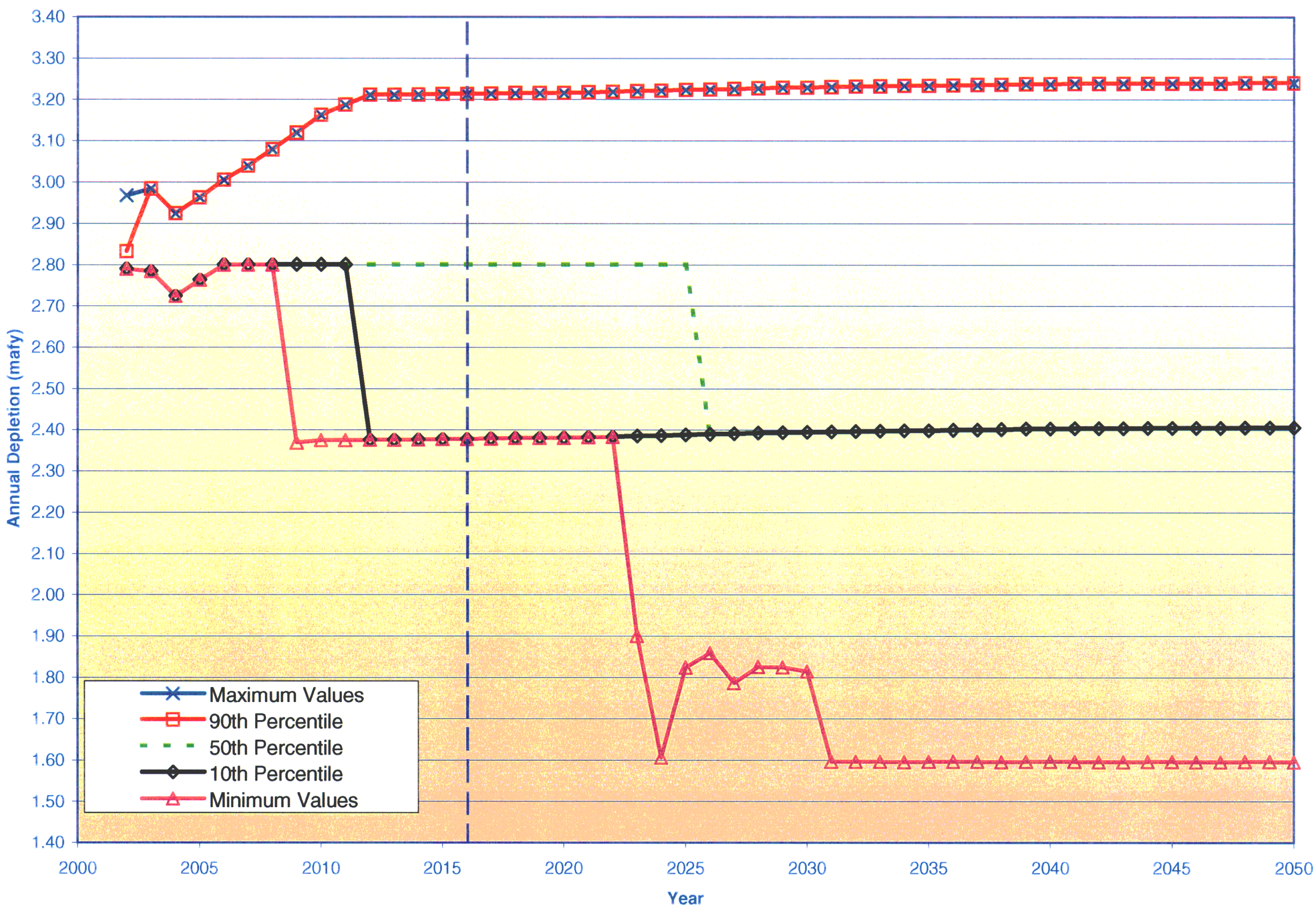
Attachment O-2
Arizona Modeled Annual Depletions Under Basin States Alternative
Maximum; 90th, 50th, and 10th Percentile; Minimum Values



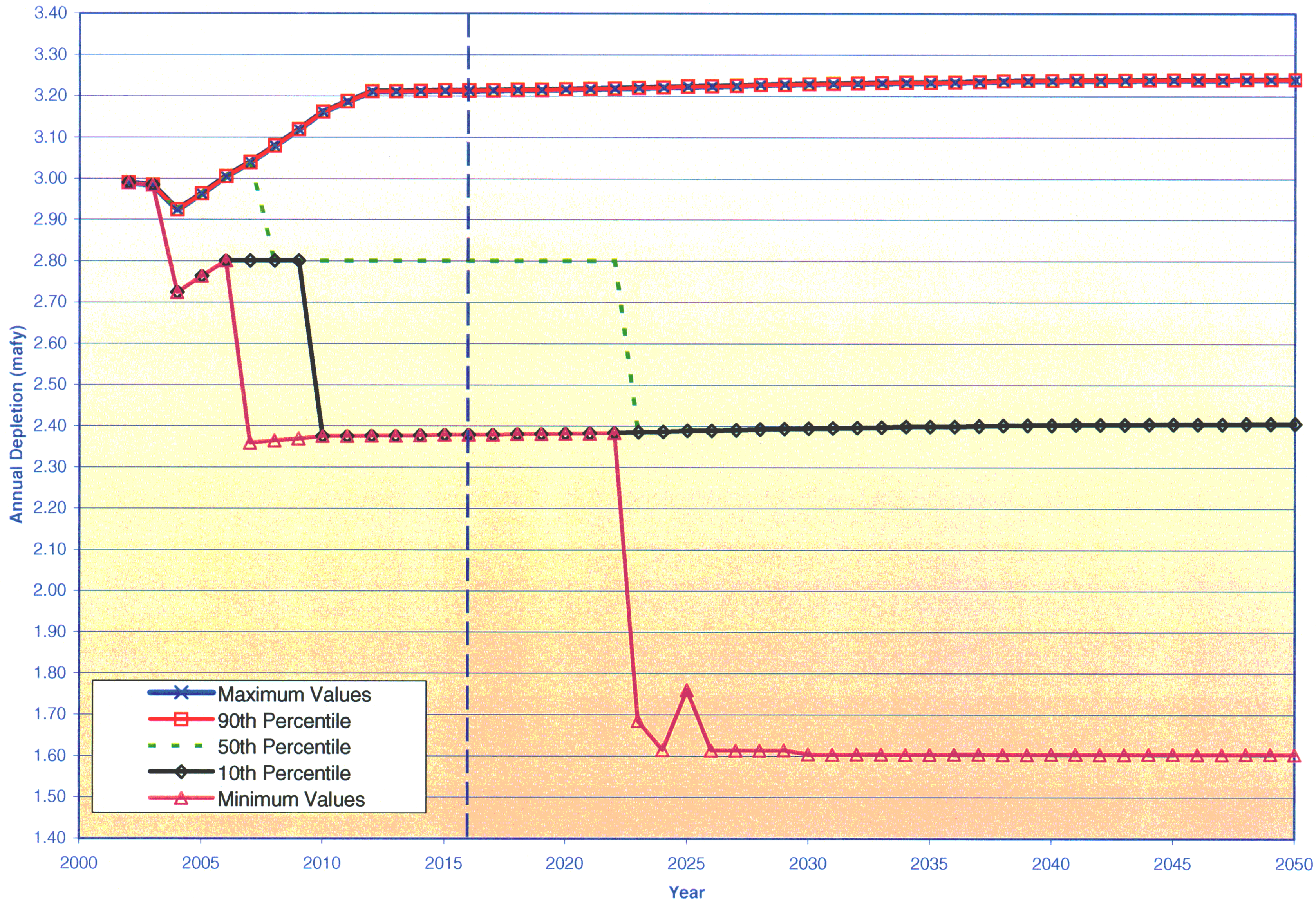
Attachment O-3
Arizona Modeled Annual Depletions Under Flood Control Alternative
Maximum; 90th, 50th, and 10th Percentile; Minimum Values



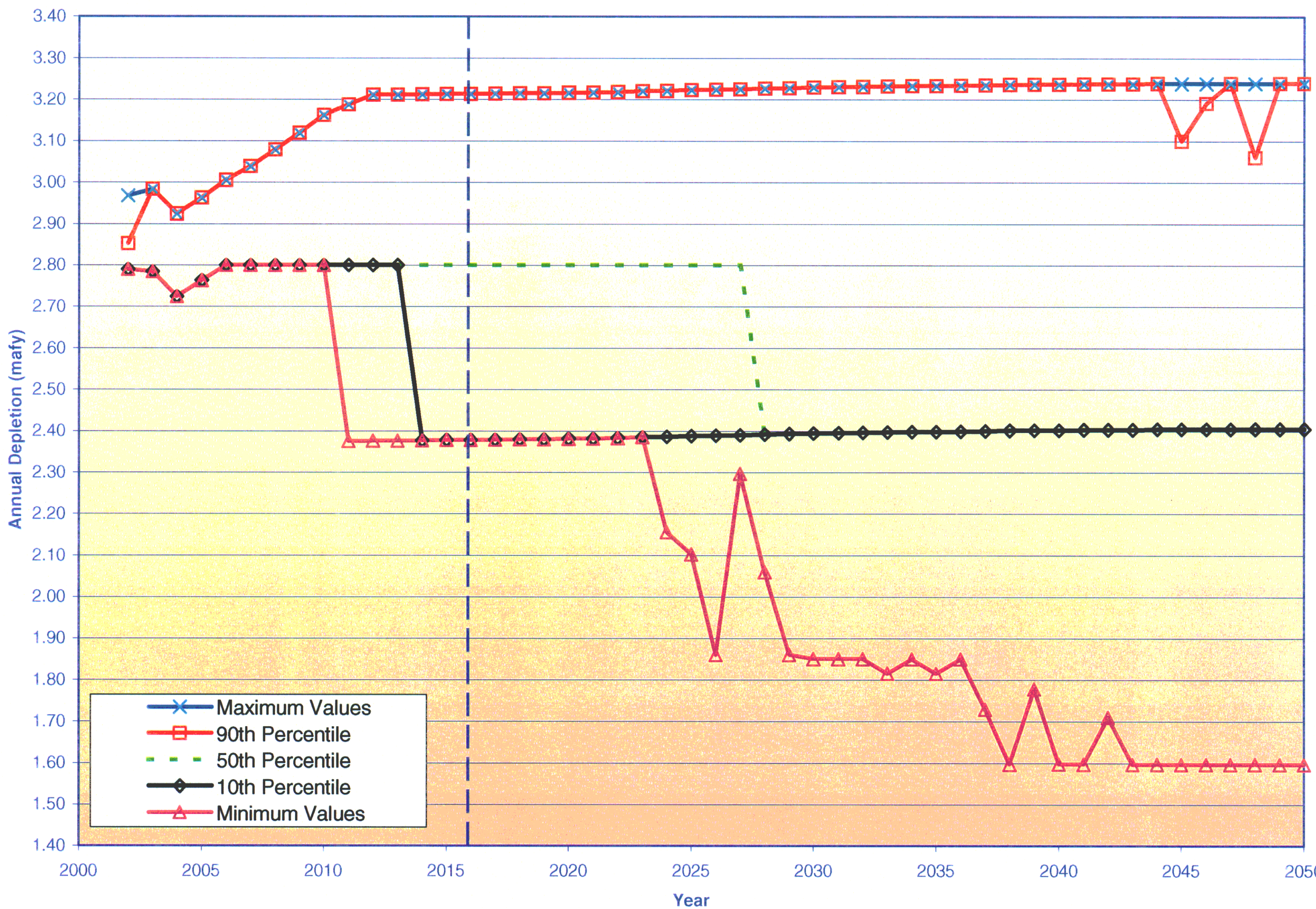
Attachment O-4
Arizona Modeled Annual Depletions Under Six States Alternative
Maximum; 90th, 50th, and 10th Percentile; Minimum Values



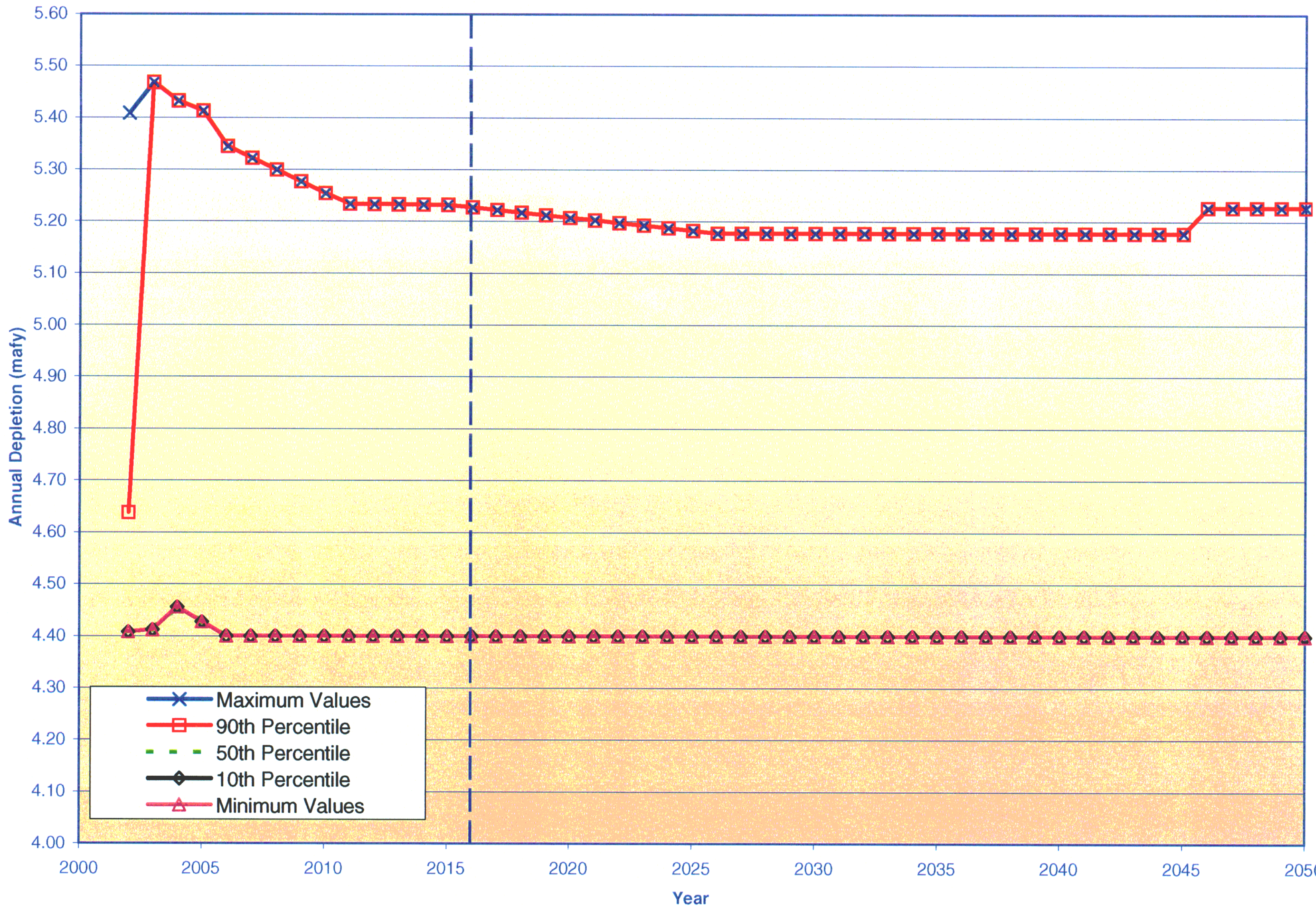
Attachment O-5
Arizona Modeled Annual Depletions Under California Alternative
Maximum; 90th, 50th, and 10th Percentile; Minimum Values



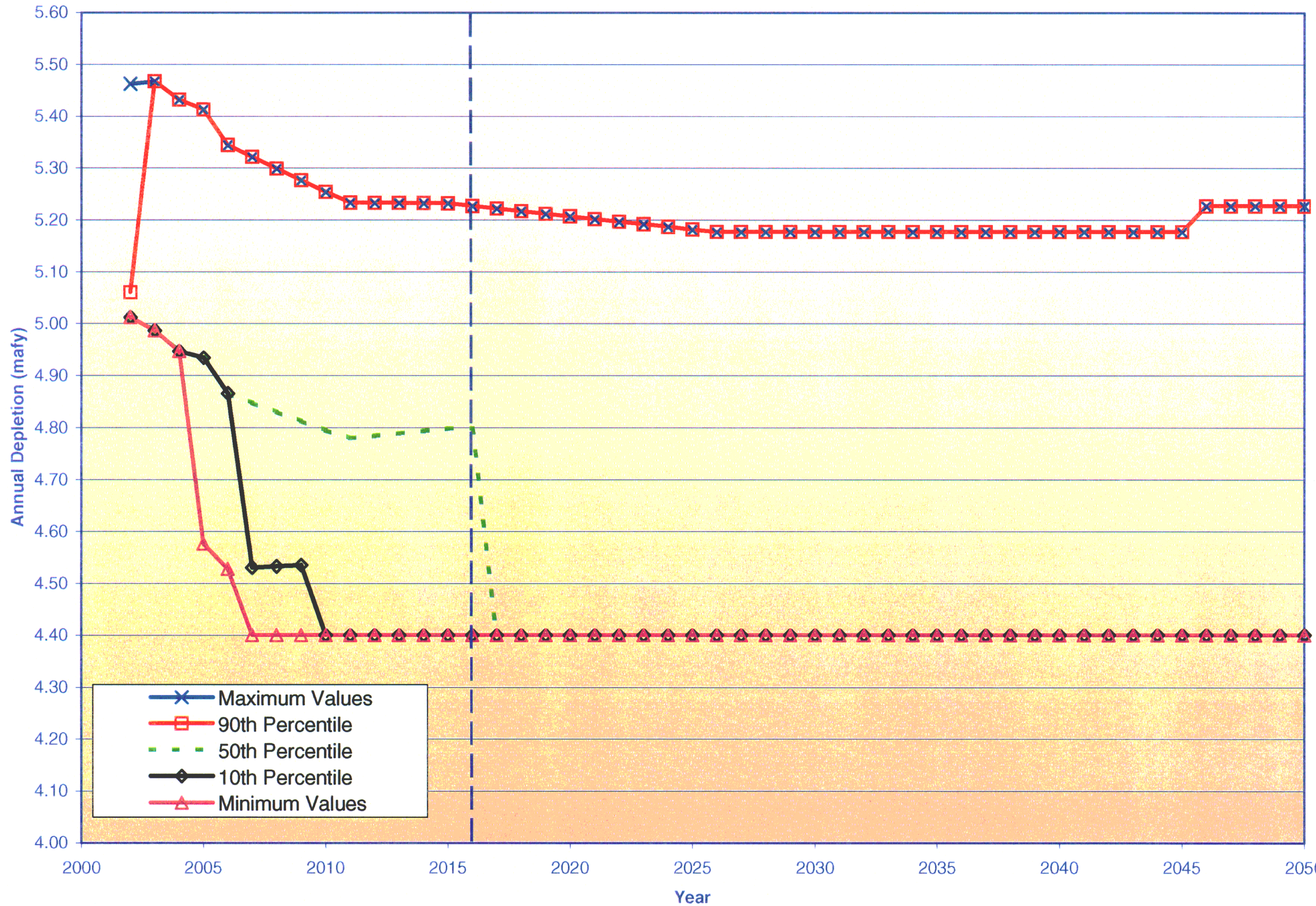
Attachment O-6
Arizona Modeled Annual Depletions Under Shortage Protection Alternative
Maximum; 90th, 50th, and 10th Percentile; Minimum Values



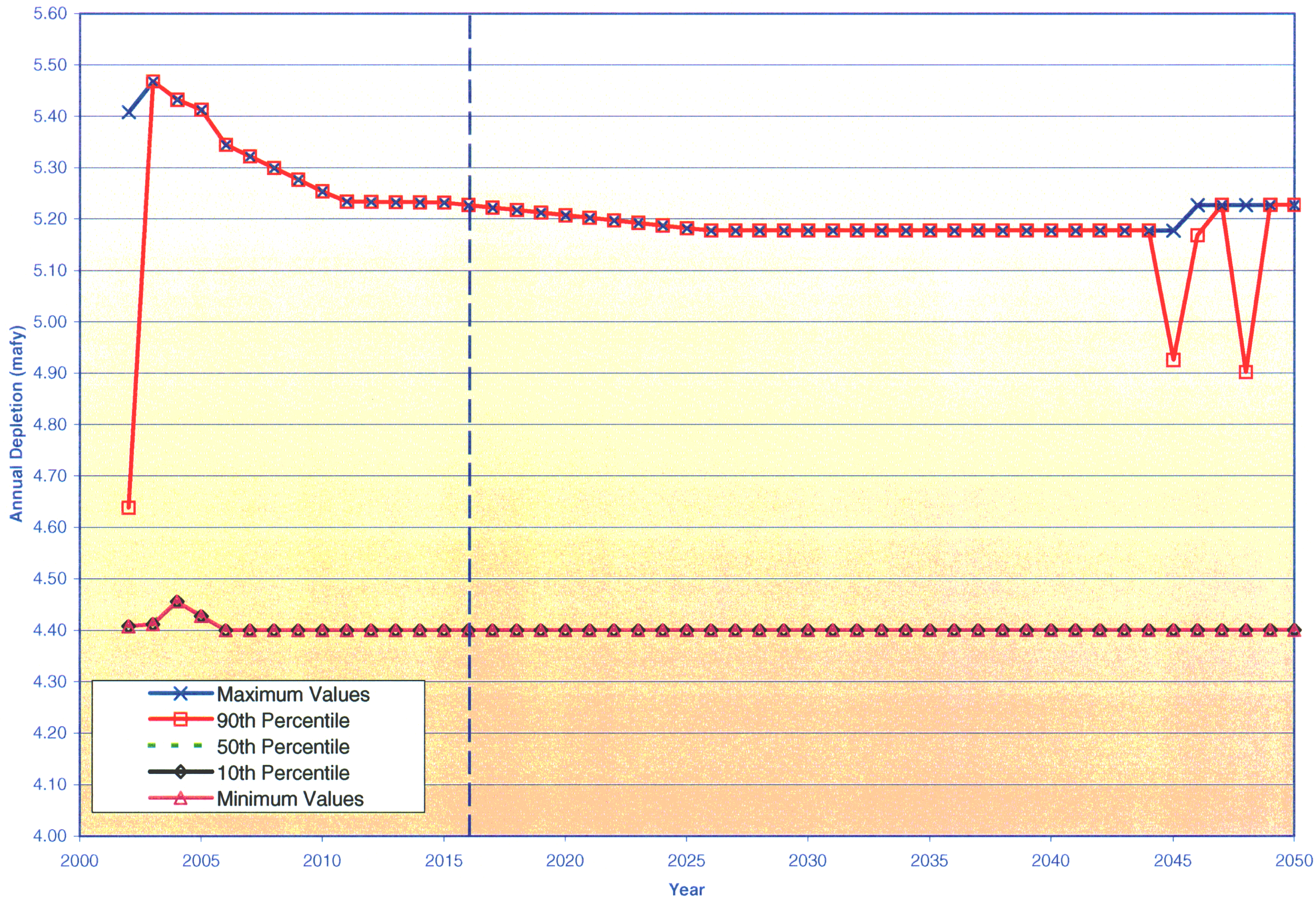
Attachment O-7
California Modeled Annual Depletions Under Baseline Conditions
Maximum; 90th, 50th, and 10th Percentile; Minimum Values



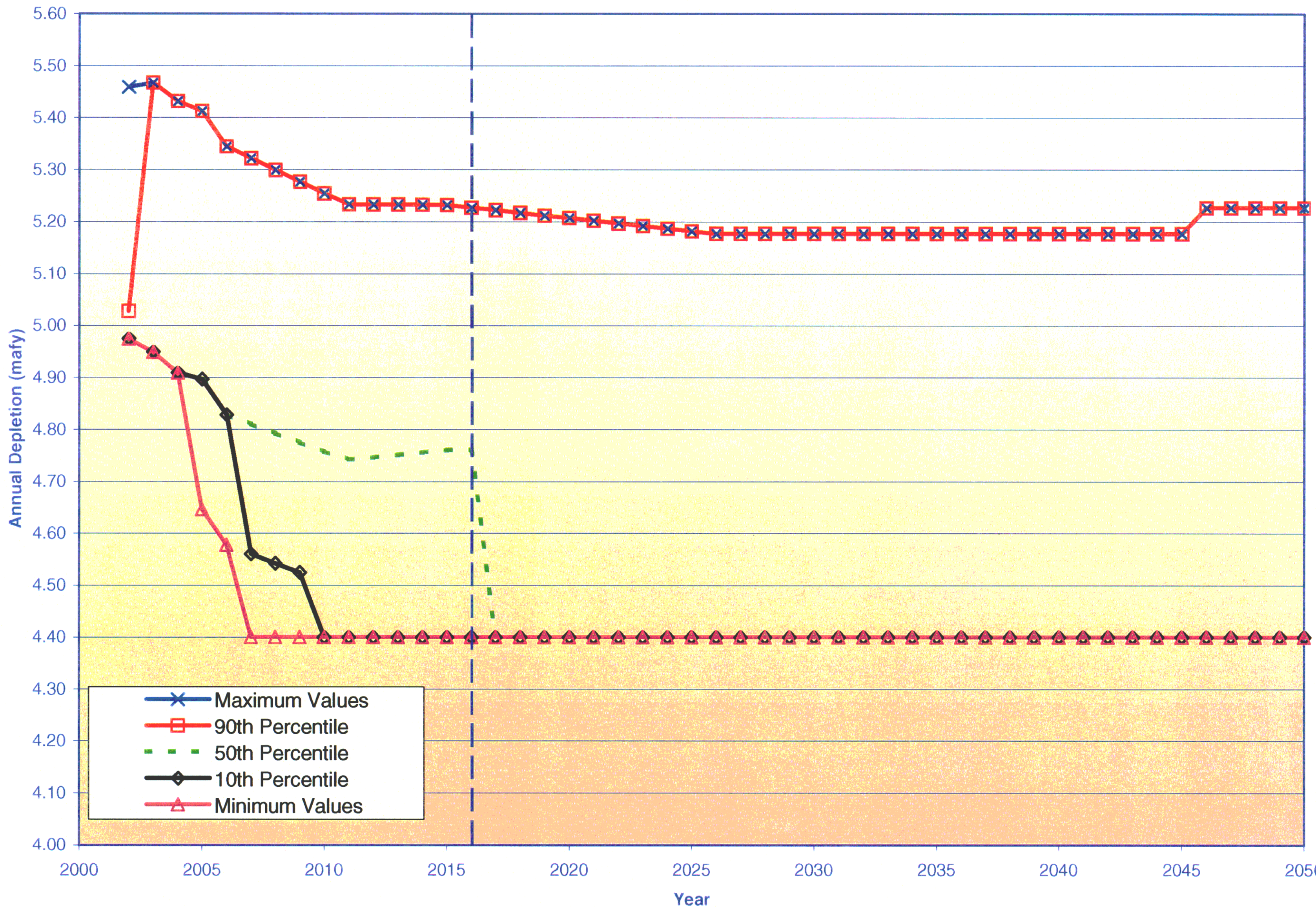
Attachment O-8
California Modeled Annual Depletions Under Basin States Alternative
Maximum; 90th, 50th, and 10th Percentile; Minimum Values



