

Chapter Two

2.1 Development of Alternatives

This chapter discusses the processes used to define, develop, and analyze the No Action Alternative, as well as a range of reasonable action alternatives and the Preferred Alternative, for implementing the proposed federal action. Based on the information and comments received during the scoping process, the proposed federal action has been designed to reflect, among others, three important considerations:

- 1) **Encouraging Conservation of Water:** Many comments submitted to Reclamation focused on the importance of encouraging and utilizing water conservation as an important tool to better manage limited water supplies and therefore minimize the likelihood and severity of potential future shortages. Water conservation could occur through a number of approaches such as fallowing of land, lining of canals, financial incentives to maximize conservation, dry-year options, and associated storage and recovery methodologies and procedures to address conservation actions by particular parties.
- 2) **Consideration of Reservoir Operations at all Operational Levels:** Many comments submitted to Reclamation urged Reclamation to consider and analyze management and operational guidelines for the full range of operational elevations of Lake Powell and Lake Mead. It was suggested that this approach is integral to the prudent development of new operational guidelines for low reservoir conditions, as the approach and management of these reservoirs at higher elevations has a direct impact on available storage, thereby affecting the likelihood and severity of potential future shortages.
- 3) **Term of Operational Guidelines:** Many comments urged Reclamation to consider interim, rather than permanent, additional operational guidelines. In this manner, Reclamation would have the ability to use actual operating experience for a period of years, thereby facilitating a better understanding of the operational effects of the new guidelines. Modifications could then be made, if necessary, based on this operating experience.

As a result of the analyses of the comments and input received by Reclamation, the following four operational elements of the proposed federal action were developed:

- 1) **Shortage Guidelines:** Adoption of guidelines that would identify those circumstances under which the Secretary would reduce the annual amount of water available for consumptive use from Lake Mead to the Lower Division states to below 7.5 maf, pursuant to the Consolidated Decree.

The primary purpose of this element is the distribution of water supplies during drought and low reservoir conditions. While Lake Powell and Lake Mead have large storage capacities, water supply demands are increasing and careful management of existing water supplies will help ensure sufficient supplies are available to meet these demands. The proposed shortage guidelines in the alternatives analyzed in the Final EIS range from aggressive shortages to no reduction of water supplies until the reservoirs are empty. Most of the alternatives have discrete levels of shortage associated with specific Lake Mead reservoir elevations.

- 2) **Coordinated Reservoir Operations:** Adoption of guidelines for the coordinated operations of Lake Powell and Lake Mead to provide improved operation of these two reservoirs, particularly under low reservoir conditions.

Lake Powell and Lake Mead operations are currently coordinated only under high reservoir elevations through storage equalization. The action alternatives consider various options designed to better utilize existing reservoir storage throughout the full range of reservoir operations to enhance both water supply and other benefits of the reservoir system for both the Upper Basin and Lower Basin.

- 3) **Storage and Delivery of