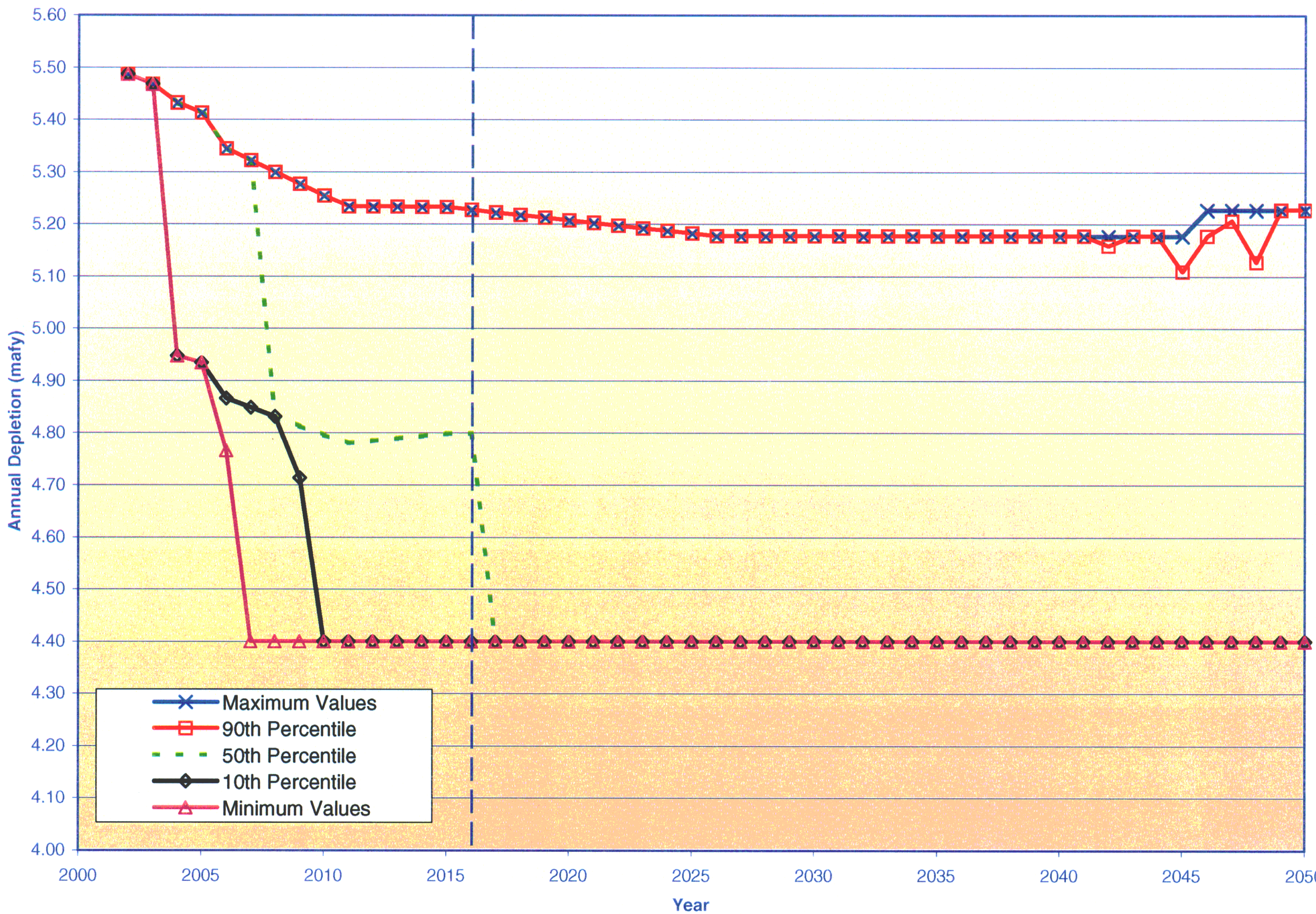
Attachment O-9
California Modeled Annual Depletions Under Flood Control Alternative
Maximum; 90th, 50th, and 10th Percentile; Minimum Values



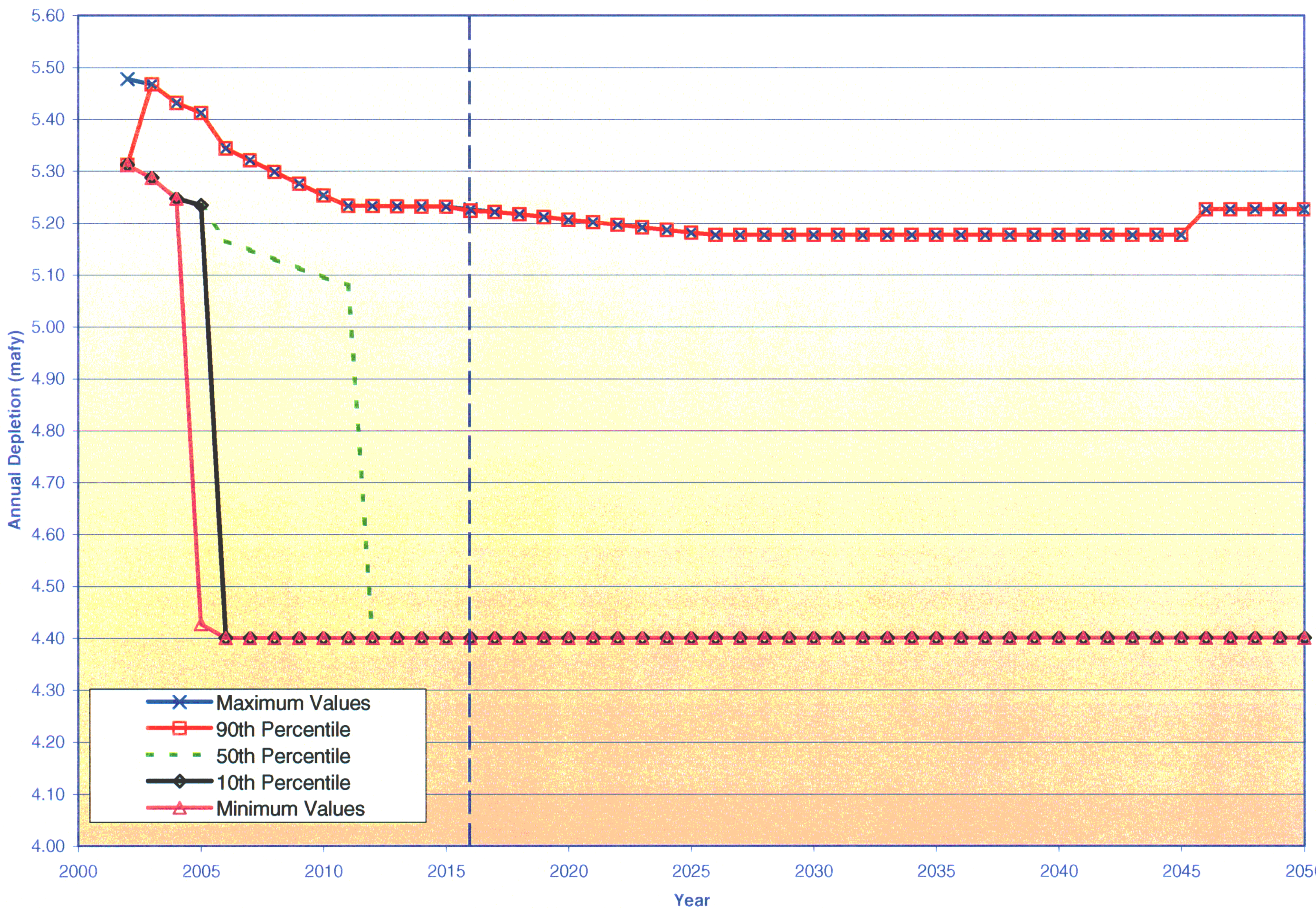
Attachment O-10
California Modeled Annual Depletions Under Six States Alternative
Maximum; 90th, 50th, and 10th Percentile; Minimum Values



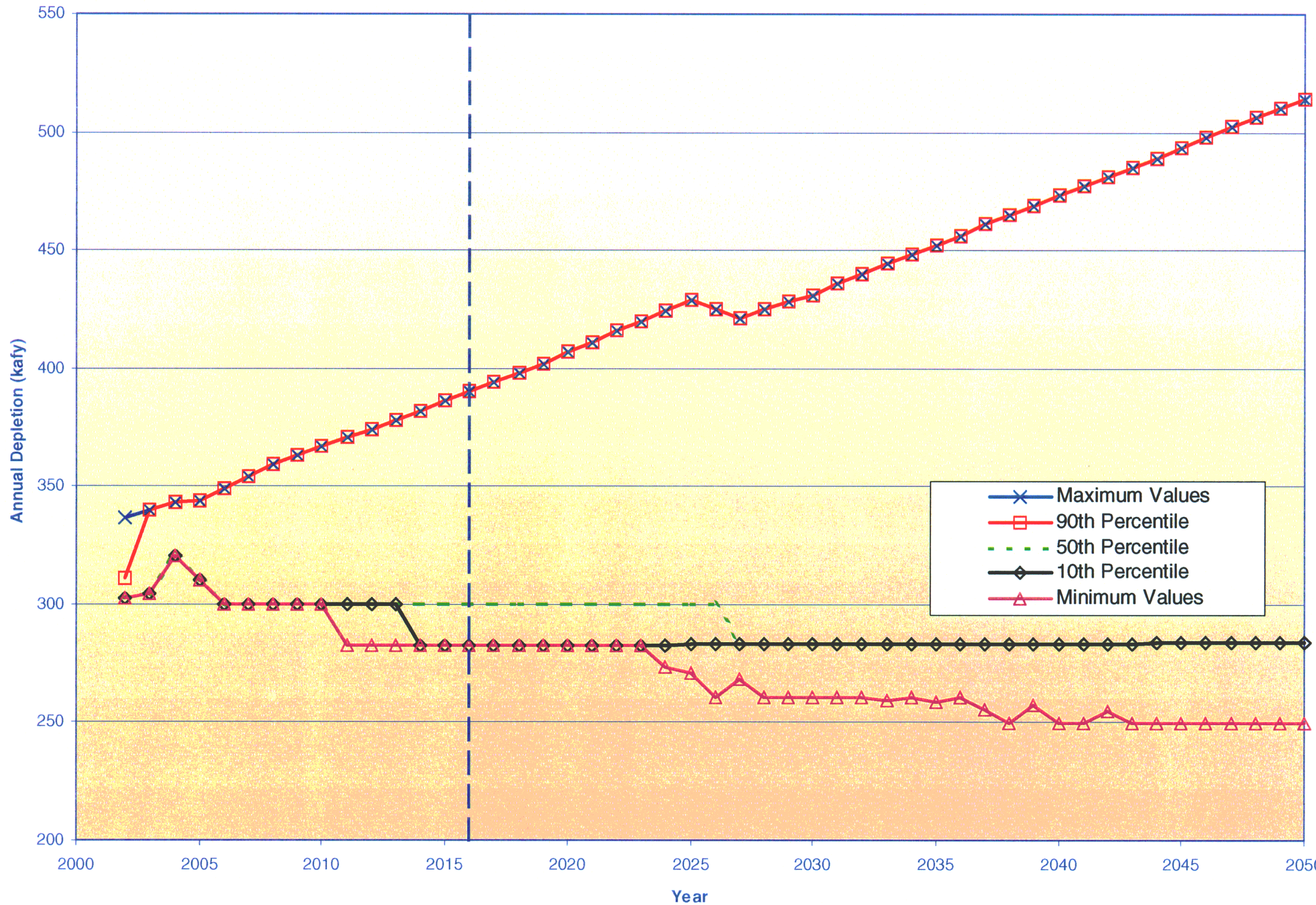
Attachment O-11
California Modeled Annual Depletions Under California Alternative
Maximum; 90th, 50th, and 10th Percentile; Minimum Values



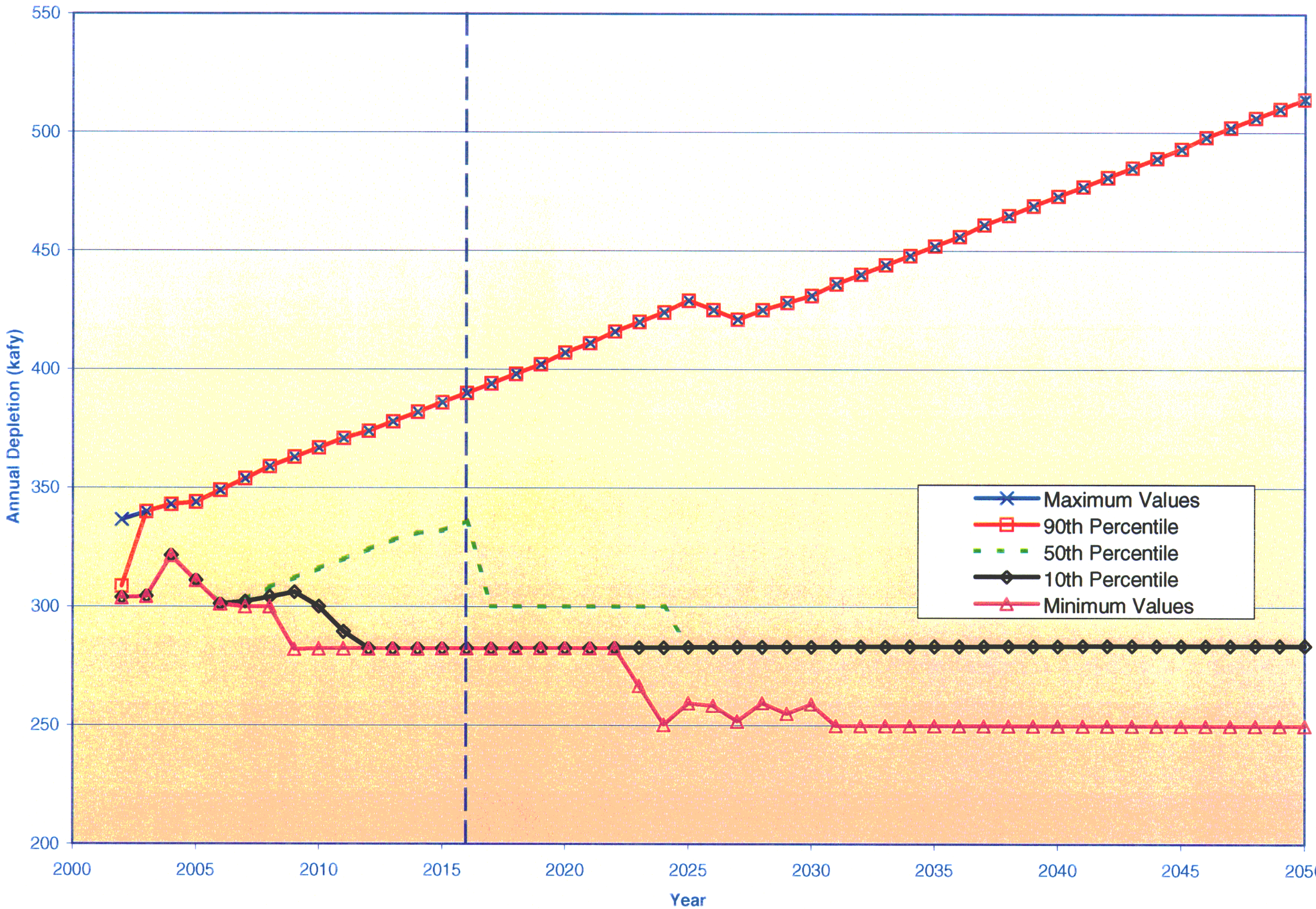
Attachment O-12
California Modeled Annual Depletions Under Shortage Protection Alternative
Maximum; 90th, 50th, and 10th Percentile; Minimum Values



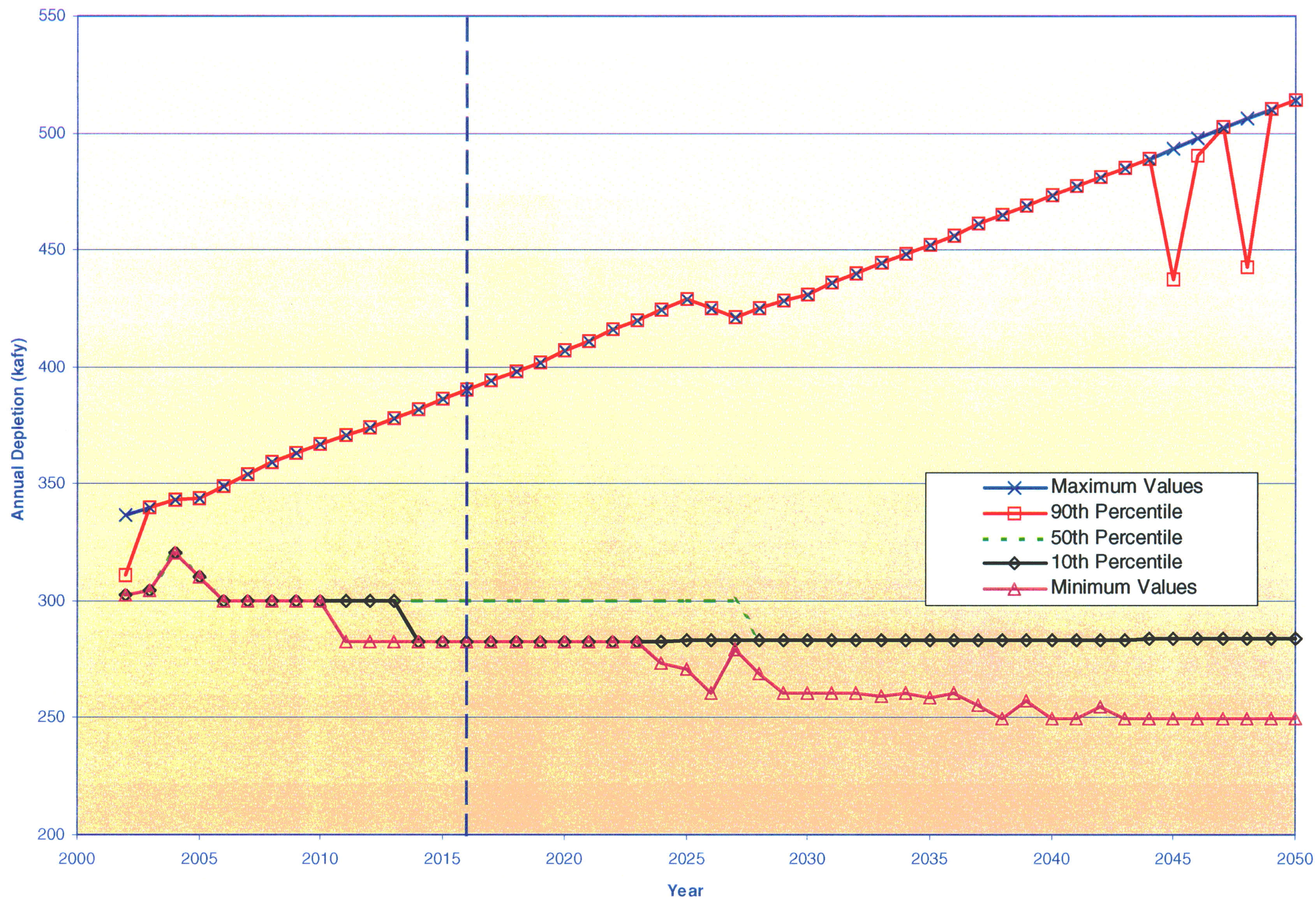
Attachment O-13
Nevada Modeled Annual Depletions Under Baseline Conditions
Maximum; 90th, 50th, and 10th Percentile; Minimum Values



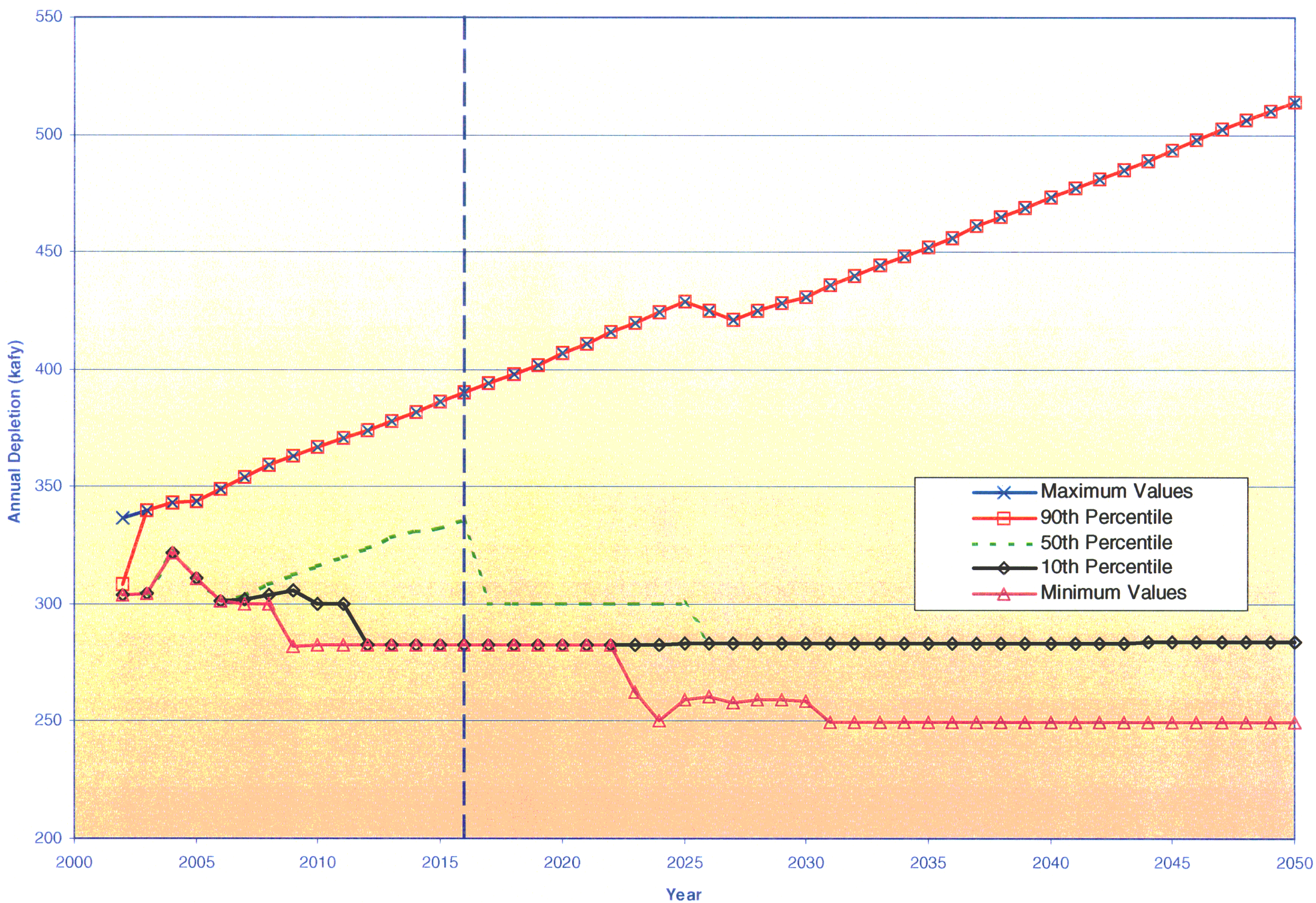
Attachment O-14
Nevada Modeled Annual Depletions Under Basin States Alternative
Maximum; 90th, 50th, and 10th Percentile; Minimum Values



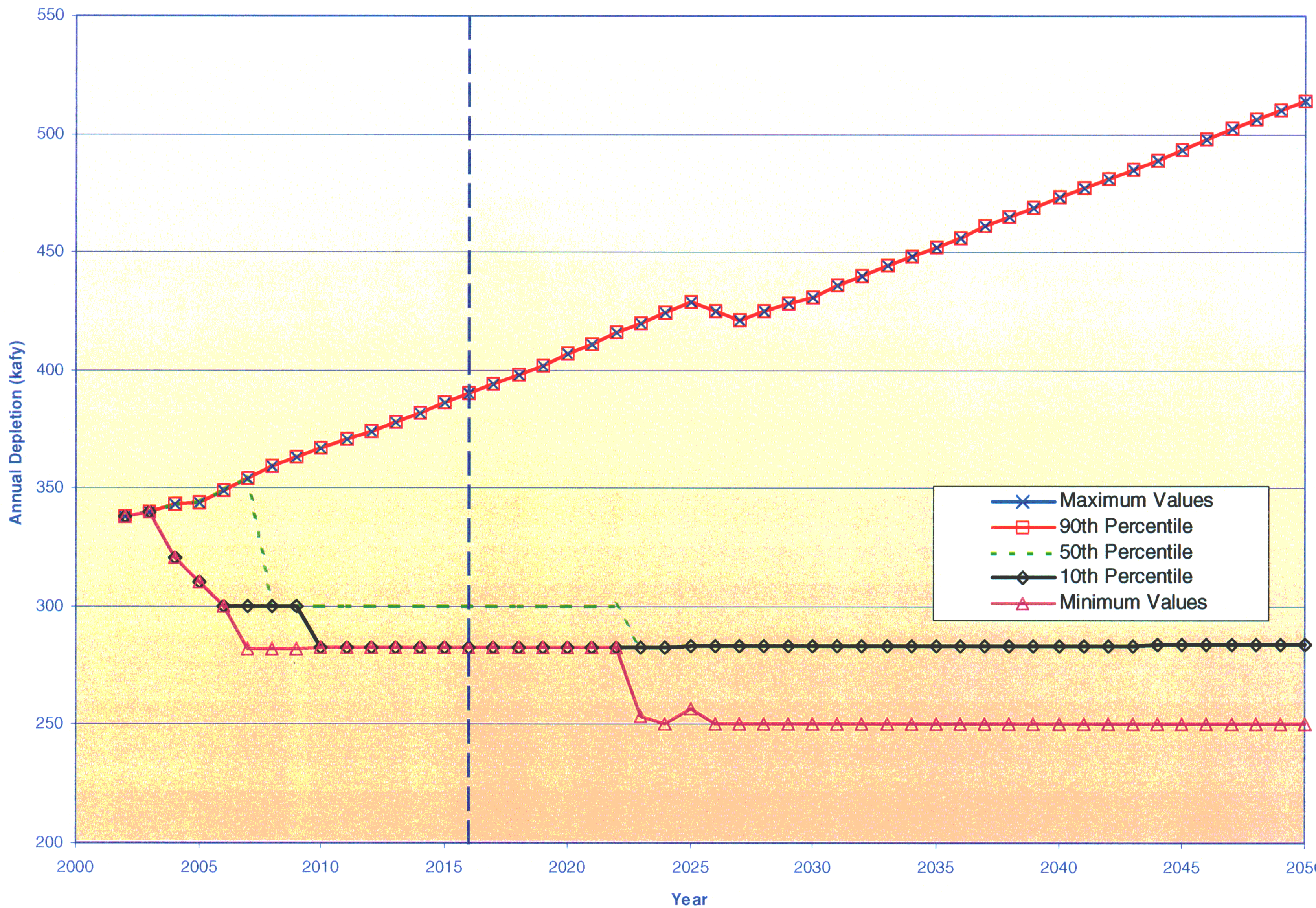
Attachment O-15
Nevada Modeled Annual Depletions Under Flood Control Alternative
Maximum; 90th, 50th, and 10th Percentile; Minimum Values



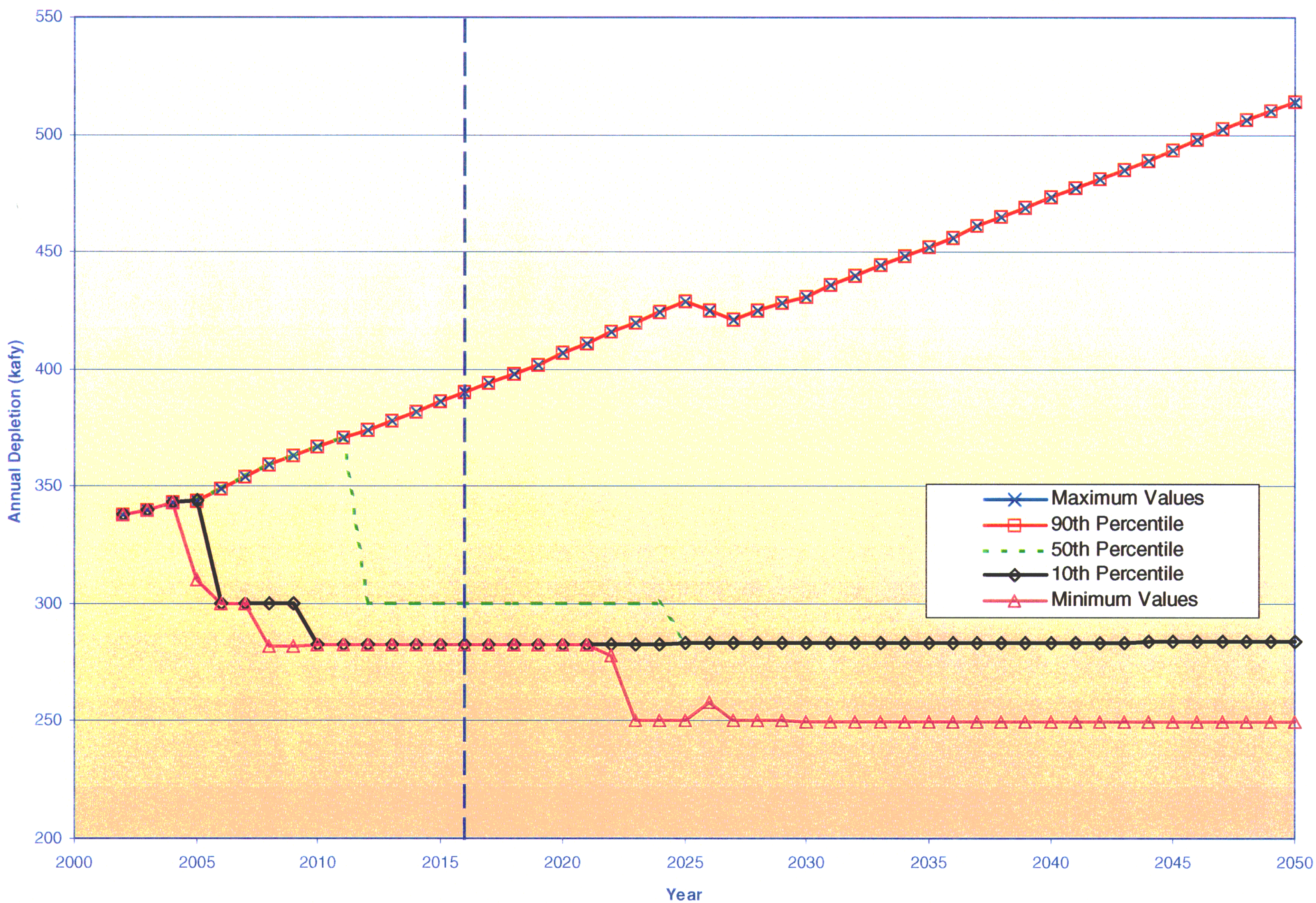
Attachment O-16
Nevada Modeled Annual Depletions Under Six States Alternative
Maximum; 90th, 50th, and 10th Percentile; Minimum Values



Attachment O-17
Nevada Modeled Annual Depletions Under California Alternative
Maximum; 90th, 50th, and 10th Percentile; Minimum Values



Attachment O-18
Nevada Modeled Annual Depletions Under Six States Alternative
Maximum; 90th, 50th, and 10th Percentile; Minimum Values



ATTACHMENT P

Energy Analysis Worksheets

This attachment contains worksheets with calculations used for the energy resources analysis in this FEIS.

Table 1

Average Lake Powell Elevation

Year	Average Water Surface Elevation (feet msl): Baseline Conditions	Flood Control Alternative	Six States Alternative	Basin States Alternative	California Alternative	Shortage Protection Alternative	Comparison to Baseline (feet msl): Flood Control Alternative	Six States Alternative	Basin States Alternative	California Alternative	Shortage Protection Alternative
2002	3,685	3,685	3,682	3,682	3,678	3,679	0	-3	-3	-6	-6
2003	3,685	3,685	3,682	3,682	3,678	3,679	0	-3	-3	-6	-6
2004	3,684	3,684	3,682	3,681	3,675	3,677	0	-3	-3	-9	-8
2005	3,683	3,683	3,678	3,677	3,671	3,672	0	-5	-5	-12	-11
2006	3,680	3,680	3,674	3,675	3,667	3,668	0	-6	-5	-13	-12
2007	3,679	3,679	3,672	3,672	3,663	3,664	0	-7	-7	-16	-15
2008	3,678	3,678	3,672	3,672	3,663	3,663	0	-6	-6	-15	-15
2009	3,676	3,676	3,669	3,669	3,660	3,660	0	-7	-7	-16	-16
2010	3,674	3,674	3,667	3,666	3,656	3,655	0	-7	-8	-18	-19
2011	3,670	3,670	3,663	3,662	3,653	3,652	0	-7	-8	-17	-18
2012	3,668	3,668	3,661	3,661	3,651	3,650	0	-7	-7	-16	-18
2013	3,661	3,661	3,653	3,652	3,650	3,649	0	-8	-9	-11	-12
2014	3,658	3,658	3,651	3,652	3,650	3,650	0	-7	-6	-8	-8
2015	3,655	3,655	3,652	3,652	3,651	3,650	0	-3	-3	-4	-4
2016	3,653	3,654	3,653	3,653	3,652	3,652	0	0	0	-2	-2
2017	3,655	3,655	3,654	3,654	3,652	3,652	0	-1	-1	-3	-3
2018	3,655	3,655	3,654	3,654	3,653	3,653	0	-1	-1	-2	-2
2019	3,656	3,656	3,655	3,655	3,655	3,655	0	-1	-1	-1	-1
2020	3,658	3,658	3,657	3,657	3,657	3,657	0	-1	-1	-1	-1
2021	3,658	3,658	3,658	3,658	3,658	3,658	0	0	0	0	0
2022	3,660	3,660	3,659	3,659	3,658	3,658	0	-1	-1	-2	-2
2023	3,660	3,660	3,659	3,659	3,659	3,659	0	-2	-2	-2	-2
2024	3,659	3,659	3,659	3,659	3,657	3,657	0	0	0	-2	-2
2025	3,661	3,661	3,661	3,661	3,660	3,660	0	0	0	-1	-1
2026	3,662	3,662	3,661	3,660	3,658	3,658	0	-1	-1	-4	-4
2027	3,662	3,662	3,658	3,658	3,658	3,658	0	-4	-4	-4	-4
2028	3,659	3,659	3,659	3,659	3,659	3,659	0	0	0	0	0
2029	3,660	3,660	3,660	3,660	3,660	3,660	0	0	0	0	0
2030	3,661	3,661	3,661	3,661	3,661	3,661	0	0	0	0	0
2031	3,661	3,661	3,661	3,661	3,661	3,661	0	0	0	0	0
2032	3,663	3,663	3,663	3,663	3,663	3,663	0	0	0	0	0
2033	3,664	3,664	3,664	3,664	3,664	3,664	0	0	0	0	0
2034	3,664	3,664	3,664	3,664	3,664	3,664	0	0	0	0	0
2035	3,665	3,665	3,665	3,665	3,665	3,665	0	0	0	0	0
2036	3,666	3,666	3,666	3,666	3,666	3,666	0	0	0	0	0
2037	3,666	3,666	3,666	3,666	3,666	3,666	0	0	0	0	0
2038	3,668	3,668	3,668	3,668	3,668	3,668	0	0	0	0	0
2039	3,668	3,668	3,668	3,668	3,668	3,668	0	0	0	0	0
2040	3,667	3,667	3,667	3,667	3,667	3,667	0	0	0	0	0
2041	3,669	3,669	3,668	3,668	3,667	3,667	0	0	0	-1	-1
2042	3,667	3,667	3,667	3,667	3,666	3,666	0	0	-1	-2	-2
2043	3,668	3,667	3,668	3,668	3,668	3,668	0	0	0	0	0
2044	3,666	3,666	3,666	3,666	3,666	3,666	0	0	0	0	0
2045	3,664	3,664	3,663	3,663	3,663	3,663	0	-2	-2	-2	-2
2046	3,665	3,666	3,665	3,665	3,665	3,665	1	0	0	0	0
2047	3,662	3,662	3,662	3,662	3,662	3,662	0	0	0	0	0
2048	3,662	3,662	3,662	3,662	3,662	3,662	0	0	0	0	0
2049	3,660	3,660	3,660	3,660	3,660	3,660	0	0	0	0	0
2050	3,661	3,661	3,661	3,661	3,661	3,661	0	0	0	0	0
AVERAGE:											
2002-2016	3,672	3,673	3,667	3,667	3,661	3,661	0	-5	-5	-11	-11
2017-2050	3,662	3,662	3,662	3,662	3,662	3,662	0	0	0	-1	-1
2002-2050	3,666	3,666	3,664	3,664	3,662	3,662	0	-2	-2	-4	-4

Table 2

Average Lake Mead Elevation and Comparison of SNWA Pumping Power Costs

	Average Water Surface Elevation (feet msl)						Comparison to Baseline (feet msl)					Pumping Power Cost Comparison to Baseline				
Year	Baseline Conditions	Flood Control Alternative	Six States Alternative	Basin States Alternative	California Alternative	Shortage Protection Alternative	Flood Control Alternative	Six States Alternative	Basin States Alternative	California Alternative	Shortage Protection Alternative	Flood Control Alternative	Six States Alternative	Basin States Alternative	California Alternative	Shortage Protection Alternative
2002	1,191	1,191	1,187	1,187	1,182	1,183	0	-4	-4	-9	-8	$0	$117,320	$124,320	$253,120	$222,600
2003	1,191	1,191	1,187	1,187	1,182	1,183	0	-4	-4	-9	-8	$0	$117,320	$124,320	$253,120	$222,600
2004	1,189	1,192	1,186	1,186	1,178	1,180	2	-3	-3	-11	-9	-$67,480	$81,200	$92,960	$305,760	$251,720
2005	1,190	1,191	1,183	1,184	1,176	1,178	1	-6	-5	-14	-12	-$24,920	$178,640	$152,880	$392,840	$330,400
2006	1,184	1,187	1,179	1,180	1,169	1,170	2	-5	-5	-16	-14	-$68,040	$150,920	$130,480	$434,560	$395,080
2007	1,182	1,183	1,176	1,176	1,167	1,168	1	-6	-6	-15	-14	-$28,840	$167,720	$175,000	$424,760	$404,040
2008	1,183	1,183	1,176	1,175	1,166	1,164	0	-7	-8	-17	-19	$0	$186,480	$210,000	$475,440	$536,200
2009	1,179	1,179	1,173	1,172	1,161	1,163	0	-6	-7	-19	-16	$280	$170,240	$191,240	$518,000	$453,320
2010	1,180	1,180	1,171	1,171	1,159	1,154	1	-9	-9	-21	-25	-$16,520	$248,640	$246,680	$575,960	$703,920
2011	1,175	1,175	1,168	1,167	1,152	1,151	0	-8	-8	-23	-24	-$3,640	$212,240	$235,760	$636,160	$666,400
2012	1,174	1,175	1,164	1,163	1,151	1,149	1	-10	-11	-23	-26	-$19,040	$281,120	$309,680	$652,400	$715,400
2013	1,169	1,172	1,158	1,158	1,145	1,143	3	-11	-11	-24	-26	-$75,040	$301,840	$307,720	$681,520	$734,720
2014	1,166	1,172	1,157	1,156	1,135	1,142	7	-9	-10	-30	-23	-$187,040	$251,160	$266,000	$843,920	$651,000
2015	1,170	1,170	1,157	1,155	1,136	1,139	0	-12	-14	-33	-31	$0	$346,640	$404,040	$932,680	$854,560
2016	1,163	1,163	1,149	1,146	1,135	1,133	0	-15	-17	-28	-30	$0	$410,200	$469,840	$792,400	$847,560
2017	1,160	1,160	1,146	1,144	1,131	1,130	0	-14	-16	-29	-30	$0	$394,520	$450,520	$808,080	$851,760
2018	1,156	1,157	1,139	1,137	1,129	1,136	1	-17	-19	-27	-20	-$21,840	$464,240	$527,800	$752,920	$552,440
2019	1,152	1,152	1,141	1,138	1,127	1,131	0	-11	-14	-25	-21	$0	$313,040	$378,840	$686,840	$580,440
2020	1,152	1,152	1,138	1,142	1,127	1,131	0	-13	-9	-25	-20	$0	$370,720	$255,920	$696,360	$568,680
2021	1,144	1,144	1,135	1,135	1,123	1,127	0	-9	-9	-21	-17	$0	$258,720	$264,600	$598,640	$479,920
2022	1,141	1,141	1,131	1,132	1,122	1,125	0	-10	-9	-19	-16	$0	$286,720	$256,760	$535,920	$444,360
2023	1,136	1,136	1,129	1,128	1,118	1,126	0	-7	-8	-18	-10	$0	$200,200	$213,360	$493,080	$266,280
2024	1,135	1,135	1,131	1,131	1,119	1,128	0	-4	-4	-16	-7	-$9,520	$111,160	$120,680	$452,200	$197,400
2025	1,134	1,133	1,128	1,128	1,119	1,123	-1	-7	-7	-15	-12	$28,280	$189,840	$182,280	$424,200	$327,040
2026	1,131	1,132	1,128	1,128	1,118	1,118	0	-4	-4	-13	-13	-$5,600	$101,360	$103,600	$371,840	$368,200
2027	1,130	1,131	1,128	1,128	1,123	1,124	2	-2	-2	-7	-6	-$42,280	$42,000	$44,800	$186,760	$165,760
2028	1,127	1,128	1,127	1,126	1,122	1,122	1	0	-1	-5	-5	-$19,600	$7,000	$25,200	$151,200	$139,160
2029	1,128	1,130	1,128	1,126	1,121	1,123	2	0	-2	-7	-5	-$59,920	$2,520	$60,200	$205,240	$143,080
2030	1,126	1,126	1,123	1,123	1,122	1,122	0	-3	-3	-3	-4	-$10,640	$78,960	$85,960	$95,480	$99,960
2031	1,124	1,126	1,123	1,123	1,121	1,120	1	-1	-1	-4	-4	-$40,600	$35,000	$35,000	$101,920	$115,080
2032	1,122	1,128	1,122	1,122	1,120	1,119	6	0	0	-2	-2	-$174,160	$1,680	$4,200	$58,240	$65,800
2033	1,123	1,123	1,121	1,121	1,119	1,119	0	-2	-2	-4	-4	-$10,360	$52,080	$52,080	$120,680	$123,200
2034	1,122	1,122	1,120	1,118	1,118	1,118	0	-2	-4	-4	-4	-$3,920	$56,560	$111,160	$117,600	$120,960
2035	1,122	1,121	1,121	1,121	1,120	1,120	-1	-1	-1	-2	-2	$29,680	$16,800	$24,080	$43,120	$46,200
2036	1,121	1,123	1,121	1,121	1,120	1,121	2	0	0	-1	0	-$53,200	$0	$0	$35,000	$0
2037	1,119	1,120	1,119	1,119	1,116	1,118	1	0	0	-3	-1	-$24,080	$11,760	$8,120	$79,520	$24,920
2038	1,120	1,120	1,120	1,120	1,116	1,116	0	0	0	-4	-4	$0	$2,800	$2,800	$106,680	$110,040
2039	1,120	1,119	1,120	1,120	1,120	1,120	0	0	0	1	0	$10,920	-$4,760	$0	-$15,120	$0
2040	1,118	1,118	1,118	1,118	1,118	1,118	0	0	0	0	0	$0	$0	$0	-$3,640	$0
2041	1,115	1,119	1,115	1,115	1,116	1,115	4	0	0	1	0	-$104,440	$0	$0	-$19,320	$0
2042	1,117	1,117	1,117	1,117	1,118	1,117	0	0	0	1	0	$10,360	$0	$0	-$14,280	$0
2043	1,113	1,116	1,113	1,113	1,114	1,113	3	0	0	1	0	-$81,760	$0	$0	-$17,080	$0
2044	1,113	1,113	1,113	1,113	1,113	1,113	0	0	0	0	0	$0	$0	$0	-$4,480	$0
2045	1,109	1,109	1,109	1,109	1,109	1,109	0	0	0	0	0	$840	$0	$0	-$4,480	$0
2046	1,109	1,112	1,109	1,109	1,110	1,109	3	0	0	1	0	-$80,360	$0	$0	-$16,800	$0
2047	1,111	1,113	1,111	1,111	1,111	1,111	2	0	0	1	0	-$55,720	$0	$0	-$21,000	$0
2048	1,113	1,113	1,113	1,113	1,113	1,113	0	0	0	0	0	$560	$0	$0	-$4,480	$0
2049	1,113	1,112	1,113	1,113	1,113	1,113	0	0	0	0	0	$1,960	$0	$0	-$4,200	$0
2050	1,110	1,110	1,110	1,110	1,111	1,110	0	0	0	0	0	$560	$0	$0	-$4,480	$0
AVERAGE:																
2002-2016	1,179	1,180	1,171	1,171	1,160	1,160	1	-8	-8	-19	-19	-$32,685	$214,779	$229,395	$544,843	$532,635
2017-2050	1,126	1,127	1,123	1,123	1,119	1,120	1	-3	-3	-7	-6	-$21,025	$88,027	$94,352	$205,652	$170,314
2002-2050	1,142	1,143	1,138	1,137	1,131	1,132	1	-5	-5	-11	-10	-$24,594	$126,829	$135,691	$309,486	$281,229

Table 3

Glen Canyon Dam
Discharge Multipliers and Powerplant Capacity vs. Elevation

Elevation	Multiplier	Capacity (MW)
3701	23.80692	1,050
3700	23.84850	1,048
3699	23.89344	1,046
3698	23.93840	1,044
3697	23.98306	1,042
3696	24.02769	1,040
3695	24.07231	1,039
3694	24.11692	1,037
3693	24.16154	1,035
3692	24.20538	1,033
3691	24.25000	1,031
3690	24.29384	1,029
3689	24.33846	1,027
3688	24.38231	1,025
3687	24.42615	1,023
3686	24.47000	1,022
3685	24.51384	1,020
3684	24.55769	1,018
3683	24.60076	1,016
3682	24.64461	1,014
3681	24.68846	1,013
3680	24.73153	1,011
3679	24.78000	1,009
3678	24.82846	1,007
3677	24.87692	1,005
3676	24.92461	1,003
3675	24.97307	1,001
3674	25.02077	999
3673	25.06846	997
3672	25.11615	995
3671	25.16385	993
3670	25.21154	992
3669	25.25923	990
3668	25.30692	988
3667	25.35385	986
3666	25.40154	984
3665	25.44846	982
3664	25.49539	981
3663	25.54231	979
3662	25.58923	977
3661	25.63615	975
3660	25.68308	973
3659	25.73539	971
3658	25.78770	969
3657	25.83923	968
3656	25.89154	966
3655	25.94385	964
3654	25.99539	962
3653	26.04692	960
3652	26.09846	958
3651	26.15000	956
3650	26.20153	954
3649	26.25307	952
3648	26.30384	950
3647	26.35538	949
3646	26.40615	947
3645	26.45692	945
3644	26.50769	943
3643	26.55846	941
3642	26.60923	940
3641	26.66000	938
3640	26.71000	936
3639	26.76692	934
3638	26.82384	932
3637	26.88000	930
3636	26.93692	928
3635	26.99307	926
3634	27.04923	924
3633	27.10538	922
3632	27.16076	920
3631	27.21692	919
3630	27.27307	917
3629	27.32846	915
3628	27.38384	913
3627	27.43923	911
3626	27.49461	909
3625	27.55000	907
3624	27.60461	906
3623	27.66000	904
3622	27.71461	902
3621	27.76923	900
3620	27.82384	899
3619	27.88538	897
3618	27.94692	895
3617	28.00846	893
3616	28.07000	891
3615	28.13076	889
3614	28.19230	887
3613	28.25307	885
3612	28.31384	883
3611	28.37461	881
3610	28.43538	879
3609	28.49538	877
3608	28.55538	875
3607	28.61615	874
3606	28.67615	872
3605	28.73538	870
3604	28.79538	868
3603	28.85538	866
3602	28.91461	865
3601	28.97384	863
3600	29.03307	861

Table 4

Hoover Dam
Powerplant Capacity vs. Elevation

Elevation	Capacity (MW)
1109	1,863
1110	1,865
1111	1,867
1112	1,868
1113	1,870
1114	1,872
1115	1,873
1116	1,875
1117	1,877
1118	1,878
1119	1,880
1120	1,882
1121	1,884
1122	1,885
1123	1,887
1124	1,889
1125	1,890
1126	1,892
1127	1,894
1128	1,895
1129	1,897
1130	1,899
1131	1,900
1132	1,902
1133	1,904
1134	1,905
1135	1,907
1136	1,909
1137	1,918
1138	1,935
1139	1,936
1140	1,938
1141	1,940
1142	1,942
1143	1,943
1144	1,945
1145	1,963
1146	1,971
1147	1,974
1148	2,003
1149	2,005
1150	2,007
1151	2,008
1152	2,010
1153	2,012
1154	2,014
1155	2,015
1156	2,017
1157	2,019
1158	2,024
1159	2,026
1160	2,027
1161	2,029
1162	2,031
1163	2,033
1164	2,034
1165	2,036
1166	2,038
1167	2,040
1168	2,043
1169	2,044
1170	2,046
1171	2,048
1172	2,050
1173	2,051
1174	2,053
1175	2,055
1176	2,057
1177	2,058
1178	2,058
1179	2,059
1180	2,060
1181	2,060
1182	2,061
1183	2,061
1184	2,061
1185	2,061
1186	2,061
1187	2,061
1188	2,062
1189	2,062
1190	2,062
1191	2,062
1192	2,062
1193	2,062
1194	2,062
1195	2,062
1196	2,062
1197	2,062
1198	2,062
1199	2,062
1200	2,062
1201	2,062
1202	2,062
1203	2,062
1204	2,062
1205	2,062
1206	2,062
1207	2,062
1208	2,074
1209	2,074
1210	2,074
1211	2,074
1212	2,074
1213	2,074
1214	2,074
1215	2,074
1216	2,074
1217	2,074
1218	2,074
1219	2,074
1220	2,074
1221	2,074
1222	2,074
1223	2,074
1224	2,074
1225	2,074
1226	2,074
1227	2,074
1228	2,074
1229	2,074
1230	2,074
1231	2,074
1232	2,074
1233	2,074
1234	2,074
1235	2,074
1236	2,074
1237	2,074

Table 5

Glen Canyon Powerplant
Summary of Average Annual Capacity and Energy Production

	Baseline Conditions		Flood Control Alternative		Six States Alternative		Basin States Alternative		California Alternative		Shortage Protection Alternative	
YEAR	CAPACITY (MW)	ENERGY (GWh)	CAPACITY (MW)	ENERGY (GWh)	CAPACITY (MW)	ENERGY (GWh)	CAPACITY (MW)	ENERGY (GWh)	CAPACITY (MW)	ENERGY (GWh)	CAPACITY (MW)	ENERGY (GWh)
2002	1,020	4,763	1,020	4,763	1,014	4,799	1,014	4,802	1,007	4,857	1,009	4,841
2003	1,020	4,778	1,020	4,777	1,014	4,813	1,014	4,814	1,007	4,864	1,009	4,851
2004	1,018	4,697	1,018	4,698	1,014	4,733	1,013	4,736	1,001	4,780	1,005	4,777
2005	1,016	4,651	1,016	4,650	1,007	4,675	1,005	4,679	993	4,720	995	4,721
2006	1,011	4,607	1,011	4,606	999	4,638	1,001	4,638	986	4,661	988	4,674
2007	1,009	4,603	1,009	4,603	995	4,606	995	4,607	979	4,599	981	4,615
2008	1,007	4,553	1,007	4,549	995	4,551	995	4,553	979	4,555	979	4,563
2009	1,003	4,532	1,003	4,530	990	4,515	990	4,514	973	4,481	973	4,482
2010	999	4,468	999	4,471	986	4,438	984	4,436	966	4,401	964	4,409
2011	992	4,448	992	4,452	979	4,417	977	4,416	960	4,380	958	4,392
2012	988	4,408	988	4,407	975	4,399	975	4,399	956	4,342	954	4,354
2013	975	4,419	975	4,424	960	4,389	958	4,391	954	4,317	952	4,320
2014	969	4,377	969	4,378	956	4,336	958	4,329	954	4,280	954	4,275
2015	964	4,351	964	4,347	958	4,305	958	4,301	956	4,256	954	4,250
2016	960	4,324	962	4,328	960	4,285	960	4,285	958	4,245	958	4,240
2017	964	4,309	964	4,309	962	4,263	962	4,257	958	4,213	958	4,213
2018	964	4,305	964	4,303	962	4,257	962	4,250	960	4,209	960	4,203
2019	966	4,268	966	4,269	964	4,234	964	4,232	964	4,187	964	4,186
2020	969	4,254	969	4,255	968	4,224	968	4,222	968	4,186	968	4,181
2021	969	4,226	969	4,227	969	4,195	969	4,192	969	4,159	969	4,162
2022	973	4,213	973	4,214	971	4,195	971	4,195	969	4,172	969	4,169
2023	973	4,207	973	4,206	971	4,190	971	4,188	971	4,164	971	4,166
2024	971	4,193	971	4,192	971	4,180	971	4,178	968	4,159	968	4,160
2025	975	4,186	975	4,190	975	4,167	975	4,167	973	4,146	973	4,147
2026	977	4,182	977	4,185	975	4,172	973	4,170	969	4,152	969	4,151
2027	977	4,159	977	4,154	969	4,147	969	4,146	969	4,126	969	4,124
2028	971	4,154	971	4,162	971	4,143	971	4,141	971	4,115	971	4,121
2029	973	4,156	973	4,163	973	4,146	973	4,144	973	4,117	973	4,120
2030	975	4,135	975	4,133	975	4,124	975	4,122	975	4,095	975	4,095
2031	975	4,113	975	4,112	975	4,102	975	4,098	975	4,073	975	4,072
2032	979	4,113	979	4,120	979	4,088	979	4,086	979	4,077	979	4,075
2033	981	4,096	981	4,096	981	4,088	981	4,087	981	4,064	981	4,071
2034	981	4,091	981	4,089	981	4,077	981	4,075	981	4,050	981	4,051
2035	982	4,065	982	4,064	982	4,051	982	4,049	982	4,022	982	4,021
2036	984	4,050	984	4,055	984	4,033	984	4,032	984	4,016	984	4,015
2037	984	4,026	984	4,030	984	4,014	984	4,013	984	4,005	984	4,003
2038	988	4,005	988	4,008	988	3,998	988	3,996	988	3,990	988	3,988
2039	988	4,005	988	4,006	988	3,996	988	3,995	988	3,987	988	3,986
2040	986	3,999	986	3,999	986	3,993	986	3,992	986	3,987	986	3,984
2041	990	3,995	990	3,998	988	3,990	988	3,989	986	3,981	986	3,980
2042	986	3,975	986	3,976	986	3,970	986	3,969	984	3,962	984	3,961
2043	988	3,968	986	3,969	988	3,962	988	3,961	988	3,948	988	3,952
2044	984	3,959	984	3,961	984	3,954	984	3,954	984	3,939	984	3,937
2045	981	3,957	981	3,958	979	3,947	979	3,947	979	3,934	979	3,934
2046	982	3,933	984	3,933	982	3,925	982	3,924	982	3,913	982	3,911
2047	977	3,928	977	3,928	977	3,918	977	3,917	977	3,909	977	3,911
2048	977	3,912	977	3,913	977	3,906	977	3,905	977	3,897	977	3,898
2049	973	3,904	973	3,904	973	3,898	973	3,897	973	3,891	973	3,892
2050	975	3,875	975	3,875	975	3,870	975	3,870	975	3,865	975	3,865
AVERAGE:												
2002-2016	997	4,532	997	4,532	987	4,527	987	4,527	975	4,516	976	4,518
2017-2050	978	4,086	978	4,087	977	4,071	977	4,069	976	4,050	976	4,050
2002-2050	983	4,222	984	4,223	980	4,211	980	4,209	976	4,193	976	4,193

Table 6

Glen Canyon Powerplant
Comparison of Capacity and Energy Production to Baseline Conditions
(Average Annual Value)

YEAR	Flood Control Alternative CAPACITY (MW)	Flood Control Alternative ENERGY (GWh)	Six States Alternative CAPACITY (MW)	Six States Alternative ENERGY (GWh)	Basin States Alternative CAPACITY (MW)	Basin States Alternative ENERGY (GWh)	California Alternative CAPACITY (MW)	California Alternative ENERGY (GWh)	Shortage Protection Alternative CAPACITY (MW)	Shortage Protection Alternative ENERGY (GWh)
2002	0	0	-5	37	-5	39	-13	94	-11	79
2003	0	-2	-5	34	-5	36	-13	86	-11	73
2004	0	0	-4	35	-5	39	-17	82	-13	80
2005	0	-2	-9	24	-11	27	-23	68	-21	70
2006	0	0	-12	31	-10	32	-25	54	-23	68
2007	0	0	-14	3	-14	5	-30	-4	-28	12
2008	0	-4	-12	-2	-12	0	-28	2	-28	10
2009	0	-2	-13	-17	-13	-18	-30	-51	-30	-51
2010	0	3	-13	-31	-15	-33	-34	-67	-36	-59
2011	0	4	-13	-31	-15	-32	-32	-68	-34	-56
2012	0	-1	-13	-8	-13	-9	-32	-66	-34	-54
2013	0	5	-15	-30	-17	-28	-21	-102	-23	-99
2014	0	1	-13	-41	-12	-48	-15	-97	-15	-102
2015	0	-4	-6	-46	-6	-50	-8	-95	-9	-101
2016	2	5	0	-38	0	-39	-2	-78	-2	-83
2017	0	0	-2	-46	-2	-51	-6	-96	-6	-96
2018	0	-2	-2	-48	-2	-55	-4	-96	-4	-101
2019	0	1	-2	-35	-2	-36	-2	-81	-2	-82
2020	0	1	-2	-30	-2	-32	-2	-67	-2	-73
2021	0	2	0	-31	0	-34	0	-67	0	-64
2022	0	1	-2	-18	-2	-19	-4	-41	-4	-44
2023	0	-1	-2	-17	-2	-19	-2	-43	-2	-40
2024	0	-1	0	-13	0	-15	-4	-35	-4	-34
2025	0	4	0	-19	0	-19	-2	-39	-2	-39
2026	0	2	-2	-11	-4	-13	-8	-30	-8	-31
2027	0	-5	-8	-12	-8	-13	-8	-33	-8	-35
2028	0	7	0	-11	0	-13	0	-39	0	-33
2029	0	7	0	-11	0	-12	0	-39	0	-37
2030	0	-1	0	-11	0	-12	0	-40	0	-40
2031	0	-1	0	-11	0	-15	0	-40	0	-41
2032	0	6	0	-25	0	-27	0	-37	0	-38
2033	0	1	0	-7	0	-9	0	-31	0	-25
2034	0	-2	0	-14	0	-16	0	-40	0	-40
2035	0	-1	0	-14	0	-15	0	-43	0	-44
2036	0	5	0	-17	0	-18	0	-34	0	-36
2037	0	4	0	-12	0	-13	0	-21	0	-23
2038	0	3	0	-7	0	-9	0	-15	0	-17
2039	0	1	0	-8	0	-10	0	-18	0	-18
2040	0	0	0	-6	0	-7	0	-12	0	-15
2041	0	4	-2	-5	-2	-6	-4	-13	-4	-15
2042	0	2	0	-4	0	-5	-2	-12	-2	-14
2043	-2	1	0	-6	0	-7	0	-20	0	-16
2044	0	2	0	-5	0	-6	0	-20	0	-23
2045	0	2	-2	-9	-2	-10	-2	-23	-2	-23
2046	2	0	0	-8	0	-9	0	-21	0	-22
2047	0	0	0	-9	0	-11	0	-18	0	-17
2048	0	1	0	-6	0	-7	0	-16	0	-15
2049	0	0	0	-5	0	-6	0	-13	0	-12
2050	0	0	0	-5	0	-5	0	-10	0	-10
AVERAGE:										
2002-2016	0	0	-10	-5	-10	-5	-21	-16	-21	-14
2017-2050	0	1	-1	-15	-1	-16	-1	-35	-1	-36
2002-2050	0	1	-4	-12	-4	-13	-8	-30	-7	-29

Table 7

Hoover Powerplant
Summary of Average Annual Capacity and Energy Production

YEAR	Baseline Conditions		Flood Control Alternative		Six States Alternative		Basin States Alternative		California Alternative		Shortage Protection Alternative	
	CAPACITY (MW)	ENERGY (GWh)	CAPACITY (MW)	ENERGY (GWh)	CAPACITY (MW)	ENERGY (GWh)	CAPACITY (MW)	ENERGY (GWh)	CAPACITY (MW)	ENERGY (GWh)	CAPACITY (MW)	ENERGY (GWh)
2002	2,062	4,451	2,062	4,451	2,061	4,664	2,061	4,680	2,061	4,956	2,061	4,881
2003	2,062	4,870	2,062	4,863	2,061	4,993	2,061	4,994	2,061	5,175	2,061	5,127
2004	2,062	4,893	2,062	4,859	2,061	4,959	2,061	4,968	2,058	5,032	2,060	5,057
2005	2,062	4,853	2,062	4,836	2,061	4,918	2,061	4,911	2,057	4,987	2,058	5,004
2006	2,061	4,852	2,061	4,873	2,059	4,890	2,060	4,901	2,044	4,923	2,046	4,931
2007	2,061	4,862	2,061	4,874	2,057	4,859	2,057	4,864	2,040	4,850	2,043	4,907
2008	2,061	4,781	2,061	4,777	2,057	4,801	2,055	4,807	2,038	4,816	2,034	4,808
2009	2,059	4,714	2,059	4,708	2,051	4,721	2,050	4,714	2,029	4,711	2,033	4,711
2010	2,060	4,652	2,060	4,657	2,048	4,622	2,048	4,629	2,026	4,623	2,014	4,614
2011	2,055	4,621	2,055	4,626	2,043	4,586	2,040	4,585	2,010	4,543	2,008	4,558
2012	2,053	4,592	2,055	4,611	2,034	4,561	2,033	4,571	2,008	4,483	2,005	4,479
2013	2,044	4,580	2,050	4,577	2,024	4,529	2,024	4,529	1,963	4,452	1,943	4,427
2014	2,038	4,553	2,050	4,553	2,019	4,485	2,017	4,482	1,907	4,407	1,942	4,393
2015	2,046	4,519	2,046	4,523	2,019	4,472	2,015	4,464	1,909	4,366	1,936	4,359
2016	2,033	4,487	2,033	4,497	2,005	4,412	1,971	4,408	1,907	4,315	1,904	4,317
2017	2,027	4,479	2,027	4,474	1,971	4,352	1,945	4,330	1,900	4,151	1,899	4,183
2018	2,017	4,449	2,019	4,448	1,936	4,309	1,918	4,308	1,897	4,162	1,909	4,180
2019	2,010	4,374	2,010	4,376	1,940	4,275	1,935	4,262	1,894	4,158	1,900	4,185
2020	2,010	4,389	2,010	4,389	1,935	4,284	1,942	4,280	1,894	4,182	1,900	4,207
2021	1,945	4,337	1,945	4,339	1,907	4,226	1,907	4,216	1,887	4,104	1,894	4,121
2022	1,940	4,294	1,940	4,299	1,900	4,195	1,902	4,198	1,885	4,038	1,890	4,077
2023	1,909	4,230	1,909	4,241	1,897	4,121	1,895	4,119	1,878	4,007	1,892	4,067
2024	1,907	4,189	1,907	4,203	1,900	4,110	1,900	4,092	1,880	3,933	1,895	4,010
2025	1,905	4,151	1,904	4,130	1,895	4,026	1,895	4,017	1,880	3,878	1,887	3,911
2026	1,900	4,108	1,902	4,124	1,895	3,975	1,895	3,962	1,878	3,825	1,878	3,846
2027	1,899	4,041	1,900	4,060	1,895	3,941	1,895	3,939	1,887	3,769	1,889	3,834
2028	1,894	3,959	1,895	3,986	1,894	3,870	1,892	3,862	1,885	3,700	1,885	3,771
2029	1,895	3,958	1,899	3,954	1,895	3,838	1,892	3,836	1,884	3,692	1,887	3,737
2030	1,892	3,961	1,892	3,956	1,887	3,805	1,887	3,784	1,885	3,674	1,885	3,710
2031	1,889	3,929	1,892	3,940	1,887	3,783	1,887	3,760	1,884	3,659	1,882	3,714
2032	1,885	3,887	1,895	3,888	1,885	3,767	1,885	3,759	1,882	3,642	1,880	3,683
2033	1,887	3,856	1,887	3,844	1,884	3,741	1,884	3,732	1,880	3,624	1,880	3,659
2034	1,885	3,855	1,885	3,875	1,882	3,742	1,878	3,738	1,878	3,634	1,878	3,684
2035	1,885	3,840	1,884	3,837	1,884	3,723	1,884	3,718	1,882	3,619	1,882	3,670
2036	1,884	3,803	1,887	3,807	1,884	3,711	1,884	3,708	1,882	3,606	1,884	3,666
2037	1,880	3,757	1,882	3,778	1,880	3,726	1,880	3,704	1,875	3,598	1,878	3,652
2038	1,882	3,727	1,882	3,740	1,882	3,677	1,882	3,655	1,875	3,544	1,875	3,595
2039	1,882	3,730	1,880	3,726	1,882	3,645	1,882	3,643	1,882	3,564	1,882	3,619
2040	1,878	3,665	1,878	3,661	1,878	3,593	1,878	3,593	1,878	3,518	1,878	3,586
2041	1,873	3,650	1,880	3,649	1,873	3,626	1,873	3,625	1,875	3,563	1,873	3,625
2042	1,877	3,584	1,877	3,591	1,877	3,569	1,877	3,568	1,878	3,511	1,877	3,564
2043	1,870	3,617	1,875	3,623	1,870	3,592	1,870	3,592	1,872	3,535	1,870	3,585
2044	1,870	3,606	1,870	3,623	1,870	3,580	1,870	3,597	1,870	3,509	1,870	3,572
2045	1,863	3,547	1,863	3,544	1,863	3,552	1,863	3,544	1,863	3,478	1,863	3,524
2046	1,863	3,566	1,868	3,593	1,863	3,557	1,863	3,543	1,865	3,490	1,863	3,540
2047	1,867	3,565	1,870	3,577	1,867	3,548	1,867	3,551	1,867	3,479	1,867	3,522
2048	1,870	3,532	1,870	3,525	1,870	3,526	1,870	3,517	1,870	3,434	1,870	3,488
2049	1,870	3,534	1,868	3,552	1,870	3,503	1,870	3,496	1,870	3,426	1,870	3,475
2050	1,865	3,532	1,865	3,511	1,865	3,499	1,865	3,496	1,867	3,413	1,865	3,453
AVERAGE:												
2002-2016	2,055	4,685	2,056	4,686	2,044	4,698	2,041	4,701	2,008	4,709	2,010	4,705
2017-2050	1,902	3,903	1,903	3,908	1,890	3,823	1,889	3,816	1,880	3,709	1,882	3,756
2002-2050	1,949	4,142	1,950	4,146	1,937	4,091	1,935	4,087	1,919	4,016	1,921	4,047

Table 8

Hoover Powerplant

Comparison of Capacity and Energy Production to Baseline Conditions

(Average Annual Value)

YEAR	Flood Control Alternative		Six States Alternative		Basin States Alternative		California Alternative		Shortage Protection Alternative	
	CAPACITY (MW)	ENERGY (GWh)	CAPACITY (MW)	ENERGY (GWh)	CAPACITY (MW)	ENERGY (GWh)	CAPACITY (MW)	ENERGY (GWh)	CAPACITY (MW)	ENERGY (GWh)
2002	0	0	-1	213	-1	228	-1	505	-1	429
2003	0	-7	-1	123	-1	124	-1	305	-1	256
2004	0	-34	-1	67	-1	75	-4	139	-2	165
2005	0	-17	-1	65	-1	58	-5	134	-4	151
2006	0	20	-2	38	-1	49	-17	71	-15	79
2007	0	12	-4	-3	-4	2	-21	-12	-18	45
2008	0	-4	-4	19	-6	26	-23	35	-27	27
2009	0	-6	-8	7	-9	0	-30	-3	-26	-3
2010	0	5	-12	-30	-12	-23	-34	-29	-46	-37
2011	0	5	-12	-35	-15	-35	-45	-77	-47	-63
2012	2	20	-19	-31	-20	-21	-45	-109	-48	-112
2013	5	-3	-20	-51	-20	-51	-81	-128	-101	-153
2014	12	-1	-19	-69	-21	-72	-131	-146	-96	-161
2015	0	3	-27	-47	-31	-55	-137	-154	-110	-160
2016	0	10	-28	-75	-62	-79	-126	-172	-129	-170
2017	0	-5	-56	-127	-83	-149	-127	-328	-129	-297
2018	2	-1	-81	-141	-100	-141	-120	-287	-108	-269
2019	0	2	-70	-99	-75	-112	-116	-216	-110	-189
2020	0	0	-75	-105	-69	-109	-116	-206	-110	-181
2021	0	2	-38	-111	-38	-121	-58	-233	-51	-216
2022	0	6	-39	-98	-38	-96	-55	-256	-50	-216
2023	0	10	-12	-109	-13	-112	-30	-224	-17	-163
2024	0	14	-7	-78	-7	-97	-27	-255	-12	-178
2025	-2	-21	-10	-125	-10	-134	-25	-272	-18	-240
2026	2	16	-5	-133	-5	-145	-22	-283	-22	-262
2027	2	19	-3	-100	-3	-102	-12	-272	-10	-206
2028	2	27	0	-89	-2	-97	-8	-259	-8	-188
2029	3	-4	0	-120	-3	-122	-12	-266	-8	-221
2030	0	-4	-5	-156	-5	-176	-7	-287	-7	-250
2031	3	11	-2	-146	-2	-169	-5	-269	-7	-215
2032	10	1	0	-120	0	-128	-3	-245	-5	-204
2033	0	-12	-3	-115	-3	-124	-7	-232	-7	-197
2034	0	20	-3	-113	-7	-117	-7	-221	-7	-172
2035	-2	-2	-2	-117	-2	-122	-3	-221	-3	-170
2036	3	5	0	-92	0	-95	-2	-196	0	-137
2037	2	21	0	-31	0	-53	-5	-159	-2	-105
2038	0	14	0	-50	0	-72	-7	-182	-7	-131
2039	-2	-4	0	-84	0	-87	0	-165	0	-110
2040	0	-5	0	-72	0	-72	0	-148	0	-79
2041	7	-2	0	-24	0	-25	2	-87	0	-25
2042	0	7	0	-16	0	-17	2	-73	0	-21
2043	5	5	0	-25	0	-25	2	-82	0	-32
2044	0	17	0	-26	0	-9	0	-96	0	-34
2045	0	-3	0	5	0	-2	0	-69	0	-23
2046	5	27	0	-8	0	-23	2	-76	0	-25
2047	3	12	0	-16	0	-14	0	-85	0	-43
2048	0	-7	0	-6	0	-15	0	-98	0	-44
2049	-2	18	0	-31	0	-38	0	-108	0	-59
2050	0	-21	0	-33	0	-36	2	-118	0	-79
AVERAGE:										
2002-2016	1	0	-11	13	-14	15	-47	24	-45	20
2017-2050	1	5	-12	-80	-14	-87	-23	-193	-20	-147
2002-2050	1	3	-12	-51	-14	-56	-30	-127	-28	-96

ATTACHMENT Q

Ten Tribes Depletion Schedule

This attachment contains a summary of Tribal water demands of the Ten Tribes Partnership used in FEIS modeling in the Colorado River Simulation System (CRSS). This listing has been updated from that presented in the DEIS.

Attachment Q
Ten Tribes Depletion Schedules

This attachment was derived from information sent to Reclamation from the Ten Tribes Partnership, as well as conversations held directly with representatives of the Jicarilla Tribe. As discussed in the DEIS, the CRSS model was altered to directly represent the scheduled diversions for the Ten Tribes.

Upper Basin Tribal Water Rights and Diversions

Table Q-1 lists the water rights and diversion locations of the Ten Tribes members in the Upper Basin, whose diversions are part of the Upper Division states apportionments. For each tribe, the table lists the diversion points which are represented in the CRSS model, the current annual volumes of diverted water (estimated 2000 volumes), and the full Colorado River water right held by the Tribe. As discussed in Section 3.14, the water rights are usually based on the amounts of agricultural acreage cited. Table Q-2 lists, for each Tribe, the current and projected depletions at each model demand node (representing each diversion point) used in model analysis. The depletions for each diversion point consist of the withdrawal from the river system minus the return flow to the river system, both of which are cited on the table.

Because each Tribal diversion is attributed to one of the Upper Basin states, the state diversion and depletion schedules used in the model include the Tribal diversions and depletions. Interim surplus criteria had no effect on Upper Basin deliveries, as expected, including the Indian demands above Lake Powell. As noted in Section 3.4.4.4, the normal delivery schedules of all Upper Basin diversions would be met under most water supply conditions. An Upper Basin diversion would be shorted only under periods of low hydrologic conditions and inadequate regulating reservoir storage capacity upstream of the diversion points. The model is not presently configured to track the relative priorities under those conditions. However, such effects are identical under baseline conditions and all alternatives.

Lower Basin Tribal Water Rights and Diversions

Table Q-3 lists the water rights and diversion locations of the Ten Tribes members in the Lower Basin, whose diversions are part of the Lower Division states normal apportionments. For each tribe, the table lists the diversion points which are represented in the CRSS model, the current annual volumes of diverted water (estimated 2000 volumes), and the full Colorado River water right held by the Tribe. As discussed in Section 3.14, the water rights are usually based on the amounts of agricultural acreage cited. Table Q-4 lists, for each Tribe, the current and projected depletions at each model demand node (representing each diversion point) used in model analysis. The depletions for each diversion point consist of the withdrawal from the river system minus the return flow to the river system, both of which are cited on the table.

Because each Tribal diversion is attributed to one of the Lower Basin states, the state diversion and depletion schedules used in the model include the Tribal diversions and depletions. Under normal conditions, deliveries to the Lower Basin are always equal to the normal depletion schedules, including those for the Indian tribes. Under shortage conditions, only CAP and SNWA share in the shortage until CAP goes to zero (which was not observed in any of the modeling runs done for this FEIS). Therefore, all tribes in the Ten Tribes Partnership in the Lower Basin receive their scheduled depletion amounts with the exception of the Cocopah Tribe, which has some Arizona Priority 4 water. However, the model is currently configured to assign all Priority 4 shortages to CAP, not other Priority 4 water users, as discussed in Section 3.4.4.4.

Table Q-1

Summary of Ten Tribes Partnership Water Rights and Diversion Locations in the Upper Basin

Tribe	State	River Basin	Point Description	Current		Full Right	
				Withdrawal (kaf)	Irrigated Acres	Allocated (kaf)	Allocated Acres
Northern Ute	Utah	Green	Ute Indian Uses Since 1965	12	3000	12	3000
Northern Ute	Utah	White	Ute Indians Compact (White River)	0	0	63	13192
Northern Ute	Utah	Green	Ute Indians Compact (Green River)	20	4350	124	27280
Northern Ute	Utah	Duchesne	Ag Abv Randlett-Pl-Ag - Ute	218	66074	218	66074
Northern Ute	Utah	Duchesne	New Indian Lands - Ute Indian Compact	0	0	54	8726
			Northern Ute Tribal Totals	250	73424	471	118272
Navajo	Arizona	San Juan	Gallup-Navajo Indian Water Supply-Tem	0	0	5	M&I
Navajo	New Mexico	San Juan	Navajo Indian Irrigation Project	183	63881	338	110630
Navajo	New Mexico	San Juan	Animas-LP New Mexico M&I - Navajo	0	0	5	M&I
Navajo	New Mexico	San Juan	Gallup Mun. Water Supply Proj.-Navajo	0	0	18	M&I
Navajo	New Mexico	San Juan	New Mexico Ag Hogback - Cudei	20	4348	42	9130
Navajo	New Mexico	San Juan	New Mexico Ag Fruitland - Misc	12	2609	32	6957
			Navajo Tribal Totals	215	70838	440	126717
Jicarilla Apache	New Mexico	San Juan	Jicarilla Apache	4	1000	32	9500
Jicarilla Apache	New Mexico	San Juan	San Juan Thermal-(PNM) - Jicarilla Lease	16	0	0	M&I
Jicarilla Apache	New Mexico	San Juan	San Juan-Chama Export (Jicarilla Portion)	7		7	Transbasin
Jicarilla Apache	New Mexico	San Juan	Future Off-Reservation M&I Leases	0		8	M&I
			Jicarilla Apache Tribal Totals	27	1000	46	9500
Southern Ute	Colorado	San Juan	P.L.-Ag Colorado - So. Utes	42	13815	49	16328
Southern Ute	Colorado	San Juan	Animas-La Plata M And I - So. Utes	0	0	40	M&I
			Southern Ute Tribal Totals	42	13815	89	16328
Ute Mountain Ute	Colorado	San Juan	Animas-La Plata M And I - Ute Mntn	0	0	40	M&I
Ute Mountain Ute	Colorado	San Juan	Colorado Ag - Ute Mntn	2	500	27	6750
Ute Mountain Ute	Colorado	San Juan	Dolores Import - Ag Use - Ute Mntn	17	5415	23	7500
Ute Mountain Ute	Colorado	San Juan	Dolores Import - M And I - Ute Mntn	2	0	2	M&I
			Ute Mountain Ute Tribal Totals	21	5915	92	14250
			Upper Basin Totals	555	164992	1137	285067
			Ten Tribes Partnership Totals	1310	265941	2063	424715

Table Q-2
Summary of Ten Tribes Partnership Development Schedules in the Upper Basin

Tribe	State	River Basin	Point Description	Development Schedule by Year (kaf)										
				Water Type	2000	2005	2010	2015	2020	2025	2030	2040	2050	2060
Northern Ute	Utah	Green	Ute Indian Uses Since 1965	Withdrawal	12	12	12	12	12	12	12	12	12	12
				Depletion	6	6	6	6	6	6	6	6	6	6
				Return Flow	6	6	6	6	6	6	6	6	6	6
Northern Ute	Utah	White	Ute Indians Compact (White River)	Withdrawal	0	8	16	24	32	40	56	63	63	63
				Depletion	0	4	8	12	16	20	28	31	31	31
				Return Flow	0	4	8	12	16	20	28	32	32	32
Northern Ute	Utah	Green	Ute Indians Compact (Green River)	Withdrawal	20	30	42	54	68	84	100	124	124	124
				Depletion	10	15	21	27	34	43	50	63	63	63
				Return Flow	10	15	21	27	34	41	50	61	61	61
Northern Ute	Utah	Duchesne	Ag Abv Randlett-Pl-Ag - Ute	Withdrawal	218	218	218	218	218	218	218	218	218	218
				Depletion	109	109	109	109	109	109	109	109	109	109
				Return Flow	109	109	109	109	109	109	109	109	109	109
Northern Ute	Utah	Duchesne	New Indian Lands - Ute Indian Compact	Withdrawal	0	6	12	18	24	30	36	54	54	54
				Depletion	0	4	9	13	18	22	27	40	40	40
				Return Flow	0	2	3	5	6	8	9	14	14	14
			Northern Ute Tribal Totals	Withdrawal	250	274	300	326	354	384	422	471	471	471
				Depletion	125	138	153	167	183	200	220	249	249	249
				Return Flow	125	136	147	159	171	184	202	222	222	222

Table Q-2
Summary of Ten Tribes Partnership Development Schedules in the Upper Basin

Tribe	State	River Basin	Point Description	Development Schedule by Year (kaf)										
				Water Type	2000	2005	2010	2015	2020	2025	2030	2040	2050	2060
Navajo	Arizona	San Juan	Gallup-Navajo Indian Water Supply-Tem	Withdrawal	0	0	5	5	5	5	5	5	5	5
				Depletion	0	0	5	5	5	5	5	5	5	5
				Return Flow	0	0	0	0	0	0	0	0	0	0
Navajo	New Mexico	San Juan	Navajo Indian Irrigation Project	Withdrawal	183	269	313	325	330	333	336	338	338	338
				Depletion	146	215	250	260	264	266	269	270	270	270
				Return Flow	37	54	63	65	66	67	67	68	68	68
Navajo	New Mexico	San Juan	Animas-LP New Mexico M&I - Navajo	Withdrawal	0	4	5	5	5	5	5	5	5	5
				Depletion	0	2	3	3	3	3	3	3	3	3
				Return Flow	0	2	2	2	2	2	2	2	2	2
Navajo	New Mexico	San Juan	Gallup Mun. Water Supply Proj.-Navajo	Withdrawal	0	5	10	14	18	18	18	18	18	18
				Depletion	0	5	10	14	18	18	18	18	18	18
				Return Flow	0	0	0	0	0	0	0	0	0	0
Navajo	New Mexico	San Juan	New Mexico Ag Hogback - Cudei	Withdrawal	20	24	26	28	32	36	42	42	42	42
				Depletion	10	12	13	14	16	18	21	21	21	21
				Return Flow	10	12	13	14	16	18	21	21	21	21
Navajo	New Mexico	San Juan	New Mexico Ag Fruitland - Misc	Withdrawal	12	14	16	18	22	26	32	32	32	32
				Depletion	6	7	8	9	11	13	16	16	16	16
				Return Flow	6	7	8	9	11	13	16	16	16	16
			Navajo Tribal Totals	Withdrawal	215	316	375	395	412	423	438	440	440	440
				Depletion	162	241	289	305	317	323	332	333	333	333
				Return Flow	53	75	86	90	95	100	106	107	107	107

Table Q-2
Summary of Ten Tribes Partnership Development Schedules in the Upper Basin

Tribe	State	River Basin	Point Description	Development Schedule by Year (kaf)										
				Water Type	2000	2005	2010	2015	2020	2025	2030	2040	2050	2060
Jicarilla Apache	New Mexico	San Juan	Jicarilla Apache	Withdrawal	4	11	11	11	11	11	11	11	11	11
				Depletion	2	7	7	7	7	7	7	7	7	7
				Return Flow	2	4	4	4	4	4	4	4	4	4
Jicarilla Apache	New Mexico	San Juan	*San Juan Thermal-(PNM) - Jicarilla Lease	Withdrawal	0	16	16	16	16	16	16	16	16	16
				Depletion	0	16	16	16	16	16	16	16	16	16
				Return Flow	0	0	0	0	0	0	0	0	0	0
Jicarilla Apache	New Mexico	San Juan	San Juan-Chama Export (Jicarilla Portion)	Withdrawal	7	7	7	7	7	7	7	7	7	7
				Depletion	7	7	7	7	7	7	7	7	7	7
Jicarilla Apache	New Mexico	San Juan	Future Off-Reservation M&I Leases	Withdrawal	0	3	3	4	4	4	4	4	4	4
				Depletion	0	3	3	4	4	4	4	4	4	4
			Jicarilla Apache Tribal Totals	Withdrawal	11	37	37	38	38	38	38	38	38	38
				Depletion	9	33	33	34	34	34	34	34	34	34
*The PNM lease begins in 2006				Return Flow	2	4	4	4	4	11	11	11	11	11
Southern Ute	Colorado	San Juan	P.L.-Ag Colorado - So. Utes	Withdrawal	42	44	45	46	48	49	49	49	49	49
				Depletion	22	23	23	24	25	26	26	26	26	26
				Return Flow	20	21	22	22	23	23	23	23	23	23
Southern Ute	Colorado	San Juan	Animas-La Plata M And I - So. Utes	Withdrawal	0	4	6	9	12	16	20	26	33	40
				Depletion	0	2	3	5	6	8	10	13	17	20
				Return Flow	0	2	3	4	6	8	10	13	16	20
			Southern Ute Tribal Totals	Withdrawal	42	48	51	55	60	65	69	75	82	89
				Depletion	22	25	26	29	31	34	36	39	43	46
				Return Flow	20	23	25	26	29	31	33	36	39	43

Table Q-2

Summary of Ten Tribes Partnership Development Schedules in the Upper Basin

Tribe	State	River Basin	Point Description	Development Schedule by Year (kaf)										
				Water Type	2000	2005	2010	2015	2020	2025	2030	2040	2050	2060
Ute Mountain Ute	Colorado	San Juan	Animas-La Plata M And I - Ute Mntn	Withdrawal	0	4	6	9	12	16	20	26	33	40
				Depletion	0	2	3	5	6	8	10	13	17	20
				Return Flow	0	2	3	4	6	8	10	13	16	20
Ute Mountain Ute	Colorado	San Juan	Colorado Ag - Ute Mntn	Withdrawal	2	4	6	8	10	12	14	18	22	27
				Depletion	1	2	3	4	6	7	8	11	15	19
				Return Flow	1	2	3	4	4	5	6	7	7	8
Ute Mountain Ute	Colorado	San Juan	Dolores Import - Ag Use - Ute Mntn	Withdrawal	17	19	20	21	23	23	23	23	23	23
				Depletion	13	15	16	17	18	18	18	18	18	18
				Return Flow	4	4	4	4	5	5	5	5	5	5
Ute Mountain Ute	Colorado	San Juan	Dolores Import - M And I - Ute Mntn	Withdrawal	2	2	2	2	2	2	2	2	2	2
				Depletion	1	1	1	1	1	1	1	1	1	1
				Return Flow	1	1	1	1	1	1	1	1	1	1
			Ute Mountain Ute Tribal Totals	Withdrawal	21	29	34	40	47	53	59	69	80	92
				Depletion	15	20	23	27	31	34	37	43	51	58
				Return Flow	6	9	11	13	16	19	22	26	29	34

Upper Basin Totals	Withdrawal	555	704	797	854	910	968	1033	1100	1118	1137
	Depletion	349	457	524	562	595	622	659	698	710	720
	Return Flow	206	247	273	292	315	346	374	402	408	417
Ten Tribes Partnership Totals	Withdrawal	1310	1509	1663	1780	1836	1894	1959	2026	2044	2063
	Depletion	763	952	1097	1214	1247	1274	1311	1350	1362	1372
	Return Flow	547	557	566	566	589	620	648	676	682	691

Table Q-3

Summary of Ten Tribes Partnership Water Rights and Diversion Locations in the Lower Basin

Tribe	State	River Basin	Point Description	Current		Full Right	
				Withdrawal (kaf)	Irrigated Acres	Allocated (kaf)	Allocated Acres
Fort Mojave	Nevada	Colorado	Fort Mohave Indian Res.(Nevada)	5	716	13	1939
Fort Mojave	Arizona	Colorado	Fort Mohave Indian Res.(Arizona)	81	10925	104	16018
Fort Mojave	California	Colorado	Fort Mohave Indian Res.(Calif.)	27	3354	17	2586
Fort Mojave	California	Colorado	Fort Mohave Land Development	0	0	0	0
			Fort Mojave Tribal Totals	113	14995	134	20543
Chemehuevi	California	Colorado	Chemehuevi Ind Res.	2	100	11	1900
			Chemehuevi Tribal Totals	2	100	11	1900
Colorado River	California	Colorado	CRIR Calif	5	3165	55	8213
Colorado River	Arizona	Colorado	CRIR Arizona	591	76633	662	99375
Colorado River	Arizona	Colorado	CRIR Pumped	0	0	0	0
			Colorado River Tribal Totals	596	79798	717	107588
Quechan	California	Colorado	Yuma Proj. Reservation Unit	31	3656.4	52	7743
			Quechan Tribal Totals	31	3656.4	52	7743
Cocopah	Arizona	Colorado	Cocopah Indian Reservation	13	2400	12	1874
Cocopah	Arizona	Colorado	Cocopah Indian Reservation	0	0	0	0
			Cocopah Tribal Totals	13	2400	12	1874

Lower Basin Totals	755	100949	926	139648
Ten Tribes Partnership Totals	1310	265941	2063	424715

Table Q-4

Summary of Ten Tribes Partnership Development Schedules in the Lower Basin

Tribe	State	River Basin	Point Description	Development Schedule by Year (kaf)										
				Water Type	2000	2005	2010	2015	2020	2025	2030	2040	2050	2060
Fort Mojave	Nevada	Colorado	Fort Mohave Indian Res.(Nevada)	Withdrawal	5	13	13	13	13	13	13	13	13	13
				Depletion	2	8	9	9	9	9	9	9	9	9
				Return Flow	3	5	4	4	4	4	4	4	4	4
Fort Mojave	Arizona	Colorado	Fort Mohave Indian Res.(Arizona)	Withdrawal	81	92	104	104	104	104	104	104	104	104
				Depletion	36	60	73	73	73	73	73	73	73	73
				Return Flow	45	32	31	31	31	31	31	31	31	31
Fort Mojave	California	Colorado	Fort Mohave Indian Res.(Calif.)	Withdrawal	27	17	17	17	17	17	17	17	17	17
				Depletion	15	12	12	12	12	12	12	12	12	12
				Return Flow	12	5	5	5	5	5	5	5	5	5
Fort Mojave	California	Colorado	Fort Mohave Land Development	Withdrawal	0	0	0	0	0	0	0	0	0	0
				Depletion	0	0	0	0	0	0	0	0	0	0
				Return Flow	0	0	0	0	0	0	0	0	0	0
			Fort Mojave Tribal Totals	Withdrawal	113	122	134	134	134	134	134	134	134	134
				Depletion	53	80	94	94	94	94	94	94	94	94
				Return Flow	60	42	40	40	40	40	40	40	40	40
Chemehuevi	California	Colorado	Chemehuevi Ind Res.	Withdrawal	2	5	8	11	11	11	11	11	11	11
				Depletion	1	3	5	8	8	8	8	8	8	8
				Return Flow	1	2	3	3	3	3	3	3	3	3
			Chemehuevi Tribal Totals	Withdrawal	2	5	8	11	11	11	11	11	11	11
				Depletion	1	3	5	8	8	8	8	8	8	8
				Return Flow	1	2	3	3	3	3	3	3	3	3
Colorado River	California	Colorado	CRIR Calif	Withdrawal	5	15	30	55	55	55	55	55	55	55
				Depletion	3	9	19	39	39	39	39	39	39	39
				Return Flow	2	6	11	16	16	16	16	16	16	16
Colorado River	Arizona	Colorado	CRIR Arizona	Withdrawal	591	612	637	662	662	662	662	662	662	662
				Depletion	327	367	414	463	463	463	463	463	463	463
				Return Flow	264	245	223	199	199	199	199	199	199	199
Colorado River	Arizona	Colorado	CRIR Pumped	Withdrawal	0	0	0	0	0	0	0	0	0	0
				Depletion	0	0	0	0	0	0	0	0	0	0
				Return Flow	0	0	0	0	0	0	0	0	0	0
			Colorado River Tribal Totals	Withdrawal	596	627	667	717	717	717	717	717	717	717
				Depletion	330	376	433	502	502	502	502	502	502	502
				Return Flow	266	251	234	215	215	215	215	215	215	215

Table Q-4
Summary of Ten Tribes Partnership Development Schedules in the Lower Basin

Tribe	State	River Basin	Point Description	Water Type	2000	2005	2010	2015	2020	2025	2030	2040	2050	2060
					Development Schedule by Year (kaf)									
Quechan	California	Colorado	Yuma Proj. Reservation Unit	Withdrawal	31	38	45	52	52	52	52	52	52	52
				Depletion	17	23	29	36	36	36	36	36	36	36
				Return Flow	14	15	16	16	16	16	16	16	16	16
			Quechan Tribal Totals	Withdrawal	31	38	45	52	52	52	52	52	52	52
				Depletion	17	23	29	36	36	36	36	36	36	36
				Return Flow	14	15	16	16	16	16	16	16	16	16
Cocopah	Arizona	Colorado	Cocopah Indian Reservation	Withdrawal	13	13	12	12	12	12	12	12	12	12
				Depletion	13	13	12	12	12	12	12	12	12	12
				Return Flow	0	0	0	0	0	0	0	0	0	0
Cocopah	Arizona	Colorado	Cocopah Indian Reservation	Withdrawal	0	0	0	0	0	0	0	0	0	0
				Depletion	0	0	0	0	0	0	0	0	0	0
				Return Flow	0	0	0	0	0	0	0	0	0	0
			Cocopah Tribal Totals	Withdrawal	13	13	12	12	12	12	12	12	12	12
				Depletion	13	13	12	12	12	12	12	12	12	12
				Return Flow	0	0	0	0	0	0	0	0	0	0
			Lower Basin Totals	Withdrawal	755	805	866	926	926	926	926	926	926	926
				Depletion	414	495	573	652	652	652	652	652	652	652
				Return Flow	341	310	293	274	274	274	274	274	274	274
			Ten Tribes Partnership Totals	Withdrawal	1310	1509	1663	1780	1836	1894	1959	2026	2044	2063
				Depletion	763	952	1097	1214	1247	1274	1311	1350	1362	1372
				Return Flow	547	557	566	566	589	620	648	676	682	691

ATTACHMENT R

Public Scoping Process

This attachment summarizes the scoping process conducted by Reclamation in 1999 to inform the public of the proposal to formulate interim surplus criteria and to obtain public input to the alternative formulation process.

PUBLIC SCOPING PROCESS

INTRODUCTION

This attachment summarizes public and governmental agency responses received during the initial scoping process. It consists of verbal responses at public scoping meetings held by Reclamation and written responses that are included in the summary table. This section also describes the various agencies involved in the production of this document, and associated permitting or formal consultation that may be necessary.

"Scoping" is an integral part of the NEPA process. It provides "an early and open process for determining the scope of issues to be addressed and for identifying the significant issues related to a proposed action" (40 CFR § 1501.7).

In the June 9, 1999 letter, addressed to "all interested persons", Reclamation inviting public participation in the scoping meeting, Reclamation invited oral or written comments concerning the following:

> "(1) the need for the development of surplus criteria, (2) the format for the criteria [either by revising Article III(3) of the Long-Range Operating Criteria or by developing interim criteria pursuant to Article III(3) of the Long-Range Operating Criteria], and (3) the specific issues and alternatives to be analyzed in the National Environment Policy Act process."

SCOPING ACTIVITIES AND ISSUES

SCOPING ANNOUNCEMENTS

Two notices were published in the *Federal Register* regarding the development of surplus criteria for management of the Colorado River. The first notice (64 FR 27008), published on May 18, 1999, was Reclamation's Notice to solicit comments and initiation of NEPA Process. The second notice (64 FR 29068), published on May 28, 1999, was Reclamation's Notice of public meetings.

Reclamation issued a press release on May 19, 1999 to ten newspapers, announcing the publication in the *Federal Register* of the Notice of Intent.

The public scoping meetings were announced by press release and by a memorandum sent to interested parties. Reclamation sent the press release to ten newspapers on May 28, 1999 with the dates and locations of the scoping meetings. The memorandum was sent on June 9, 1999 to nearly 530 interested parties.

PUBLIC SCOPING MEETINGS

Four public scoping meetings were held within the Colorado River Basin (including the Southern California service area) as part of the scoping process. The location, date, attendance and number of oral comments received at each meeting are summarized in Table 1.

Table 1

Summary of Scoping Meetings

Date	Location	Number Attending	Number Speaking
June 15, 1999	Phoenix, AZ	34	4
June 16, 1999	Ontario, CA	12	1
June 22, 1999	Las Vegas, NV	32	6
June 23, 1999	Salt Lake City, UT	15	2

ISSUES RAISED THROUGH SCOPING MEETINGS

A total of 35 response letters and eight oral responses (several individuals and organizations made both oral and written comments) were received during the scoping process.

To assist in understanding public concerns, a list of all responses including the name of the person commenting, their organizational affiliation, if any, and the subjects which they commented on is included in Table 2. A review of the responses helped identified areas of concern. The review used a list of five areas to categorize the responses:

- Authorized project purposes (32 comments, 26% of the comments)
- Habitat (12 comments, 10%)
- Socio-economic (11 comments, 9%)
- Special concerns (10 comments, 8%)
- Process (57 comments, 46%)

Typically the responses included comments in several different categories and often had several thoughts in a single category. For purposes of quantifying the public concerns, multiple thoughts in a single category contained in a single response were only counted once.

AUTHORIZED PROJECT PURPOSES

The Boulder Canyon Project Act identified five authorized project purposes: navigation, flood control, water supply, recreation and power. Nineteen (19) of the 32 comments in this category focused on water supply. There was no single focus of these water supply comments. Only one comment was received on navigation and the concern with regard to navigation was not identified.

HABITAT

The twelve (12) comments on habitat were wide ranging. There were no concerns expressed over air quality.

SOCIO-ECONOMIC

The comments on Socio-economic concerns were highly focused. All eleven addressed the regional distribution of water supply. This high level of concern is due to recognition that the allocation of surplus water and impacts of shortages are not equally shared among all users of Colorado River water. There were no concerns raised with possible impacts on land use, social conditions or growth inducing impacts. Note that the comments on project purposes discussed previously could also be considered socio-economic.

SPECIAL CONCERNS

The ten comments received within the area of Special Concerns noted the potential impacts of the Interim Surplus Criteria on Indian Issues (predominately reliability of water supply) and on obligations to Mexico.

PLAN FORMULATION PROCESS

The 57 comments received on the process to be followed dominated the letters. Many had specific alternatives they wanted considered. Most significant among those were supporters of the "Six States Plan" and supporters of the "California Plan". Additional remarks included opinions as to whether or not the Long-Range Operating Criteria should be modified to implement to Interim Surplus Criteria, concerns that the alternatives address the impacts on Lake Powell and three requests for additional time to respond.

Table 2

Colorado River Interim Surplus Criteria -- Analysis of Public Scoping Meetings & Response Letters

Letter #/Oral Comment #	Meeting Date	Transcript Page	Name	Position	Organization	Authorized project purposes					Habitat								Socio-economic				Special concerns			Process					Remarks
						Navigation	Flood Control	Water Supply	Recreation	Power	Fishery Habitat	Backwater Channel	Colorado River Delta	Endangered Species/ESA	Water Quality	Air Quality	Salton Sea	Other habitat/ general	Land Use Change	Social Conditions	Regional Impacts	Growth-inducing	Mexico	Indian Issues	Geology	Alternatives	Criteria Format	Need for Development of Surplus Criteria	Other Process	Legal Issues	(Note: "1" is used throughout as an indicator that can be computed by Excel. There is no ranking or priority associated with this digit)
1			Pamela Hyde	Executive Director	Glen Canyon Institute			1										1						1		1		1	1		**Water Supply:** Increased water from surpluses increases dependency in-lieu of alternative supplies or conservation. **Alternatives:** Analysis based on no storage available at Lake Powell. **Need for Development of Surplus Criteria:** LROC is inadequate. Wants criteria established. **Habitat:** Increased consumptive use reduces instream uses. **Other Process:** Wants full NEPA.
2			Joe Muniz (faxed by Jessica Aberly, att.)	Chairman, Jicarilla Apache Tribe	Colorado River Basin Tribes Partnership ("Ten Tribes Partnership")			1																1					1		**Water Supply and Indian Issues:** May impact tribes' water supply rights. **Other Process:** Tribes need funding for technical assistance in review of study. Tribes need more time to comment on Scope.
3			Maureen George	City Attorney	Lake Havasu City			1													1										**Water supply & Regional:** Concerned with impact of shortages on City and AZ. Some cities along river do not have supplemental source to river.
4			Rachel Thomas	President	Arizona People for the USA																								1		**Other Process:** Request extension to comment period.
5			Joe Muniz (original of letter 2)	Chairman	CO River Basin Tribes Partnership																										Original of letter No. 2. (Boxes checked at letter only to avoid double counting)
6			Donald R. Pope	Manager	Yuma County Water Users' Association		1	1							1										1	1	1	1			**Criteria Format:** No need to revise LROC. **Need for Development of Surplus Criteria**: More definitive criteria needed, but w/i framework of AOP. **Mexico:** Need more specific guidelines for surpluses to Mexico. **Water Supply & Alternatives:** Favor more liberal definition of surplus -- 50% or 30% flood probability should trigger surplus releases. **Flood Control & Geology**: Hoover releases in excess of 19,000 cfs cause flooding/high groundwater on 25,000 ac of farm land. Also subject to flooding: Gila Valley, City of Yuma, County of Yuma, Cocopah Indians, Yuma Project, Bard ID, Quechan Tribe.
7			Tom Levy	Gen. Managr & Ch Eng'r	Coachella Valley Water District			1																		1	1	1		1	Support comments of Colorado River Board of California.

Letter #/Oral Comment #	Meeting Date	Transcript Page	Name	Position	Organization	Authorized project purposes					Habitat								Socio-economic				Special concerns			Process					Remarks (Note: "1" is used throughout as an indicator that can be computed by Excel. There is no ranking or priority associated with this digit)
						Navigation	Flood Control	Water Supply	Recreation	Power	Fishery Habitat	Backwater Channel	Colorado River Delta	Endangered Species/ESA	Water Quality	Air Quality	Salton Sea	Other habitat/ general	Land Use Change	Social Conditions	Regional Impacts	Growth-inducing	Mexico	Indian Issues	Geology	Alternatives	Criteria Format	Need for Development of Surplus Criteria	Other Process	Legal Issues	
8			Stanley M. Pollack	Water Rights Counsel	The Navajo Nation, Dept of Justice, Natural Resources Unit.																			1					1		**Indian Issues**: May impact tribal water rights. **Other Process**: Tribes need more time to comment on Scope.
9			Larry J. Paulson, Ph.D. (via e-mail) (reference No. 25 also)	Citizen	Public (member of Lake Mead Water Quality Forum & SNWA Water Quality Citizens Advisory Committee)			1							1						1					1	1				**Water Supply, Water Quality & Regional:** In favor of lower levels at Lake Mead to reduce evaporation. Concerned with hierarchy of beneficial uses (see oral comments O-6) NV needs more than 4%. NV relies of credits due to return flows of treated wastewater and contaminated groundwater to Lake Mead via Las Vegas Wash. **Criteria Format:** Follow NEPA. **Alternatives:** Operate Mead to reduce evaporation.
10			Peter H. Evans (via fax) (original received 7/6/99)	Director	State of Colorado, Colorado Water Conservation Board, Department of Natural Resources			1													1					1					**Alternatives & Regional:** Will not favor any alternative which isn't tied to CA 4.4 Plan (specific steps are listed). Needs to allocate surpluses among states. Banking in CA of Co River water limited to when a reservoir spill is otherwise imminent. Must be interim. Must examine & mitigate increased risk of shortage on AZ & NV. Includes a proposed criteria. Extra M&I water to CA must be incremental to other sources available to CA. **Water Supply & Regional:** Concerned that balancing between Mead and Powell and more liberal criteria at Mead will lead to lowering Powell and impacts on Upper Basin supply.
11			Robert S. Lynch, Attny (via fax-original rec'd 7/6/99)	Chairman of the Board	Central Arizona Project Association					1																1		1			**Need for development of surplus criteria:** Not needed. **Implementation Options:** Don't change LROC. **Power**: Study 1083 elevation and gauge power impacts.
12			Manuel R. Ybarra (via fax) (original rec'd 7/6/99)	Secretary	International Boundary and Water Commission																		1								**Mexico:** Must meet treaty obligations. **Water quality:** Salinity of water delivered to Mexico.

Letter #/Oral Comment #	Meeting Date	Transcript Page	Name	Position	Organization	Authorized project purposes					Habitat								Socio-economic				Special concerns			Process					Remarks (Note: "1" is used throughout as an indicator that can be computed by Excel. There is no ranking or priority associated with this digit)
						Navigation	Flood Control	Water Supply	Recreation	Power	Fishery Habitat	Backwater Channel	Colorado River Delta	Endangered Species/ESA	Water Quality	Air Quality	Salton Sea	Other habitat/ general	Land Use Change	Social Conditions	Regional Impacts	Growth-inducing	Mexico	Indian Issues	Geology	Alternatives	Criteria Format	Need for Development of Surplus Criteria	Other Process	Legal Issues	
13			Rita P. Pearson (via fax) (original rec'd 7/6/99)	Director	Arizona Department of Water Resources		1	1	1	1								1			1				1		1	1			**Criteria Format & Need for development of Surplus Criteria:** No change in LROC is needed. **Regional Impacts:** AZ is particularly sensitive to shortages. Power: Normal water deliveries probably maximize power. **Flood control & Geology:** Minimize flood damage. High flows cause water logging and increase need for drainage pumping in Yuma Area (per oral comments). **Recreation & Environment:** Balance these purposes.
14			Gregory Oleson	Corporate Counsel	US Filter																						1			1	**Criteria Format & Legal Issues:** Criteria should address & establish consistency w/ exist laws. **Alternatives:** Emphasize efficiencies of water markets.
15			William J. Snape, III and John A. Fritschie (via fax-original rec'd 7/6/99)	Legal Director Litigation Counsel	Defenders of Wildlife								1	1			1	1					1	1				1			**Colorado River Delta:** Cottonwood-willow forests depend on spills. **Need for development of surplus criteria:** Dire need for specific criteria for surplus, shortage and normal years. **Endangered Species:** Compliance with Endangered Species Act. **Other issues:** Letter listed others without discussing, they have been checked off.
16			Bernadine Boyd (via fax-original rec'd 7/6/99)	President, Tribal Council	Fort McDowell Indian Community			1																1							**Water supply & Indian Issues:** Water supply must be reliable.
17			Gordon W. Fassett (via fax - original rec'd 7/6/99)	State Engineer	Wyoming State Engineer's Office																					1	1				**Need for development of Surplus Criteria:** Support development of both Surplus and Shortage criteria. **Criteria Format:** Don't modify LROC.
18			Larry R. Dozier (via fax)	Deputy General Manager	Central Arizona Project (Central Arizona Water Conservation District)			1		1											1					1	1	1			**Criteria Format:** NEPA process not required. Use the AOP process. **Alternatives & Regional:** AZ is impacted first by shortages. Thus consider shortages. CA to comply with 4.4. AZ to get RRA Section 215 waiver. **Power & Regional:** CAP is largest AZ user of Hoover B & C power allocation (from 15 Jun hearing comment O-3)
19			Wayne E. Cook (via fax) (original received 7/6/99)	Executive Director	Upper Colorado River Commission																					1	1				**Criteria Format:** NEPA process not required. Use the AOP process. **Alternatives:** Concur with Six Basin States Proposal recommendations.

Letter #/Oral Comment #	Meeting Date	Transcript Page	Name	Position	Organization	Authorized project purposes					Habitat								Socio-economic				Special concerns			Process					Remarks (Note: "1" is used throughout as an indicator that can be computed by Excel. There is no ranking or priority associated with this digit)
						Navigation	Flood Control	Water Supply	Recreation	Power	Fishery Habitat	Backwater Channel	Colorado River Delta	Endangered Species/ESA	Water Quality	Air Quality	Salton Sea	Other habitat/ general	Land Use Change	Social Conditions	Regional Impacts	Growth-inducing	Mexico	Indian Issues	Geology	Alternatives	Criteria Format	Need for Development of Surplus Criteria	Other Process	Legal Issues	
20			D. Larry Anderson, P. E. (via fax)	Director	State of Utah, Dept of Natural Resources, Div of Water Resources																					1	1	1			**Need for development of Surplus Criteria:** Concur. **Alternatives:** Dependent on CA 4.4 Plan. Criteria **Format:** Oppose changes to LROC.
21			Richard Bunker and Patricia Mulroy (via fax)	Chairman General Manager	Colorado River Commission of Nevada & Southern Nevada Water Authority			1													1					1	1				**Water supply:** M&I uses should be higher priority than before other uses. **Alternatives:** Depend on CA efforts and success with 4.4 Plan. Must address shortages. **Format for the criteria:** Do not incorporate into LROC. Use AOP as vehicle it implement criteria. **Other process:** Develop specific surplus criteria prior to NEPA process. **Regional:** States have special role.
22			Tim Henley	Manager	Arizona Water Banking Authority			1													1						1			1	**Water supply:** Generally in favor of more liberal surplus as long as shortage addressed. **Legal:** Consistent w/ AZ vs. CA. **Also,** concur w/AZ DWR comments.
23			Michael Cohen	Research Associate	Pacific Institute for studies in development, environment, and security.								1										1			1			1		**Alternatives:** Address shortages include climate changes. **Other process:** Include range of consumption scenarios, include water conservation. **Colorado River Delta**: Cottonwood-willow forests depend on spills. **Endangered species:** Include formal Section 7 consultations w/USF&W. **Mexico:** Mexico has surplus rights under '44 treaty. (Oral Comments O-7).
24			Roger Manning	Executive Director	Arizona Municipal Water Users Association		1	1	1	1								1			1						1	1			Concur with AZ DWR comments.
25			Larry J. Paulson, Ph.D.	Citizen	Public																										See letter 9. (Boxes checked at letter 9 only to avoid overcounting)
26			William I. Jackson, Ph.D. (via fax-original rec'd 7/6/99)	Chief, Water Operations Branch	National Park Service	1			1		1							1								1	1	1			**Criteria Format:** Support NEPA process. **Recreation & Habitat in General:** Dependent on frequency of spills from Powell & impacted by flows. Liberal surplus criteria will reduce natural spills. **Recreation and Fishery Habitat:** Impacts when Powell below 3,650. **Navigation:** Issue when Mead below 1170. **Alternatives:** Prefer fuller reservoirs. **Need for development of surplus criteria:** In favor.

Letter #/Oral Comment #	Meeting Date	Transcript Page	Name	Position	Organization	Authorized project purposes					Habitat								Socio-economic				Special concerns			Process					Remarks (Note: "1" is used throughout as an indicator that can be computed by Excel. There is no ranking or priority associated with this digit)
						Navigation	Flood Control	Water Supply	Recreation	Power	Fishery Habitat	Backwater Channel	Colorado River Delta	Endangered Species/ESA	Water Quality	Air Quality	Salton Sea	Other habitat/ general	Land Use Change	Social Conditions	Regional Impacts	Growth-inducing	Mexico	Indian Issues	Geology	Alternatives	Criteria Format	Need for Development of Surplus Criteria	Other Process	Legal Issues	
27			Gerald R. Zimmerman	Executive Director	Colorado River Board of California			1																		1	1	1		1	**Alternatives:** Must have specific term. Contain 3 tiers of surplus. **Criteria Format:** Develop pursuant to LROC & use in conjunction w/LROC to develop AOP. **Need for Development of Surplus Criteria & Water Supply:** Exist criteria does not optimize Water Supply. **Other Process:** Dependent on Cal 4.4 Plan & agreements internal to CA, or comments don't apply.
~~28~~				~~Cental Arizona Project~~																											Original of No 18 Fax.
29			Jay B. Burnham	City Attorney	City of Farmington			1													1										**Water Supply & Regional:** Upper Basin will in future need more than allocation & should have rights to surplus flows.
30			R. Eric Kuhn	Secretary/ General Manager	Colorado River Water Conservation District			1	1	1											1										**Water Supply & Regional:** Oppose increased drawdown of Powell caused by equalization. **Recreation and Power:** Drawdown of Powell would adversely affect both. **Alternatives:** Must be tied to CA 4.4 Plan. Must be interim. Modify or eliminate equalization. **Also:** Endorse comments of Colorado Water Conservation Board.
31			Ronald R. Gastelum	General Manager	Metropolitan Water District of Southern California			1																		1	1	1		1	Concur with Colorado River Board comments.
32			Thomas C. Havens	President	American Water Resources,Inc.																								1		**Other process:** Need to address 50 to 100 year path rather than short term.
33			Philip B. Mutz	Upper CO River Commissioner for NM	New Mexico Interstate Stream Commission																					1	1	1			**Need for Development of Surplus Criteria:** Not until CA 4.4 Plan is developed. **Criteria Format:** Use the Annual Operating Plan. **Alternatives:** Short term strategy must terminate if CA doesn't make progress.
34			John Penn Carter	Attorney, Horton, Knox, Carter & Foote	Imperial Irrigation District																								1		**Other Process:** Concur with Colorado River Board of CA comments only if settlement of issues being negotiated by CRB agencies. Otherwise, reopen comment period to allow IID & other CA agencies to submit independent comments..
35			Nino J. Mascolo		Southen California Edison Co.																										No comments, but interested in water banking.
O-1	15-Jun	49	Herb Dishlip	Assistant Director	AZ DWR																										See letter 13. (Boxes checked at letter only to avoid double counting)

Letter #/Oral Comment #	Meeting Date	Transcript Page	Name	Position	Organization	Authorized project purposes: Navigation	Flood Control	Water Supply	Recreation	Power	Habitat: Fishery Habitat	Backwater Channel	Colorado River Delta	Endangered Species/ESA	Water Quality	Air Quality	Salton Sea	Other habitat/ general	Socio-economic: Land Use Change	Social Conditions	Regional Impacts	Growth-inducing	Special concerns: Mexico	Indian Issues	Geology	Process: Alternatives	Criteria Format	Need for Development of Surplus Criteria	Other Process	Legal Issues	Remarks (Note: "1" is used throughout as an indicator that can be computed by Excel. There is no ranking or priority associated with this digit)
O-2	15-Jun	57	Larry Dozer	Deputy General Manager	Central Arizona Project (Central AZ Water Conservation District)																										See letter 18. (Boxes checked at letter only to avoid double counting)
O-3	15-Jun	61	Bob Lynch	Chairman	Central Arizona Project Assoc.																										See letter 11. (Boxes checked at letter only to avoid double counting)
O-4	16-Jun				No comments at this hearing.																										There were no comments at the 16 Jul scoping meeting.
O-5	22-Jun	28 & 35	Donald Pope	Manager	Yuma County Water Association																										See letter 5 (Boxes checked at letter only to avoid double counting).
O-6	22-Jun	31 & 41	Larry Paulson		Public																										See letter 9. (Boxes checked at letter only to avoid double counting).
O-7	22-Jun	33	Mike Cohen		Pacific Institute for Studies in Development, Environment and Security.																										See letter 23. (Boxes checked at letter only to avoid double counting).
O-8	22-Jun	36	Mary Manning		Las Vegas Sun Newspaper			1																							**Water Supply:** Consider extended drought.
O-9	23-Jun	29	Brent Israelsen		Salt Lake Tribune			1													1										**Water Supply and Regional:** Estimation of Upper Basin depletions.
					Comments by category	1	3	19	4	5	1	0	2	1	2	0	1	5	0	0	11	0	3	5	2	16	16	13	7	5	
					Comments by group	32					12								11				10			57					
					Total comments	122																									

ATTACHMENT S

Correspondence with U.S. Fish and Wildlife Service and National Marine Fisheries Service

This attachment contains correspondence between Reclamation and the U.S. Fish and Wildlife Service on Section 7 consultation regarding the potential effects of interim surplus criteria downstream on listed species and upstream of Lake Mead in the United States, and in the Colorado River Delta area of Mexico. Downstream of Lake Mead the consultation also addressed changes in water delivery points under California's Colorado River Water Use Plan. Upstream of Lake Mead the consultation involved minor operational changes of Glen Canyon Dam operation on evaluation of the effects from the Colorado River corridor below Glen Canyon Dam. Consultation with the National Marian Fisheries Service addressed effects on aquatic species in the Colorado River estuary and the upper Sea of Cortez.

Bcco - 461

United States Department of the Interior

BUREAU OF RECLAMATION
Lower Colorado Regional Office
P.O. Box 61470
Boulder City, NV 89006-1470

IN REPLY REFER TO:
LC-2011
ENV-7.00

MAY 22 2000

MEMORANDUM

To: Mr. David Harlow, State Superintendent, Arizona Ecological Services, 2321 W. Royal Palm Road, Suite 103, Phoenix AZ 85021

From: William E. Rinne, Area Manager
Boulder Canyon Operations Office

Subject: Species List for Conducting an Accounting of the Potential Effects of Interim Surplus Criteria, Elements of the California Water Plan Requiring the Secretary of the Interior's Approval, and Associated Conservation Measures on Listed or Proposed Species and Designated or Proposed Critical Habitat

Per 50 CFR §402.12(c), this is a request for a list of any listed or proposed species or designated or proposed critical habitat that may be present in the action area. Based on our previous discussions and pending a determination of effects, if any, on the reach of the Colorado River from immediately above Lake Mead to flows into Lake Powell, the minimum action area for the proposed actions encompass the lower Colorado River from Lake Mead to the southerly international boundary, including the 100-year flood plain and Lakes Mead, Mohave, and Havasu to full pool elevations.

The actions being considered in this accounting are (1.) interim surplus criteria which is intended to provide surplus water (that above a normal year of 7.5 million acre-feet) to the lower basin states (AZ, CA, NV) for a period of 15 years (2001-2015), (2.) Secretary's approval, via implementation agreements with California, for the transfer of up to 400,000 acre feet/year of California's entitlement water from the current diversion at Imperial Dam to an up stream point of diversion at Lake Havasu, and (3.) associated conservation measures that may be developed as part of the action subject to the accounting of effects. Detailed descriptions of these actions are being prepared.

Based on our previous consultation (1996-97) on lower Colorado River operations and maintenance and recent discussions among our staffs, the effects of the proposed actions on the following species and critical habitat will be determined:

- Endangered: Southwestern willow flycatcher, brown pelican, Yuma clapper rail, razorback sucker, and bonytail
- Threatened: Desert tortoise

- Potential Proposed: Black rail, yellow-billed cuckoo
- Critical Habitat: Bonytail and razorback sucker

Your concurrence or modification of this list is requested.

If you have questions regarding this request and the action elements, please contact Tom Shrader at 702-293-8703.

/s/ William E. Rinne

cc: Ms. Nancy Kaufman
Regional Director
Region Two
Fish and Wildlife Service
PO Box 1306
Albuquerque NM 87103-1306

Mr. Mike Spear
California-Nevada Operations Manager
Fish and Wildlife Service
2800 Cottage Way, Room W-2606
Sacramento CA 95825

Mr. Ken Berg
Field Supervisor
Fish and Wildlife Service
Carlsbad Field Office
2730 Loker Avenue West
Carlsbad CA 92008

bc: Commissioner,
Attention: W-6333
Regional Director, Boulder City NV
Attention: LC-2011, LC-2311, LC-2312, LC-2316
Regional Director, Salt Lake City UT
Attention: UC-438, UC-720
Area Managers,
Attention: YAO-1000, YAO-1400, YAO-2200, BCOO,1000, BCOO-1010, BCOO-4400, BCOO-4600

United States Department of the Interior
U.S. Fish and Wildlife Service
2321 West Royal Palm Road, Suite 103
Phoenix, Arizona 85021-4951
Telephone: (602) 640-2720 FAX: (602) 640-2730

In Reply Refer To:
AESO/SE
2-21-00-I-273

June 5, 2000

6-13 RC 1200 4600

Memorandum

To: Area Manager, Boulder Canyon Operations Office, Bureau of Reclamation, Boulder City, Nevada

From: Acting Field Supervisor

Subject: Request for Concurrence with Species List for Potential Effects of Interim Surplus Criteria, Elements of California Water Plan Requiring Secretary of the Interior's Approval, and Associated Conservation Measures on Listed and Proposed Species and Designated or Proposed Critical Habitat

The Fish and Wildlife Service has reviewed the list of listed, proposed and candidate species in your memorandum dated May 22, 2000 for the subject project. We concur with the list of species provided, with the addition of the following species to your list.

Bald eagle (Haliaeetus leucocephalus)
Desert pupfish (Cyprinodon macularius)

This list does not include species found in or adjacent to the Colorado River above Lake Mead. Should the impact area of the project be expanded to include the Colorado River above Lake Mead, please contact us to obtain a list of species to be considered for that area. This list also does not include any species found in the Republic of Mexico that are not found in the United States. Species under jurisdiction of the National Marine Fisheries Service are also not included in this concurrence.

If there are any questions regarding this list of species, please contact Lesley Fitzpatrick (x236) or Tom Gatz (x240).

for David L. Harlow

surplus species list:LAF:kh

United States Department of the Interior

U.S. Department of the Interior 1849•1999

OFFICE OF THE SOLICITOR
Washington, D.C. 20240

IN REPLY REFER TO:

AUG 14 2000

Memorandum

To: Eluid L. Martinez, Commissioner, Bureau of Reclamation

From: John Leshy, Solicitor, U.S. Department of the Interior John Leshy

Subject: Interim Surplus Guidelines and the Endangered Species Act -- Possible Effects in the Republic of Mexico

The Secretary of the Interior currently manages the lower Colorado River system in accordance with federal law, including the 1964 Decree of the U.S. Supreme Court in *Arizona v. California*, the Colorado River Basin Project Act of 1968 (CRBPA), and Long Range Operating Criteria (LROC) adopted pursuant to the CRBPA. Within this legal framework, the Secretary makes annual determinations regarding the availability of surplus water from Lake Mead, by considering various factors, including the amount of water in storage and predictions for natural runoff. The 1964 Decree provides that if sufficient mainstream Colorado River water is available for release (primarily from Lake Mead) to satisfy annual consumptive use in the states of Arizona, California, and Nevada in excess of 7.5 million-acre feet, as determined by the Secretary, such excess consumptive use in Arizona, California and Nevada is "surplus."

Interim Surplus Guidelines currently being developed by the Bureau of Reclamation are intended to be used by the Secretary through the year 2015 in making annual determinations of surplus conditions. Reclamation is preparing these guidelines in compliance with applicable federal law, including the provisions of the National Environmental Policy Act (NEPA) and the Endangered Species Act (ESA). An issue has arisen whether Reclamation must, as part of its ESA compliance, consider any effects of the proposal to adopt these guidelines on species in Mexico listed as endangered or threatened under the Endangered Species Act. This issue is complex, involving analysis of international treaties, domestic statutes and regulations, as well as the Supreme Court's 1964 Decree. Its resolution has attracted considerable attention outside as well as inside the Executive Branch.

I am in the process of analyzing this issue and discussing it with the Department of Justice and the Department of Commerce, as well as other agencies in Interior. Among other things, I am reviewing statements made on behalf of the United States in prior litigation such as Defenders of Wildlife v. Lujan, 504 U.S. 555 (1992), and considering the recent complaint filed in D.C. District Court challenging the adequacy of Reclamation's existing Lower Colorado ESA compliance. Defenders of Wildlife, et. al. v. Babbitt, et. al., No. 1:00CV01544 (D.D.C. filed June 28, 2000).

FILE

The adoption of interim surplus guidelines is a high priority for Secretary Babbitt, and it is important that we move that process forward. Therefore, while we continue our internal discussions on this complex legal issue, consultation between Reclamation and agencies with consultation responsibility over the species involved (the U.S. Fish and Wildlife Service and the National Marine Fisheries Service) should continue. The continuation of consultation does not reflect any conclusion on our part that consultation is required, as a matter of law or regulation, on any possible impact the adoption of interim surplus guidelines may have on U.S.-listed species in Mexico. Rather, Reclamation's consultation on these effects should proceed with the express understanding that it may exceed what is required under applicable federal law and regulations and does not establish a legal or policy precedent. The exchange of information between Reclamation and the consulting agencies during this consultation may prove useful in any event, such as for use in any future discussions with the Republic of Mexico pursuant to section 8 of the ESA, which directs the Secretary to promote the conservation of listed species beyond our borders, including by agreements with foreign governments. ESA § 8(b). I understand that much of this information is already available in Reclamation's Draft EIS on this project.

The ongoing discussions with the consulting agencies should also take into consideration the fact that the United States cannot unilaterally control hydrologic conditions in the Colorado River south of the international boundary. Under the terms of the U.S.-Mexican Water Treaty of 1944, waters of the Colorado delivered to the Republic of Mexico are subject to its control, and the treaty contains no provisions requiring Mexico to use any of that water for species preservation in the Delta. Finally, the discussions should take into account mandates and limitations on Reclamation's actions pursuant to the Supreme Court's 1964 Decree. Because of the unique complexity of this situation, if these discussions produce suggestions for measures to minimize or avoid adverse effects on listed species, we will need to review them to determine their consistency with these various legal requirements.

Please contact me if you have any questions or concerns regarding this matter.

cc: Jamie Clark, Director, U.S. Fish and Wildlife Service
Penny Dalton, National Marine Fisheries Service

LC-2811

United States Department of the Interior

BUREAU OF RECLAMATION
Boulder Canyon Operations Office
P.O. Box 61470
Boulder City, NV 89006-1470

IN REPLY REFER TO:
BCOO-1000
ENV-7.00

AUG 3 1 2000

MEMORANDUM

To: Mr. David Harlow, Field Supervisor, US Fish and Wildlife Service, 2321 West Royal Palm Road, Suite 103, Phoenix AZ 85021-4951

From: Mr. William E. Rinne
Area Manager

Subject: Final Biological Assessment and Request for Formal Section 7, Endangered Species Act(ESA), Consultation on Interim Surplus Criteria (ISC), Secretarial Implementation Agreement (SIA) for California Water Plan Components, and Conservation Measures (August 2000)

Reclamation requests formal consultation with the Fish and Wildlife Service (FWS) pursuant to section 7 of the ESA for the above referenced actions. The Secretary of the Interior, acting through Reclamation, is considering the adoption of specific ISC under which surplus water conditions may be declared in the Lower Colorado River Basin and the execution of SIAs that provide for a change in point of delivery of Colorado River water for use within California. Several conservation measures would also be implemented as part of these proposed actions.

The attached Biological Assessment was prepared to evaluate the likely effects of these proposed actions on listed species or critical habitat as required by the ESA. The Biological Assessment includes determinations that the proposed action may affect the endangered Southwestern willow flycatcher, Yuma clapper rail, razorback sucker, and bonytail chub; and may adversely modify critical habitat for the razorback sucker.

An initial draft of the Biological Assessment was provided to your office and to applicants for the SIAs on August 15, 2000, for review. We have subsequently considered comments received from the FWS and two applicants, San Diego County Water Authority and Imperial Irrigation District, in revising the attached Biological Assessment. Copies of the applicant comment letters are also attached for your reference. Additional responses to points raised in your August 22, 2000 memorandum are provided in the remainder of this memorandum.

After further consideration, we have decided to limit this consultation to the ISC, SIAs and associated conservation measures. The water administration and quantification of priority 3 agricultural entitlements are no longer part of the proposed actions, and therefore, have been removed from the attached Biological Assessment.

We have also provided more information, beginning on page 35 of the Biological Assessment, on how any indirect effects associated with the proposed actions will be addressed. The overall approach is to assure ESA coverage for any indirect effects of the ISC and SIAs, through either section 10 permits issued with the adoption of Habitat Conservation Plans (HCPs) and/or project specific section 7 consultations, if necessary.

With regard to your suggestion to raise the river bed to offset aquatic impacts of all Lower Colorado Region operations, we believe the viability of this option should continue to be evaluated through the Multi-Species Conservation Program (MSCP) process. As we have discussed before, this option addresses issues beyond these proposed actions and would be difficult and very expensive to implement and sustain on such an incised channel and a sediment deficient hydrology.

Based on our mutual discussions during our meetings of August 15 and 18, 2000, we had not settled on a replacement ratio for backwater, marsh, and riparian habitat. We agree that should any habitat be lost, it is likely that it will be necessary to provide habitat in excess of that lost to achieve equal value of replacement. However, we do not believe that a specific replacement ratio for this consultation is appropriate in light of the following circumstances: 1) changes in point of delivery on the Colorado that result from conservation and transfer activities will ramp up gradually and likely not reach 200,000 acre-feet before 2008, 2) potential impacts are based on a maximum movement of 400,000 acre-feet with a lesser amount being more likely, 3) it is not certain that there will be any impacts to occupied flycatcher habitat from a decline in groundwater levels, and 4) Reclamation has previously committed to work with the MSCP Partners on a long-term on and off site compensation plan for historical flycatcher habitat as specified in RPA 11 of the April 30, 1997, Biological Opinion on Lower Colorado Rivers operations and maintenance. Because much remains to be refined with regard to flycatcher habitat needs regarding moist soils, micro climate, food base requisites and others factors, we think it is better to commit to replacement of any of the 372 acres of occupied habitat with habitat of equal value. In addition, we commit to restore, protect and/or enhance approximately 124 acres of riparian habitat primarily for Southwestern willow flycatchers within the next 5 years and 62 acres of restored or replaced backwater and marsh habitat. By undertaking these activities in the near future instead of when effects occur, Reclamation will be able to ensure that the acreage of compensation habitat will always be in excess of any losses due to the proposed actions, thereby fulfilling our responsibilities under the ESA.

Since our working generalization for potential flycatcher habitat is based solely on subjective height densities for habitat types, and has no further refined classification for moist soils, micro climate, and food base requisites, we feel it is inappropriate to compensate for an unknown amount of habitat with a specific predetermined ratio until complete site suitability is determined on the basis of known requisites.

With regard to any potential effects of the proposed adoption of ISC on ESA listed species in the Republic of Mexico or the Gulf of California, Reclamation is preparing additional information that will supplement this assessment. We will provide this additional information to your office along with the National Marine Fisheries Service in the near future. The purpose of providing this additional information is to address effects, if any, of the proposed adoption of ISC on ESA listed species in the Republic of Mexico. This information will be provided pursuant to and consistent with guidance we have received from the Solicitor of the Department of the Interior (see Solicitor John Leshy's Memorandum of August 14, 2000, to Mr. Eluid Martinez, Commissioner, Bureau of Reclamation). His memorandum provided that, "The continuation of consultation does <u>not</u> reflect any conclusion on our part that consultation is required, as a matter of law or regulation, on any possible impact the adoption of interim surplus guidelines may have on US listed species in Mexico. Rather, Reclamation's consultation on these effects should proceed with the express understanding that it may exceed what is required under applicable Federal law and regulations and does not establish a legal or policy precedent."

After the document was printed for distribution, a last minute correction in the model run for changes in elevation for the river solely for the month of April, was required as a result of change in point of diversion. The net effect of this revision will be that predicted impacts to backwater and river surface area will be slightly less (<12%) than shown in the document, and any corresponding adjustment in conservation measures will be similarly revised. As soon as the corrected elevations are integrated into the Geographic Information Systems model, the new analysis will be distributed.

In summary, we remain available to further discuss our rationale for the above statements and the content of the Biological Assessment. We express our appreciation to you for the time that you and your staff have dedicated to this priority undertaking by the Department of the Interior, your agreement to an accelerated consultation schedule, and your willingness to meet with the California applicants. We look forward to resolving any continuing issues with you and the applicants. In order to keep the applicants advised as to the status of the consultation, they will be provided a courtesy copy of this memorandum and its attachment.

Please contact me at (702) 293-8414 if you have additional questions or would like to schedule a meeting to discuss further.

WILLIAM E. RINNE

Attachments

cc: Mr. Larry Purcell
Water Resources Manager
San Diego County Water Authority
3211 Fifth Avenue
San Diego CA 92103-5718

Mr. John R. Eckhardt
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Mr. Dennis Underwood
Executive Director to the General Manager
Metropolitan Water District of
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Mr. Tom Levy
General Manger-Chief Engineer
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Coachella CA 92236

Mr. Clyde Romney
Congressional Facilitator
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220 West Grand Avenue
Escondido CA 92025
(w/att to ea)

bc: Director, Operations
Attention: W-6333
Field Solicitor, Washington DC
Attention: Robert Snow
Field Solicitor, Phoenix AZ
Attention: Joan Card
Area Manager, Yuma AZ
Attention: YAO-1400, YAO-2200
(w/att to ea)

LC-2011, LC-2311, LC-2312, LC-2316
(w/o att to ea)

United States Department of the Interior

BUREAU OF RECLAMATION
Upper Colorado Regional Office
125 South State Street, Room 6107
Salt Lake City, Utah 84138-1102

IN REPLY REFER TO
UC-720
ENV-7.00

NOV 29 2000

MEMORANDUM

To: Field Supervisor, U.S. Fish and Wildlife Service, Ecological Services Office, Region 2, Arizona State Office, 2321 W. Royal Palm Road, Suite 103, Phoenix, AZ 85021-4951

From: Acting for Charles A. Calhoun
Regional Director

Subject: Finding of "May Affect, Not Likely to Adversely Affect" for Listed Species Which May Be Present in the River Corridor Below Glen Canyon Dam Due to Minor Operational Changes Resulting From the Secretary of the Interior's proposed Adoption of Interim Surplus Criteria; Supplemental Information to the August 30, 2000 Biological Assessment

The Secretary of the Department of the Interior (Secretary), acting through the Bureau of Reclamation is considering the adoption of specific interim criteria under which surplus water conditions may be declared in the lower Colorado River Basin during a 15-year period that would extend through 2016. As the agency which is designated to act on the Secretary's behalf with respect to this action, Reclamation is preparing an Environmental Impact Statement to evaluate the potential effects of adopting interim surplus criteria. As a part of this process, the potential effects on listed species from the headwaters of Lake Mead to the Southerly International Boundary with Mexico were evaluated in a biological assessment which was transmitted to the U.S. Fish and Wildlife Service (Service) on August 30, 2000.

Preliminary evaluations of the effects of adopting interim surplus criteria indicated that minor modifications to the operations of Glen Canyon Dam were within the range of operations previously evaluated by the Service in a December 21, 1994, Biological Opinion (FWS, 1994). The proposed minor changes to operations would not preclude the continued implementation of the previously agreed to reasonable and prudent alternative, or the functioning of the Adaptive Management Program. We concluded that these minor changes would have no affect on listed species occurring along the river from Glen Canyon Dam to the headwaters of Lake Mead. For these reasons, that area was not included in the biological assessment.

Since that time we have updated the model used to predict future dam operations and riverflows and determined that there would be a minor change in the frequency with which Beach/Habitat-Building flows and low steady summer flows as recommended in the opinion would be triggered.

It has been determined that this change may affect, but is not likely to adversely affect, listed species in the Colorado River corridor between Glen Canyon Dam and the headwaters of Lake Mead. We have also determined there would be no adverse modification of critical habitat.

This memorandum serves to document the re-evaluation of potential impacts to listed species from Glen Canyon Dam to the headwaters of Lake Mead based on the updated model runs. This data was discussed with your Phoenix, AZ staff on November 8, 2000. We would appreciate your concurrence or response to our finding of 'may affect, not likely to adversely affect' and 'no adverse modification of critical habitat' at your earliest convenience. Should you have additional questions or concerns feel free to contact me or a member of my staff at (801) 524-3600.

Attachment

CC: UC-105, -700, - 438, - 432, - 433
LC-1000, -2011, -2311, -1050
U.S. Department of the Interior, Office of the Solicitor, 1849 C. Street N.W. Washington D.C. 20240 Attention: Robert Snow MS-6412-MIB
U.S. Fish and Wildlife Service, Ecological Services Office, Region 2 Arizona State Office, 2321 Royal Palm Road Suite 103, Phoenix, AZ 85021-4951
Attention: Debra Bills, Leslie Fitzpatrick, Thomas Gatz
U.S. Fish and Wildlife Service, Ecological Services Office, Region 2, PO Box 1306, Albuquerque, NM 87103 Attention: Steve Helfert
✓Navigant Consulting, 225 W. Broadway, Suite 400, Glendale, CA 91204

Background

The Secretary of the Interior (Secretary) is vested with the responsibility of managing the mainstem waters of the lower Colorado River pursuant to applicable federal law. This responsibility is carried out consistent with a collection of documents known as the *Law of the River*, which includes a combination of federal and state statutes, interstate compacts, court decisions and decrees, an international treaty, contracts with the Secretary, operating criteria, regulations and administrative decisions.

The Colorado River Basin Project Act of 1968 directs the Secretary to adopt criteria for coordinated long-range operation of reservoirs on the Colorado River in order to comply with and carry out the provisions of the Colorado River Compact, the Colorado River Storage Project Act, the Boulder Canyon Project Act of 1928, and the United States-Mexico Water Treaty of 1944. Collectively, these criteria are the Long-Range Operating Criteria (LROC). The 1922 Colorado River Compact apportioned the exclusive beneficial consumptive use of 7.5 million acre feet of water a year to the Upper Basin and 7.5 maf of water a year to the Lower Basin. The LROC define a *normal year* as a year in which annual pumping and release from Lake Mead will be sufficient to satisfy 7.5 maf of consumptive use in accordance with the Decree entered by the United States Supreme Court in 1964 in the case of *Arizona V. California*. If there exists sufficient water available in a single year for pumping or release from Lake Mead to satisfy annual consumptive use in the states of California, Nevada and Arizona in excess of 7.5 million acre-feet, such water may be determined by the Secretary to be available as "surplus" water. The Secretary is authorized to determine the conditions upon which such water may be made available. The Secretary is considering the adoption of specific interim criteria under which surplus water conditions may be declared in the lower Colorado River Basin during a 15-year period that would extend through 2016, in accordance with the LROC. The interim surplus criteria would be used annually to determine the conditions under which the Secretary may declare the availability of surplus water for use within the States of Arizona, California and Nevada.

The LROC are used by the Secretary, on an annual basis, to make determinations with respect to the projected plan of operations of the storage reservoirs in the Colorado River Basin. Reclamation released a Draft Environmental Impact Statement in July, 2000 which evaluated 5 alternatives for interim surplus criteria. The LROC require that, when Upper Basin storage is greater than the storage required under Section 602(a) of the Colorado River Basin Project Act, releases from Lake Powell are governed by the objective to maintain, as nearly as practicable, active storage in Lake Mead equal to the active storage in Lake Powell. Because of this equalization provision, changes in operations of Lake Mead will, in some years, result in increases in annual release volumes from Lake Powell. It is through this mechanism that delivery of surplus water from Lake Mead can influence the operation of Glen Canyon Dam. The equalization requirement of Section 602(a) is suspended if water stored in the Upper Basin is not sufficient to meet Upper Basin demand during a critical low-runoff period.

Of the five alternatives evaluated, the preferred alternative (proposed action) is the Basin States Alternative. The Basin States Alternative specifies ranges of Lake Mead water surface elevations to be used through 2015 for determining the availability of surplus water through 2016. The elevation ranges are coupled with specific uses of surplus water in such a way that, if Lake Mead's surface elevation were to decline, the permitted uses of surplus water would become more restrictive, thereby reducing the delivery of surplus water. The interim criteria would be reviewed at five-year intervals or as otherwise needed based upon actual operational experience.

The surplus determination elevations under the preferred alternative consist of the tiered Lake Mead water surface elevations, each of which is associated with certain stipulations on the purposes for which surplus water could be used.

In acknowledgment that the operation of Glen Canyon Dam, as authorized, to maximize power production was having a negative impact on downstream resources, the Secretary determined in July 1989 that an Environmental Impact Statement should be prepared. The *Operation of Glen Canyon Dam EIS* developed and analyzed alternative operation scenarios that met statutory responsibilities for protecting downstream resources and achieving other authorized purposes, while protecting Native American interests. The final EIS was completed in March 1995 and the Secretary signed a Record of Decision (ROD) on October 8, 1996. The ROD describes criteria and plans for dam operations and included other measures to ensure Glen Canyon Dam is operated in a manner consistent with the Grand Canyon Protection Act. Reclamation also consulted with the Service under the Endangered Species Act and incorporated the Service's recommendations into the ROD. Also among the provisions of the ROD are an Adaptive Management Program and experimental flows.

The Adaptive Management Program provides a process for assessing the effects of current operations of Glen Canyon Dam on downstream resources and using the results to develop recommendations for modifying operating criteria and other resource management actions. This is accomplished through the Adaptive Management Work Group, of which the Service is a member. The AMP includes long-term monitoring and research activities that provide a continual record of resource conditions and new information to evaluate the effectiveness of operational modifications on downstream resources, including listed species. Through the AMP, testing and evaluation of releases recommended by the Service's biological opinion are being implemented. The releases are designed to verify a program of flows that would improve habitat conditions for listed species. Releases from Glen Canyon Dam for equalization purposes, due to the proposed interim surplus criteria, would affect the range of storage conditions in Lake Powell and alter the flexibility to schedule and conduct such releases or to test other flow patterns. The amount of this reduction in flexibility has been evaluated for the proposed action. Specifically, effects on the frequency of triggering beach/habitat-building flows and of low steady summer flows were estimated through the use of modeling and compared to the baseline conditions for the interim period to 2016, and for an additional period to the year 2050 to evaluate both short and long term effects.

Baseline conditions are the current conditions, or those conditions which would occur if interim surplus criteria were not adopted. If interim surplus criteria is not adopted, determination of surplus would continue to be made on an annual basis as part of developing the Annual Operating Plan, pursuant to the LROC and Decree. Consideration of factors such as end-of-year system storage, potential runoff conditions, and projected water demands of the Basin States would be considered. A specific operating strategy, which could be described mathematically in a computer model that simulates specific operating parameters and constraints, was selected as the baseline. This strategy is the "70R" spill avoidance strategy, which Reclamation has utilized for both planning purposes and studies in past years. The R strategy assumes a particular percentile historical runoff, along with normal 7.5 maf delivery to Lower Division states for the following year. Applying these values to the current reservoir storage, the projected reservoir storage at the end of the next year is calculated. If the calculated space available at the end of the next year is less than the space required by flood control criteria, then a surplus condition is determined to exist. The 70R strategy uses an annual runoff of 17.3 maf.

During preparation of the GCD EIS it was hypothesized that steady flows with a seasonal pattern may have a beneficial effect on the potential recovery of special status species down stream of Glen Canyon Dam. Accordingly, development of an experimental water release strategy was recommended by the Service in the December, 1994 biological opinion to achieve steady flows when compatible with water supply conditions and the requirements of other resources. The biological opinion recommended developing and verifying a program of experimental flows which would include high steady flows in the spring and low steady flows in summer and fall during water years of approximately 8.23 maf. The probability that conditions would occur allowing the testing and verification of these flows, know as low steady flows and beach/habitat-building flows, could be affected by the implementation of interim surplus criteria.

The probabilities that minimum releases of 8.23 maf would occur during the interim period to 2016 and during the subsequent period to 2050, were estimated using a mathematical model. The results indicate that under baseline conditions, the probability of an 8.23 maf annual release would be approximately 38.2 % of the years, during the interim period, and 61.6 % during the subsequent period to 2050. Under the propose d action, this probability would be approximately 36.3 % during the interim period, and 61.9 % during the subsequent period. This is an approximate reduction of 2.9 % in the probability of an 8.23 maf year during the interim period, and an increase in the probability of an 8.23 maf year of 0.3% during the subsequent period. Given the margin of error in forecasting runoff, this decrease of 2.9% in the probability of occurrence of an 8.23 maf year through 2016, and of 0.3 % through 2050 is insignificant, and would have no effect on the amount of take occurring due to ongoing conditions under the existing biological opinion when compared to the baseline condition. The AMP would remain in effect, the 1994 biological opinion would continue to be implemented, and reservoir operations would remain within the historical ranges.

We have therefore concluded that adoption of interim surplus criteria as described in the Basin States Alternative may affect, but is not likely to adversely effect any listed species occurring between Glen Canyon Dam and Separation Rapid, and that no critical habitat would be adversely modified.

The frequency at which BHBF releases from Glen Canyon Dam would occur under baseline conditions and under each of the interim surplus criteria alternatives was also estimated through use of the model. The model was configured to simulate BHBF releases by incorporating the BHBF triggering criteria into the Glen Canyon Dam operating rules. The model was also configured to make no more than one BHBF release in any given year. The effects of the interim surplus criteria alternatives on BHBF releases were analyzed in terms of the yearly frequency at which BHBF releases could be made, as indicated by the occurrence of one or both of the triggering criteria during a calendar year.

Under baseline conditions, the frequency of one or both BHBF flow release triggers occurring would be as follows: during the period through 2016 for which interim surplus criteria are being considered, the probability that BHBF releases could be made in a given year would be approximately 15.9 %, which is equivalent to about 1 year in 6. This yearly probability is an average over that period. During the subsequent period, ending in 2050, the average probability that BHBF releases could be made in any year would be approximately 13.5 %, which is equivalent to about 1 year in 7. The reduction in probability after 2016 under baseline conditions results from the fact that with time, the Lake Powell water level will probably decline because of increased Upper Basin depletions as the states develop their compact entitlements. The concept of BHBF releases developed in the Glen Canyon Dam Operations EIS was based on an estimated frequency of occurrence of 1 in 5 years. The difference occurs due to modeling refinements and changes in the forecasted upper basin depletion schedules received from the upper basin states through the Upper Colorado River Commission. Under the proposed action (the Basin States Alternative) the probability that BHBF releases would be triggered is approximately 14.8 %, and, during the subsequent period ending in 2050, the average probability that BHBF releases would be triggered would be 13.4 %. This is an approximate change in probability of 1.1% during the initial period to 2016, and of 0.1% during the remaining period of analysis, through 2050. Given the margin of error in forecasting runoff, this change is insignificant, and would not change the amount of take occurring due to ongoing conditions under the existing biological opinion when compared to the baseline condition. The AMP would remain in effect, the 1994 biological opinion would continue to be implemented, and reservoir operations would remain within the historical ranges.

ATTACHMENT T

Consultation with Mexico

This attachment consists of the following documents and correspondence prepared individually by the United States Section and the Mexico Section of the International Boundary and Water Commission (USIBWC and MIBWC, respectively), as part of the consultation between the United States and Mexico regarding the proposed interim surplus criteria.

Draft Authority and Assumptions governing the US-Mexico consultations on the proposed Colorado River interim surplus criteria prepared by the USIBWC, December 28, 1999;

Letter of May 22, 2000 from Commissioner J. Arturo Herrera Solis, MIBWC, to Commissioner John M. Bernal, USIBWC, regarding potential effects on Mexico's natural and physical environment;

English translation of May 22, 2000 letter from Commissioner J. Arturo Herrera Solis, MIBWC, to Commissioner John M. Bernal, USIBWC, regarding potential effects on Mexico's natural and physical environment; and

Letter of October 10, 2000 from Commissioner J. Arturo Herrera Solis, MIBWC, to Commissioner John M. Bernal, USIBWC, transmitting additional information regarding Mexico's natural environment and the shrimp harvest in the Sea of Cortez.

English translation of letter of October 10, 2000 from Commissioner J. Arturo Herrera Solis, MIBWC, to Commissioner John M. Bernal, USIBWC, transmitting additional information regarding Mexico's natural environment and the shrimp harvest in the Sea of Cortez.

US Section, International Boundary and Water Commission
Draft Authority and Assumptions
US - Mexico Consultations - Colorado River Surplus Criteria
December 28, 1999

Authority

	Authority	United States Position
1.	Article 10, 1944 Water Treaty	Mexico has a right to 1.5 million acre feet annually in scheduled deliveries. Mexico may receive an additional 200,000 af annually, but does not have right to system waters beyond the 1.5 maf.[1]
2.	Resolution 1, Minute 242	Establishes quantity and salinity of waters delivered to Mexico at northern boundary and the southern boundary area.
3.	Resolution 6, Minute 242	Provides that "With the objective of avoiding future problems, the United States and Mexico shall consult with each other prior to undertaking any new development of either the surface or the groundwater resources, or undertaking substantial modifications of present developments, in its own territory in the border area that might adversely affect the other country."

Assumptions

	Assumption	United States Position
1.	U.S. has right to make maximize its use of waters reserved under the 1944 Water Treaty, while recognizing Mexico's right to 1.5 maf annually under the 1944 Treaty.	Mexico's right to system waters is limited to the 1.5 maf annual amount and thus the U.S. obligation is ensure delivery of the 1.5 maf annually.
2.	Use in the United States assumes the 15 maf Upper and Lower Basin compact allocation (Article III(a) and the lower basin right to increase its beneficial consumptive use by 1 maf (Article III(b))	Mexico should be allowed to schedule up to 200,000 af in addition to 1.5 maf, when storage in Lakes Powell and Mead are anticipated to exceed full conservation capacity.
3.	U.S. surplus criteria seeks to maximize use of U.S. waters and avoid flood control releases.	The United States develop and supply technical data that identify impacts to future deliveries of up to 200,000 af of use in Mexico.
4.	U.S. would not mitigate for impacts in Mexico, but would consider joint cooperation projects provided there is no net negative impact to the United States and that there is cost sharing based on benefits to each.	The United States should be prepared to identify a range of opportunities for joint cooperation projects with a benefit to the United States.

1 Article 10 describes a "guaranteed" annual quantity of 1.5 maf to be delivered to Mexico. Article 15, Section E, describes that "in any year in which there shall exist in the river water in excess of that necessary to satisfy the requirements in the United States and the guaranteed quantity of 1,500,000 acre feet allotted to Mexico, the Mexican Section may schedule such surplus water to complete a quantity up to a maximum of 1,700,000 acre-feet." Article 10 provides that Mexico acquires no right beyond the 1.5 maf annually by the use of the waters in excess of 1.5 maf. The decree in AZ v. CA allows the U.S. to release water in satisfaction of its obligations to the Mexican treaty without regard to the priorities listed in Article II(A). The Colorado River Basin Project Act describes that the satisfaction of the requirements of the Mexican Water Treaty shall be the first obligation of any water augmentation project planned. In the absence of such augmentation, the legislation states that the requirements of the Mexican Water Treaty, shall be from the waters of the Colorado River pursuant to the treaties, laws, and compacts until the augmentation of the water supply is available. This language seems to infer that the Mexico Treaty right to 1.5 maf is guaranteed and viewed as an obligation that the United States must meet each year prior to delivery of U.S. basic and surplus apportionments.

COMISION INTERNACIONAL DE LIMITES Y AGUAS
ENTRE MEXICO Y LOS ESTADOS UNIDOS

SECCION MEXICANA

SECRETARIA
DE
RELACIONES EXTERIORES

NUM: LAE 01012/00
EXP: LAE/33

Ciudad Juárez, Chih., a 22 de mayo del 2000.

John M. Bernal,
Comisionado estadounidense,
Comisión Internacional de Limites y Aguas,
The Commons Building C., suite 310,
4171 North Mesa,
El Paso, Texas 79902-1422.

Estimado comisionado:

Me refiero a las reuniones binacionales realizadas en las ciudades de Henderson, Nevada y Mexico, D.F. el pasado 12 de abril y los dias 11 y 12 de mayo respectivamente, en las que la Oficina de Restauración de los Estados Unidos (USBR por sus siglas en inglés), presentó el criterio interino de excedentes en la cuenca del Rio Colorado, el cual considera modificar la operación del sistema hidráulico de esta cuenca para la distribución de dichos excedentes en la cuenca baja, y apoyar al Estado de California para se ajuste a su asignación en los próximos 15 años, tiempo que se prevé durarā la implantación de dicho criterio.

En las condiciones de operación actuales, desde 1950 Mexico ha recibido en promedio un volumen aproximado de 2,530 millones de m3 anuales (2 millones de acres pies) producto de excedentes, los cuales tienen un uso benéfico en mi país evitando el deterioro ambiental del medio físico y natural, del entorno del Río Colorado.

El plan propuesto para la distribución de excedentes entre los Estados de Arizona, Nevada y California, ubicados en Ia cuenca baja, tiende a eliminar por 15 aflos estos flujos. Asimismo, dentro del Plan de California, se consideran medidas de conservación de agua, que afectarían la recarga de las aguas subterráneas que comparten ambos países, tal es el caso particular del revestimiento del Canal Todo Americano.

Se estima que la eliminación de estos flujos tendrían los siguientes efectos en el medio físico y natural mexicano:

...2

1. Afectación de la recarga del acuífero en cantidad y calidad reduciendo el uso benéfico del mismo.

2. Incremento en la salinización de las 200,000 hectáreas de cultivo del Valle de Mexicali, ya que parte de los excedentes son utilizados para el lavado de estos suelos.

3. Deterioro en la calidad del agua recibida por México en el Lindero Internacional Sur (LIS), sobre todo en lo que respecta a la salinidad, en virtud de que los flujos de agua fresca se utilizan para reducir las altas concentraciones de sal en este sitio.

4. Deterioro en la calidad del agua recibida por Mexico en el LIN, al reducirse el flujo al valor de la demanda mexicana, y mantener las descargas al río de flujos provenientes del drenaje agrícola del área de Yuma, Az.

5. En la parte alta del Mar de Cortés se afectarán especies en peligro de extinción o que requieren protección especial, tales como el cetáceo más raro y escaso del mundo, la Vaquita marina y la Totoaba. Además, se afectará la actividad pesquera comercial en la región, principalmte de camarón y dos especies de curvina, peces que no habían aparecido en números significativos en los últimos 25 años.

6. En cuanto a la flora existente en el tramo comprendido entre la Presa Morelos y la desembocadura del Río Colorado al Mar de Cortés, en los últimos años se han restablecido cerca de 33,000 hectáreas de vegetación nativa ribereña, establecida en el cauce, conformada por álamos, sauces, mezquites y pino salado, entre otras especies que son fundamentales en el ecosistema, ya que muchas de éstas son utilizadas para la anidación de gran número de aves como el Palmoteador de Yuma, la Gaviota amarilla, la Golondrina de mar y la Garza real azul, entre otras, mismas que se verán afectadas por estas medidas.

...3

Cabe resaltar que los impactos indicados pueden debilitar las relaciones de cooperación bilateral referentes al Delta, que incluyen la coordinación entre las áreas naturales protegidas contiguas, el manejo ambiental de las cuencas y los acuerdos binacionales de protección de hábitats de humedales y especies migratorias en las que, ambos países son signatarios como la Convención de Ramsar, el Plan de Manejo de Aves Acuáticas de Norteamerica y la Red de Reservas de la UNESCO.

Finalmente, me permito hacer notar a usted que el gobierno mexicano no está de acuerdo en que el esquema propuesto, se lleve a la práctica sin considerar las medidas que se implementarían para mitigar su impacto en territorio mexicano. Asimismo, hago patente nuestra solicitud para que se considere al medio ambiente como un usuario de los excedentes que se declaren para la cuenca baja del Río Colorado. Apoyamos la buena disposición del Departamento del Interior de los Estados Unidos en proponer una "pérdida cero neta de beneficio ambiente" en la implantación del criterio de excedentes.

Aprovecho la oportunidad para reiterar a usted la seguridad de mi atenta y distinguida consideración.

ATENTAMENTE
(Signed)
J. ARTURO HERRERA SOLÍS
COMISIONADO MEXICANO

INTERNATIONAL BOUNDARY AND WATER COMMISSION
UNITED STATES AND MEXICO
MEXICAN SECTION

(SEAL Secretariat of
Foreign Relations)

TRANSLATION
No.: LAE 01012/00
File: LAE/33
Ciudad Juárez, Chih.
May 22, 2000

JOHN M. BERNAL
United States Commissioner
International Boundary and Water Commission
The Commons Building C, Suite 310
4171 North Mesa
El Paso, Texas 79902-1422

Dear Commissioner:

I refer to the binational meetings carried out in Henderson, Nevada and Mexico City last April 12th and May 11th and 12th respectively, in which the United States Bureau of Reclamation (USBR) presented the interim surplus criteria for the Colorado River basin, which considers modifying the operation of the river system in this basin for the distribution of said surplus in the lower basin, and supports the state of California in adjusting its allocation in the next 15 years, the time period for the implementation of said criteria.

Under the current operating conditions, since 1950, Mexico has received an average volume of 2,530 Mm^3 annually (2 million acre-feet) of surplus water, which volume has been put to beneficial use in my country avoiding environmental deterioration of the physical and natural environment in the Colorado River.

The proposed plan for the distribution of surplus water between the states of Arizona, Nevada and California, located in the lower basin, tends to eliminate these flows for 15 years. Also, within the California Plan, water conservation measures are contemplated which will affect the recharge of the groundwaters shared by both countries, as is the case with the All-American Canal lining.

It is estimated that the elimination of these flows would have the following effects on the Mexican natural and physical environment:

1. Effects on the recharge of the aquifer both in quantity and quality, reducing the beneficial use of the same;

2. Increase in salinity in the 200,000 hectares of cultivation in the Mexicali Valley, since part of the surplus is used to leach this soil;

3. Deterioration in the quality of water delivered to Mexico at the Southerly International Boundary (SIB), especially in terms of salinity given that the flows of fresh water are used to reduce high concentrations of salinity at this site;

4. Deterioration in the quality of water received by Mexico at NIB in reducing the flow to the value of the Mexican demand and maintaining the discharges to the river from agricultural drains in the Yuma, Arizona area;

5. In the upper part of the Sea of Cortez, species in danger of extinction or which require special protection will be affected, such as the rarest and most scarce cetacean in the world, the sea cow and the Totoaba. Also, commercial fishing activities will be affected in the region, especially shrimping and two species of (*curvina*), fish which had not appeared in significant numbers in the last 25 years; and,

6. In terms of the existing flora in the reach between Morelos Dam and the mouth of the Colorado River at the Sea of Cortez, in recent years around 33,000 hectares of native riparian vegetation have been restored in the channel, mostly poplars, willows, mesquite and salt cedar, among other species which are fundamental in the ecosystem since many of these are used as nesting areas for a great number of birds, such as the Yuma Clapper Rail, the yellow seagull, the sea swallow and the royal blue swan, among others, same which would be affected by these measures.

It should be noted that the indicated impacts could weaken the bilateral cooperative relations regarding the delta, which include coordination between the contiguous protected natural areas, the environmental management of the basins and the binational agreements for protection of wetlands and migratory species in which both countries are signatory such as the Ramsar Convention, the Plan for the Management of North American Sea Birds, and the Network of Reserves of UNESCO.

Finally, let me bring to your attention that the government of Mexico is not in agreement with putting the proposed scheme into practice without considering the measures which would be implemented to mitigate its impact in Mexican territory. In the same light, I make known our request that the environment be considered a user of the surpluses which may be declared for the lower Colorado River basin. We support the goodwill of the Department of the Interior of the United States in proposing a zero net loss of benefit to the environment in the implementation of the surplus criteria.

I take this opportunity to reiterate to you the assurances of my most distinguished consideration.

Sincerely,
(Signed)
J. Arturo Herrera Solís
Mexican Commissioner

SECRETARIA
DE
RELACIONES EXTERIORES

COMISION INTERNACIONAL DE LIMITES Y AGUAS
ENTRE MEXICO Y LOS ESTADOS UNIDOS
SECCION MEXICANA

NUM: LAE 01859/00
EXP: LAE 33

Ciudad Juárez, Chih., a 10 de octubre de 2000.

John M. Bernal,
Comisionado estadounidense,
Comisión Internacional de Límites y Aguas,
The Commons Building C., suite 310,
4171 North Mesa,
El Paso, Texas 79902-1422.

Estimado Ing. Bernal:

Me refiero a mi oficio LAE 1012 del pasado 22 de mayo de 2000 con relación a los impactos identificados por México sobre el Criterio Interino de Excedentes del Río Colorado, que está desarrollando actualmente el Buro de Reclamación de los Estados Unidos, así como al Borrador de Manifiesto de Impacto Ambiental (DEIS) y a la reunión del 12 de mayo de 2000 en México D.F. en la cual el Buró de Reclamación presentó a México este Criterio.

Con relación al punto 3.16.3. titulado Consulta con México, del Borrador de Manifiesto de Impacto Ambiental, en donde se menciona "No está claro para el Buro de Reclamación de los Estados Unidos que la preocupación de México se deba al Criterio Interino de Excedentes, y que los temas que no emanen del mismo están fuera del ámbito de este reporte", comunico a usted que de acuerdo con el Manifiesto referido cualquiera de las alternativas propuestas alterarán en mayor o menor grado la frecuencia y magnitud de los flujos de avenidas que llegan a México, lo cual significa que la preocupación de México por el impacto adverso de este criterio en su territorio es real y por lo tanto debe considerarse como tal.

El Borrador de Manifiesto de Impacto Ambiental no profundiza en cuanto al hábitat y a la composición de las especies en México a lo largo del Río Colorado, sin embargo existe información documentada que confirma lo expuesto sobre el tema en el escrito de referencia. Ejemplo de esta información son los documentos: "A Delta Once More" Restoring Riparian and Wetland Habitat in the Colorado River Delta , Washington D.C. , Environmental Defense Fund. Publications de Daniel F. Luecke, entre otros.

En cuanto a la afectación de la actividad pesquera comercial en la región, la Universidad Autónoma de Baja California ha desarrollado un documento "Comentarios al Borrador de Impacto Ambiental del Criterio Interino de Excedentes del Río Colorado" (anexo), en el cual se hace un análisis del impacto de dicho criterio sobre la productividad pesquera. Asimismo, el estudio "Penaeid Shrimp Landings in the Upper Gulf of California in Relation to Colorado River Freshwater Discharge" de Manuel S. Galindo Bect y Edward P. Glenn, sugiere que el decremento de la descarga de agua del Río Colorado al Delta y estuarios puede afectar adversamente la producción de camarón (anexo).

... 2

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Finalmente, hago notar a usted que en la reunión de referencia se hizo énfasis en que la identificación de los impactos físicos y ambientales en mi país se haría de forma cualitativa, en virtud de los tiempos tan reducidos para la presentación de comentarios, y por lo tanto no hubo la oportunidad para emitir una respuesta en la cual se incluyeran estudios específicos sobre los impactos en mi país por la aplicación del citado criterio, por lo que en tal sentido, le solicito considerar las preocupaciones expuestas por México vinculadas directamente con la implementación del Criterio Interino de Excedentes.

Aprovecho la oportunidad para reiterar a usted la seguridad de mi atenta y distinguida consideración.

ATENTAMENTE

J. ARTURO HERRERA SOLÍS,
COMISIONADO MEXICANO.

COMENTARIOS AL BORRADOR DE MANIFIESTO DE IMPACTO AMBIENTAL DEL CRITERIO INTERINO DE EXCEDENTES

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KM. 107 CARRETERA TIJUANA ENSENADA

RESUMEN

La Universidad Autónoma de Baja California (UABC) está en desacuerdo con las cuatro alternativas propuestas por DEIS ya que considera que la única alternativa posible para lograr que no exista pérdida neta de los beneficios al ambiente, es la NO ACCION o condición de línea base. No estamos de acuerdo con los datos proporcionados en la notación 75R en la cual se indica que los flujos históricos naturales que llegan al punto Lee Ferry son menores que el valor de 18.1 millones de acre pie. Esto se muestra en la Figura 1, en la cual se presenta el comportamiento del flujo del río desde principios del siglo a la fecha. El valor promedio (18.1) que obtienen de 75% de flujos históricos anuales está probablemente considerando los flujos después de la creación de las presas Hoover y Glenn Canyon, construidas en 1935 y 1960 respectivamente. Esta última presa estuvo reteniendo el agua del río por aproximadamente 20 años (1960-1980), por lo que cualquier valor promedio que se obtenga no reflejará la condición de no acción actual. También se nota claramente que posterior al llenado de la presa Glenn Canyon en 1980, el volumen de agua manejado como excedente y que fue enviado a México alcanzó valores de flujo similares a los del río sin la presencia de presas, este fenómeno extraordinario se debió a deshielos no previstos en las Montañas Rocallosas y ocasionó que el flujo del río no pudiera controlarse en los Estados Unidos de América (EUA).

El concepto de ecosistema para el enfoque del funcionamiento de toda la cuenca del Río Colorado, en donde el agua es un servicio ambiental interactuante con el estado de la salud de la cuenca en su conjunto, no fue considerado cuando se firmó el Tratado de 1944, tampoco se toma en cuenta en la actualidad, cuando se constata que no se considera la cuenca baja en México y su zona de influencia el

Delta del Río Colorado y el Golfo de California como parte del ecosistema. Sin embargo, actualmente a nivel mundial los gobiernos se han estado preocupando por el equilibrio ecológico de los ecosistemas, considerando entre los más importantes las cuencas hidrográficas y sus zonas de influencia marina, como se menciona en el Programa de Acción Mundial (PAM). Ambos países deben considerar en el manejo del Río Colorado a la cuenca baja del Río Colorado, el Delta y el Golfo de California en México, como parte del ecosistema y que no debe ser afectada. Los efectos ambientales, y sobretodo de los impactos al desarrollo de la región del Delta y el Alto Golfo, se han documentado en la Figura 2, donde se analizan las capturas de camarón (principal actividad de la región) y su relación con los flujos de agua dulce del Río Colorado. Como se ve claramente, hay una relación directamente proporcional entre flujos y capturas. De tomarse cualquier alternativa de uso de los "EXCEDENTES", el desarrollo económico y social de esta porción del país, se verá seriamente afectada.

Los impactos económicos son tan importantes como los de conservación y restauración que se han manejado por otras instancias.

INTRODUCCION

El control del flujo del Río Colorado mediante la construcción de presas en los EUA y México, han dado lugar a numerosas manifestaciones de protestas por grupos no gubernamentales de ambos países y a prolongadas negociaciones para determinar la cantidad y calidad del agua que se debe enviar a México. El manejo del río en presas de los EUA y la utilización del agua otorgada a México a través del Tratado Internacional de 1944 para actividades urbanas y agrícolas, ha conducido a un cambio en el funcionamiento ecológico de la cuenca baja del Río Colorado, considerando como parte de la cuenca a la Reserva de la Biosfera Alto Golfo de California y Delta del Río Colorado.

La variabilidad del flujo del río al océano es un aspecto que ha recibido muy poca atención por parte de ambos países, la alteración ecológica del estuario como área de crianza de muchas especies comercialmente importantes debe representar uno de los aspectos más relevantes en el control del flujo del río. La afluencia de agua dulce al océano desempeña un papel clave en el equilibrio y productividad de los ambientes estuarinos, no solamente por la cantidad de los escurrimientos, sino también por la calidad y estacionalidad de los mismos. La alteración de uno o más de los aspectos señalados, debe tener repercusiones ecológicas notables que se manifiestan en las primeras etapas de desarrollo de las especies comercialmente importantes y que en una etapa de su desarrollo son estuarino-dependientes como el camarón, la curvina y la totoaba, ésta última actualmente en peligro de extinción; en segundo término, en la reducción de la producción pesquera de la región que finalmente repercute en las comunidades pesqueras que viven de estos recursos como lo mencionan Greenberg y Vélez-Ibáñez, (1994); Mcguire y Greenberg, (1994)

IMPORTANCIA ECOLOGICA

El Delta del Río Colorado alrededor de las Islas Montague y Pelícano, representa un hábitat de gran importancia para especies marinas que en una etapa temprana de su desarrollo, buscan alimento, refugio y condiciones hidrológicas óptimas (estuarinas) para su desarrollo. Esta área es considerada como zona de reproducción, desove y crianza de especies que posteriormente serán reclutadas al soporte de las pesquerías de la región (Cabtree, 1989).

Considerando la importancia ecológica y con el propósito de proteger las especies que temporal o permanentemente habitan esta región, el Gobierno Mexicano ha realizado tres iniciativas de decreto. La primera en 1955 donde declara esta región como zona de refugio de fauna marina; la segunda en 1974 la establece como zona de reserva, cultivo y/o repoblación; la tercera emitida el 10 de junio de 1993 la decreta como "Reserva de la Biosfera Alto Golfo de California y el Delta del Río Colorado" (Diario Oficial, 1993; Morales-Abril, 1994). El objetivo primordial de este último decreto es garantizar la protección de los valores biológicos y ecológicos que permita el aprovechamiento racional y sustentable de los recursos naturales.

FLUJO DEL RIO COLORADO ANTES Y DESPUES DE LA CONSTRUCCION DE PRESAS

El flujo promedio del Río Colorado hasta antes de la construcción de presas en los Estados unidos fue de 20.7 X 10^9 M^3.año^{-1} (Fradking 1981). Después de nueve años de la construcción de la presa Hoover y dentro de la legislación en el uso de las aguas del Río Colorado, el 3 de febrero de 1944 se firmó el Tratado de Aguas con Estados Unidos por el cual se asignó a México un volumen de agua anual no menor de 1.85 x 10^9 m^3.año^{-1}, correspondiendo aproximadamente al 10% del flujo anual promedio del río. En la asignación de la cuota anual de agua a México no se consideró el impacto ecológico por la restricción del agua dulce al ecosistema.

IMPACTO POR LA RESTRICCION DEL RIO COLORADO

Sykes (1937), describió cambios en la hidrología estuarina asociada a la construcción de la presa Hoover en los E.U.A. Estos cambios incluyen, pérdida de humedales y hábitat de aguas someras; incremento en la erosión por la acción de mareas; desaparición de canales; cambios en la vegetación y una declinación en la abundancia de peces, pájaros y mamíferos.

Glenn *et al* (1995), mencionan que la biodiversidad y la vitalidad de los humedales han sido afectados, de tal forma que de 1973 a 1993, el área de marismas de agua dulce y salobre varió entre 5,800 y 63,000 ha. Sin embargo a partir de 1977, aportes significativos de agua ligeramente salobres (2 a 3 ups) conducidas por el canal Welton Mohawk, recuperaron ligeramente los últimos cenagales remanentes del Río Colorado (Glenn *et at.* , 1992). Mellink *et al.* (1997) resaltan la importancia de estos humedales perdidos para aves acuáticas, las cuales actualmente están utilizando principalmente extensas planicies lodosas en la boca del delta.

Alvarez-Borrego *et al* (1975) y Hernández-Ayón *et al* (1993) mencionan que el Alto Golfo de California y el Delta del Río Colorado han perdido en gran medida sus condiciones estuarinas, excepto en algunos inviernos caracterizados por alta precipitación pluvial e incremento del flujo del río por excedentes en las presas.

La afluencia de agua dulce desempeña un papel clave en el equilibrio y productividad de los ambientes estuarinos, no solamente por la cantidad sino por la calidad y estacionalidad de los escurrimientos. La alteración de uno o más de los aspectos señalados, tiene repercusiones sociales y económicas que se manifiestan en una reducción de la producción pesquera de la región del Alto Golfo de California.

Entre los impactos importantes por el manejo del río se encuentra el camarón azul *Litopenaeus stylirostris*, que de acuerdo a la parte de su ciclo de vida como organismo estuarino dependiente, las postlarvas suben al estuario en busca de alimento, protección y condiciones óptimas para su desarrollo. El Alto Golfo de California a pesar de la ausencia del flujo del río, es un área que está caracterizada por ser rica en nutrientes inorgánicos y altamente productiva (Hernández Ayón *et al.*, 1993). Sin embargo, el impacto ecológico para esta especie en particular no es un problema de osmoregulación sino la pérdida de una barrera física de salinidad que brinda protección evitando la predación por la introducción de especies exóticas al área. Así también, cambios en la dinámica hidrológica del Alto Golfo disminuyendo la intensidad de la corriente residual perpendicular a la costa la cual es de vital importancia para el transporte de larvas desde el océano hacia la costa.

Carbajal *et al.*, (1997), diseñaron un modelo tridimensional, no lineal, para establecer el comportamiento teórico de la hidrodinámica del estuario antes de la construcción de las presas y el impacto físico por la reducción de la descarga del río al mar. Muestran que la barrera salina donde actualmente se encuentra la isohalina de los 37, requiere de un flujo del río de 2000 $m^3.seg^{-1}$, para reducir a una salinidad de 15. Mediante este modelo se podrá determinar la dimensión mínima del estuario de acuerdo los requerimientos para la restauración ecológica.

ANALISIS DE LA PESQUERIA DE CAMARON EN EL ALTO GOLFO DE CALIFORNIA

La pesquería del camarón representa la principal fuente de ingresos económicos de las comunidades del Alto Golfo de California. Galindo-Bect *et al.*, (2000) al analizar el comportamiento histórico de esta pesquería muestra que las capturas desembarcadas en San Felipe han sido muy irregulares, con incrementos y decrementos relacionados al flujo variable del Río Colorado. Es claro que este crustáceo responde a impulsos físicos estimulados por la presencia o ausencia de agua dulce al área de crianza.

En 1980, cuando el flujo de agua del Río Colorado recibido en México fue de 17.5×10^9 $m^3.año^{-1}$, flujo comparable al río sin presas, las capturas comerciales de camarón fueron las mayores en la historia de esta pesquería (Fig. 2). Así también se observa que existe una respuesta biológica ante un impulso físico, mayores capturas de camarón con relación a la precipitación pluvial en la región (Fig.3) y aunado a los excedentes del río en esos periodos. Por esta razón consideramos que la diferencia entre la máxima captura de camarón registrada en 1980, con respecto a cualquier otra captura anual registrada en la historia de esta pesquería, es el impacto producido por el manejo del agua del Río Colorado.

CONCLUSION

1.- Se debe reconocer que la Cuenca Baja del Río Colorado no termina en la frontera con los EUA y que la Reserva de la Biosfera Alto Golfo de California y Delta del Río Colorado forma parte de la misma.

2.- Que el manejo del agua del río en ambos países ha estado alterando el funcionamiento ecológico de la Cuenca Baja del Río Colorado.

3.- En desacuerdo con la propuesta de los EUA para la distribución de los llamados "EXCEDENTES" del Río Colorado, ya que va a ocasionar mayor deterioro ecológico, económico y social en la cuenca baja y el Alto Golfo correspondiente al lado mexicano.

4.- El deterioro ecológico mencionado ha creado una crisis social y económica de las poblaciones ribereñas que viven de los recursos bióticos y abióticos impactados y que además el problema se agravará en caso de aprobarse la propuesta de los EUA para la utilización de los "EXCEDENTES".

4.- Se debe considerar una cuota de agua del río específicamente para restauración ecológica.

5 .- En desacuerdo con la propuesta de EUA para revestir el Canal Todo Americano, por considerar que se impactarán los mantos freáticos del lado mexicano.

6.- Respeto a las normas internacionales para el manejo del agua de los ríos cuando éste pasa por dos o más países.

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Penaeid shrimp landings in the upper Gulf of California in relation to Colorado River freshwater discharge

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A commercial trawl fishery in the upper Gulf of California provides the principle source of income for the coastal communities of the region, but catches of estuarine-dependent crustaceans and fish have declined in recent years (Hernan, 1997; Cudney-Bueno and Turk-Boyer, 1998). Declines in shrimp landings, mainly *Litopenaeus stylirostris* (formerly classified as *Penaeus stylirostris*) (Perez-Farfante and Kinsley, 1997) have been attributed primarily to over-exploitation of the resource and to viral diseases (Rosas-Cota et al., 1996; Hernan, 1997).

The Biosphere Reserve of the upper Gulf of California and Colorado River Delta was created in 1993 to address some fisheries management problems. A more fundamental problem, however, may be the lack of river flow after construction of upstream dams. Historic reductions in river discharge have caused dramatic increases in salinity in the estuary and changes in the distribution of nutrients (Alvarez-Borrego et al., 1975; Hernandez-Ayon et al., 1993). Since 1979, occasional flood releases have entered the upper Gulf of California by means of the Colorado River when upstream impoundments are filled (Glenn et al., 1996).

Effects of freshwater on penaeid shrimp population development are controversial (Garcia and Le Reste, 1981; Day et al., 1989), but recruitment of spawning stocks of white shrimp (*Penaeus setiferus*) has been positively correlated with river discharge in the southwestern Gulf of Mexico and has been attributed to an expansion in estuarine nursery habitat for white shrimp (Garcia, 1991). River discharge also can stimulate the migration of subadults from estuaries (Deben et al., 1990; Vance et al., 1998). Fishermen have a strong perception that shrimp and fish catches in the northern Gulf of California are related to freshwater discharge from the Colorado River (Cudney-Bueno and Turk-Boyer, 1998). To evaluate their perception we conducted a correlation analysis of shrimp landings at San Felipe Baja California (nearest shrimping station to the delta) with freshwater discharges from the Colorado River to the northern Gulf of California.

Materials and methods

Data on annual shrimp landings and number of trawlers legally fishing from San Felipe were obtained from the Secretary of Environment, Natural Resources and Fish (SEMARNAP), San Felipe, Mexico. Landings were available from 1977 and number of trawlers from 1982. The artisanal catches by small boats (pangas) or the significant illegal shrimp fishery are not accounted for in reported shrimp landings. Annual shrimp landings serve as indicators of the variability in the total landings and are reported for all species of shrimp, even though landings are >90% *L. stylirostris* in San Felipe (Rosas-Cota et al., 1996). Data on freshwater discharge of the Colorado River were from the Southerly International Border (S.I.B.) gauging station which is below the last diversion on the river and were obtained from the United States

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Bureau of Reclamation, Yuma, Arizona (Williams[1]). We assumed that this flow entered the delta and the upper Gulf of California.

Annual shrimp landings and landings divided by numbers of trawlers (normal catch per unit of effort, CPUE) were correlated with river flow and number of trawlers. Our normal CPUE was a crude approximation of stock abundance or catchability. We lacked actual fishing time (days, weeks, hours of net deployment), size frequency of the legal vessels, and number of small boats (pangas) fishing. We made landings lag river discharge by one year because the life cycle of shrimp from hatching to capture is approximately one year (Gracia-Pamanes[2]). Transformed river flow ($\log_{10}$) was tested for nonlinearity; then we conducted a multiple regression analysis to predict shrimp landings from variables that were individually correlated ($P<0.05$) with landings.

Results

Annual shrimp landings ranged from 701 metric tons (t) (1983–84) to 217 t (1992–93), decreasing significantly from 1977 to 1996 ($r=0.78$, $P<0.001$, Fig. 1A). The reported number of trawlers legally fishing from San Felipe ranged from a high of 59 in 1988 to a low of 20 in 1995 (Fig. 1B). Catch per unit of effort (CPUE) increased from 1982 to 1984, then markedly decreased back to the 1982–83 level in 1985, remaining low until 1993, after which a positive trend was achieved and the highest CPUE ever was recorded in 1995 (Fig. 1C). There were substantial flows (>700 million cubic meters, Mm^3) in 8 of the 21 years from 1976 to1996 and varied over 10^4-fold, ranging from 1 Mm^3 in 1990 and 1996 to 15,657 Mm^3 in 1984 (Fig. 1D). Highest volume occurred between 1980 and 1987 as a result of overflow from Lake Powell in the United States (Glenn et al., 1996). The flow spike in 1993 was due to releases from Painted Rock Dam on the Gila River in Arizona. Periods of significant river flow at the S.I.B. were closely matched to El Nino Southern Oscillation (ENSO) events that occurred in 1983 and 1993.

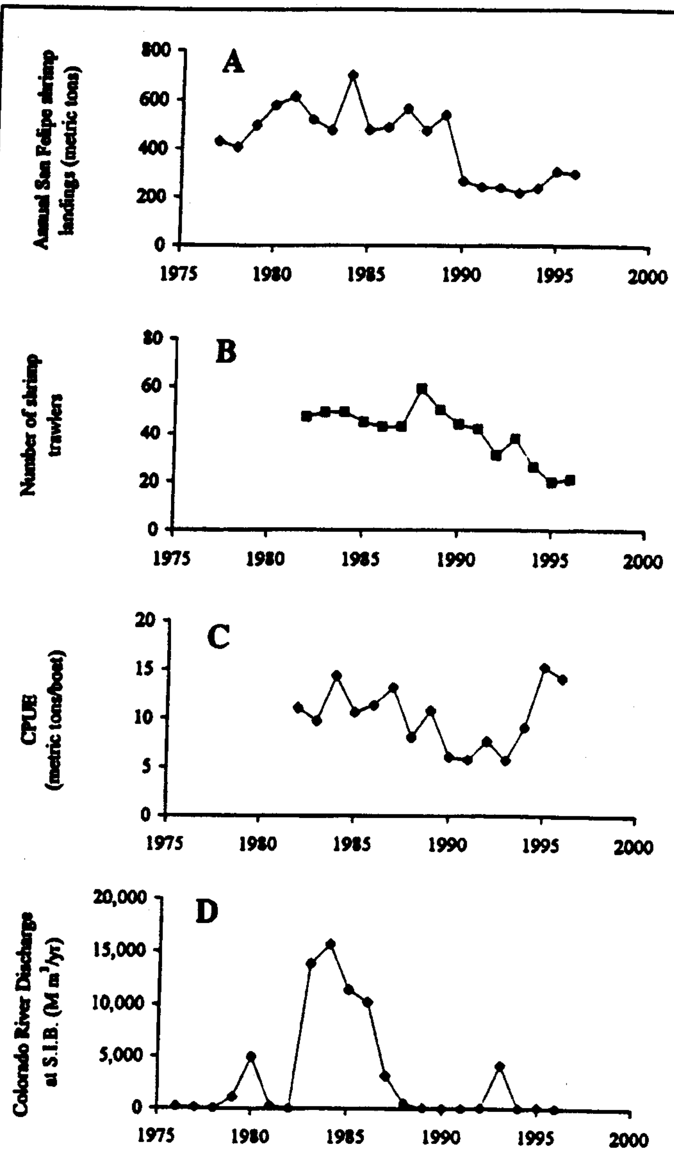

Figure 1

(A) Annual San Felipe shrimp landings (metric tons); (B) Number of shrimp trawlers fishing annually in San Felipe; (C) CPUE (metric tons/boat); (D) Colorado River freshwater discharge flow below the Southerly International Border (million m^3/yr).

Shrimp landings were significantly ($P<0.05$) correlated with same year river discharge, but $\log_{10}$-transformed river discharge in the year prior to shrimp harvest produced the highest correlation coefficient ($r=0.67$, $P<0.001$) (Table 1). The number of trawlers also significantly correlated with shrimp landings ($r=0.77$, $P<0.001$), as expected. The best correlation (r) of shrimp landings was the product

[1] Williams, B. 1998. United States Bureau of Reclamation, Yuma, Arizona. Personal commun.

[2] Garcia-Pamanes, F. C. 1992. Biologia reproductiva y dinamica poblacional del camaron azul Penaeus stylirostris en el Alto Golfo de California. Instituto de Investigaciones Oceanologicas, Universidad Autonoma de Baja California, Ensenada. Unpubl. final report.

Table 1

Correlation coefficients (r) and significance levels (P) from regression analysis relating San Felipe annual shrimp landings (1977–96) and CPUE (1982–96) to rainfall and discharge of the Colorado River at the Southern International Border. A "1-year lag" indicates that shrimp landings were paired with the previous year's river discharge in the correlation analysis.

	Correlation with shrimp landings		Correlation with CPUE	
Variable	r	P	r	P
River discharge	0.47	0.0362	0.25	0.3360
Log_{10} river discharge	0.54	0.0112	0.25	0.3368
River discharge (1-yr lag)	0.52	0.0127	0.34	0.1826
Log_{10} of river discharge (1-yr lag)	0.67	0.0006	0.38	0.1304
Number of shrimp trawlers	0.77	0.0003	0.18	0.4804
Log_{10} of river discharge (1-yr lag) × number of shrimp trawlers	0.80	0.0004	0.29	0.8771

of $\log_{10}$-lagged river discharge and number of trawlers (r=0.80, P<0.001). CPUE was not significantly (P>0.05) correlated with river flow or number of trawlers (Table 1), nor with total landings (r=–0.26, P=0.31). The equation of best fit (0.64) for predicting shrimp landings took the form

$$Y = a + m(X_1X_2),$$

where X_1 = $\log_{10}$-lagged river discharge (Mm^3/yr);
X_2 = number of trawlers;
Y = shrimp landings (t/yr);
M = the slope of the equation (1.67); and
a = the Y-intercept (232 t/yr).

Discussion

Our analyses represent a first attempt to identify relationships between variability in shrimp landings in the upper Gulf of California and factors influencing these landings. Total shrimp landings and the size of the shrimping fleet at San Felipe have declined over the past 15 years. Social and economic changes have affected shrimping. In the late 70s and early 80s shrimping was reserved for social units (cooperatives), with the result that privately owned shrimp trawlers were banned from the fishery. In addition, the government subsidized building of additional vessels and many new unskilled fishermen entered the industry. Then policies were reversed in the late 1980s, private boats returned, interest rates increased, and many of the shrimp trawlers were removed from the fleet.

We found a significant relationship (P<0.001) between total catch and the rate of freshwater discharge of Colorado River water into the marine ecosystem, although the mechanisms through which river discharge might affect the shrimp fishery are unknown. Lower salinity may improve the survival of early life stages by providing "enlarged nursery" protected habitat (Garcia, 1991), even though *L. stylirostris* and *P. californiensis* are generally considered euryhaline species (Hernan, 1997), having large numbers of postlarvae and juveniles in hypersaline habitats (Brusca, 1980; Page[3]). Salinity and nutrient gradients in the estuary and upper Gulf during river flows have not been reported to our knowledge.

Future plans for the Colorado River will likely decrease freshwater discharge into the estuary as more water is diverted upstream for farms and domestic use (Morrison et al., 1996). Our analyses suggest that decreases in river discharge to the delta and estuary may adversely affect shrimp landings. The United States and Mexican governments should initiate a research program on the effects of river flow on ecologically and commercially important species in the upper Gulf of California and incorporate these findings into a comprehensive management plan for the Biosphere Reserve as well as the Colorado River Basin at large.

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INTERNATIONAL BOUNDARY AND WATER COMMISSION
UNITED STATES AND MEXICO
MEXICAN SECTION

(SEAL Secretariat of Foreign Relations)

TRANSLATION
No.: LAE 01859/00
File: LAE/33
Ciudad Juárez, Chih.
October 10, 2000

Eng. John M. Bernal
United States Commissioner
United States Section
International Boundary and Water Commission
The Commons Building C, Suite 310
4171 North Mesa
El Paso, Texas 79902-1422

Dear Engineer Bernal:

I refer to my letter No. LAE 1012 of May 22, 2000 concerning the impacts identified by Mexico in the context of the Colorado River Interim Surplus Criteria which is presently being developed by the United States Bureau of Reclamation (USBR). I also refer to the draft environmental impact statement and the meeting of May 12, 2000 in Mexico City, the latter in which the USBR presented this criteria concerning point 3.16.3 of the Draft Environmental Impact Statement (DEIS) "Consultations with Mexico". It mentions that " it is not clear to the USBR whether the concern of Mexico is due to the Interim Surplus Criteria and that the issues outlined in this concern are outside the scope of this report." Concerning this I inform you that in accordance with the report in reference any of the alternatives proposed will alter to a large or small degree the frequency and the magnitude of the flood flows that arrive in Mexico. This indicates that the concern of Mexico of the adverse impact of this criteria in Mexico is a real one and therefore should be considered as a serious one.

The Draft Environmental Impact Statement does not cover in detail the habitat and the composition of species in Mexico along the Colorado River. Nevertheless, there is documented information on this information as shown in the referenced paper, an example of this information are the documents "A Delta Once More"Restoring Riparian and Wetland Habitat in the Colorado River Delta, Washington, D.C., Environmental Defense Fund. Publications by Daniel F. Luecke, and others.

Concerning the impact on the commercial fisheries in the region, the Autonomous University of Baja California has developed a document entitled, "Comments on the Draft Environmental Impact Statement on the Interim Surplus Criteria, Colorado River" (enclosed), which provides an analysis of the impact of such criteria on the fishing productivity. At the same time, the study "Penaeid

Shrimp Landings in the Upper Gulf of California in Relation to Colorado River Freshwater Discharge," by Manuel S. Galindo Bect and Edward P. Glenn, suggests that the decrease in the discharge of Colorado River water to the Delta and its estuaries could adversely affect the production of shrimp (enclosed).

Finally, I make note of the referenced meeting in which there was emphasized that the identification of the physical and environmental impacts in my country would be made in a qualitative manner. This was in view of the short time frames provided for the presentation of comments. For this matter there was not sufficient opportunity to provide a response that would include specific studies on impacts in my country that would resulting from the Interim Criteria therefore in this manner I request that you consider the concerns expressed by Mexico that are directly linked to the implementation of the Interim Surplus Criteria.

I take this opportunity to reiterate the assurances of my most courteous and distinguished consideration.

Sincerely,
(Signed)
J. Arturo Herrera Solís
Mexican Commissioner

COMMENTS ON THE ENVIRONMENTAL IMPACT STATEMENT DRAFT OF THE INTERIM SURPLUS CRITERIA

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SUMMARY

The Autonomous University of Baja California, (UABC), disagrees with the four alternatives proposed in the DEIS as it considers that the only possible alternative, that would arrive at a no net loss to the environmental benefits, would be the no action alternatives or, that is, the baseline condition. We do not agree with the data provided in the notation 75R which indicates that the natural historic flows that arrive at Lee Ferry are less than 18.1 maf. This is shown in figure 1, which shows the flow regimens since the beginning of this century. The average value (18.1) obtained by the 75% of historical annual flows is probably considering the flows after the creation of Hoover and Glenn Canyon dams, constructed in 1935 and 1960, respectively. This last dam has stored river water for approximately 20 years (1960-1980), thus the average value obtained does not reflect the condition of no action at this time. We also note clearly that prior to the filling of Glenn Canyon Dam in 1980, the water volume considered as surplus and which was delivered to Mexico had a flow value similar to the river without the presence of the two dams. This extraordinary phenomenon was due to the unforeseen snow melt in the Rocky Mountains and resulted in a flow that could not be controlled in the United States.

The concept of an ecosystem that focuses on the overall management of the Colorado River basin, in which water also serves an interactive role in the basin health in totality, was not considered with the signing of the Treaty of 1944. This situation is also not covered in the current period. This is because the Lower Basin in Mexico is not considered, nor are these zone of influences in the Delta of the Colorado River and the Gulf of Mexico as a part of the ecosystem. Nevertheless, at the global level the governments have been presenting their preoccupation concerning the ecological equilibrium of ecosystem considering that the more important parts of the hydrologic basins and their influence in the marine zones are part of the world action program (PAM). Both countries should consider the Lower Basin of the Colorado River, the Delta and the Gulf of California in Mexico, in the management of the Colorado River as part of the ecosystem, and thus, the latter should not be affected.

The environmental impacts, and overall the impacts to the development of the Delta and the Upper

Gulf Region, are documented in Figure No. 2, in which the shrimp landing (the principal region activity) are analyzed, and its relations to the flows of the sweet waters of the Colorado river. One can see clearly that there is a direct proportional relation between the flows and the landings. Should any alternative for the Surplus Criteria be adopted, the economic and social development, of this part of the country, would be very seriously affected.

The economic impacts are as important as the conservation and preservation which have been dealt with in other cases.

INTRODUCTION

The control of the flow of the Colorado River through the dams in the U. S. and Mexico have provided the number of protests by non-government groups presented to both countries and have led to prolonged negotiation to determine the quantity and quality of the water that should be delivered to Mexico. The management of the river in U. S. dams and the utilization of water provided to Mexico through the 1944 Water Treaty for urban and agricultural activities has brought about a change in the ecological functioning of the Lower Basin of the Colorado River. This is especially when one considers the Upper Gulf of California Biosphere Reserve and the Colorado River Delta.

The flow variability in the river to the ocean is an aspect that has received very little attention on the part of both countries. The ecological alteration of the estuary as an area for breeding of many commercial species of great importance should represent one of the most relevant aspects in the control and management of the river flow. The flow of the sweet water to the ocean plays an important role in the equilibrium and productivity of the environmental estuaries not only because of the quantity of the flows but also because of the quality and seasonality of the same period. The alteration of one or more of the aspects pointed out should have ecological repercussions that are significant and are manifested in the first stages of development of the important commercial species. Also important, is that during a stage of their development these are esturine-dependant, including species such as shrimp, corvina and the totoaba. The latter is actually in danger of extinction. Secondly, reducing fish production in the region would, in the end, adversely affect the fishery communities that live with these resources as mentioned by Greenberg and Vélez Ibañez, (1994) and Mcquire and Greenberg, (1994).

ENVIRONMENTAL IMPORTANCE

The Delta of the Colorado River along the Montague and Pelícano Islands, represents a habitat of great importance to the marine species specially in the early stages of their development. This is a stage in which they seek food, refuge, and optimum hydrological conditions (esturine) for their development. This area is considered as a reproduction area, which for the development and breeding of species, will later be brought in in support of the fisheries of the region (Cabtree, 1989).

Considering the ecological importance and the proposal to protect the species that are temporarily or permanently inhabiting the region, the Government of Mexico has carried out three initiatives by means of decree. The first was in 1955 when the area was declared a marine wildlife refuge region. The second was in 1974 when the area was declared a reserve for cultivation and reproduction. The third was issued on June 10, 1993 as the "Upper California and Colorado River Delta Biosphere Reserve" (Official Daily, 1993; Morales-Abril, 1994). The primary objective of this last decree is to guarantee the protection of the biological and ecological values that allow the rational and sustainable utilization of the natural resources.

FLOW OF THE COLORADO RIVER BEFORE AND AFTER THE CONSTRUCTION OF THE DAMS

The average flow of the Colorado River before the construction of the dams in the United States was 20,700 mcm/year (Fradking, 1981). After nine years, the construction of Hoover Dam and within the legislation for use of the waters of the Colorado River, the U. S. - Mexico water Treaty of February 3, 1944 was signed. This Treaty provided to Mexico an annual volume of 1,850 mcm annually or approximately 10% of the annual flow of the river. The allotment of the annual amount of water to Mexico did not consider the environmental impact of reducing the amount of fresh water in the ecosystem.

IMPACT DUE TO RESTRICTION OF THE COLORADO RIVER

Sykes (1937), described changes in the esturine hydrology associated with the construction of Hoover Dam in the U.S. These changes included the loss of wet lands and habitat in the submerged areas and increased the erosion due to tidal action. There was also the loss of drainage, changes in vegetation and a decline in the abundance of fish, birds, and mammals.

Glenn *et al* (1995), mentioned that the biodiversity and the vitality of the wetlands have been affected, such that from 1973-1983, the fresh water and salt water mixing zones varied between 5,800 to 63,000 hectares. Nevertheless, since 1977, significant contributions of highly saline waters (2 to 3 ups) conveyed by the Welton-Mohawk quickly recuperated the last of the remaining marshes in the Colorado River (Glenn *et al*, 1992). Mellink *et al* (1997) pointed out to the importance of the lost wetlands available for aquatic birds which currently use the extensive fenns in the mouth of the Delta.

Alvarez-Borrego *et al* (1975) and Hernández-Ayón *et al* (19 ›3) mention that the Upper California and the Upper Colorado River Delta have lostto a large extent their esturine characteristics, except in some winter time conditions characterized by rainfall and increased by flows by the river due to excess flows from the reservoirs.

The freshwater inflow has a key role in the equilibrium productivity in the estuary environment. Not solely because of quantity, but also because of quality and the variability of the flows. The alteration of one or more of the aspects above, could have social and economic repercussions that would be reflected in the reduction of fisheries production in the upper Gulf of California region.

Among the important aspects in the management of the river are the blue shrimp, *Litopanaeus stylirostris*, whose post larvae migrate upwards to estuary seeking food, protection, and optimal conditions for their development. This is in accordance with the life cycle of the esturine dependant organism. The Upper California Gulf, even with its lack of river flows, is an area which is characterized as rich in inorganic nutrients and is highly productive (Hernández Ayón *et al*,1993). However, the ecological impact, to this species in particular, is not a problem of osmoregulation but rather the loss of a physical salinity barrier which provides protection and therefore avoids this specie being victim by the introduction of predatory species in the area. Also, the changes in the dynamic hydrology of the Upper Gulf decreases in intensity with a residual flow being perpendicular to the coast which is something that is vitally important for the transport of larvae to the coast.

Carbajal *et al* (1997), designed a tri-dimensional model, not a linear one, to establish the theoretical behavior of the hydrodynamics of the estuary before the construction of the dams and the physical impact of the reduction of the flow to the sea. The model shows that the saline barrier located in the isohaline at 37 requires a flow of 2,000 cms in order to reduce the salinity to 15. Based on this model one could determine the minimum dimension of the estuary in accordance to the requirements for its ecological restoration.

ANALYSIS OF THE SHRIMP LANDS IN THE UPPER GULF OF CALIFORNIA

The shrimp fisheries represent an important source of economic revenues for communities in the Upper California. Galindo-Bect *et. al.* (2000). In their analysis of the historical behavior of the fisheries, their study shows that the landings from San Felipe have been very irregular with increases and decreases related to the variable flow of the Colorado River. It is clear that this crustaceous response to physical impulses stimulated by the presence or absence of fresh water in the breeding area.

In 1980, when the flow of the Colorado River received by Mexico was at some 17,500 cm per year, a flow comparable to the river before the dams, the commercial fishery captures were the greatest in history of the industry (Figure 2). This also shows the observation that there is a biological response brought about by a physical influence, that is, greater landing o.'fish in relation to rainfall in the region (Figure 3), and added to this the existence of surplus flows of the river during these periods. For this reason, we consider that the difference between the maximum shrimp landings in 1980 with respect to any other landings registered in history. The impact is brought about by the management of the waters of the Colorado River.

CONCLUSION

1. It should be recognized that the Lower Basin of the Colorado River does not end at the boundary with the U. S. and that the Upper Gulf of California and the Colorado River Delta Biosphere Reserve form part of the basin.

2. That the management of the river water in both countries is altering the ecological operations of the Lower Basin of the Colorado River.

3. There is disagreement with the proposal by the U. S. to distribute the surplus flows of the Colorado River, as these will cost greater ecological deterioration as well as economic and social damage in the Lower Basin and the Upper Gulf in Mexico.

4. The ecological deterioration mentioned has created a social and economic crisis in the riparian communities that depend on the biotic and antibiotic resources impacted and that the problem would be more aggravated if the proposal by the U. S. for the use of surplus waters is approved.

5. *[sic]* A allocation of water specifically dedicated to ecological restoration should be considered.

5. *[sic]* There is objection to the proposal of the U. S. to line the All American Canal because this will impact the groundwaters in Mexico.

6. [*sic*] There should be a respect to the international standards for the management of river waters when this river passes through one or more countries.

LITERATURE CITED

(Refer to original)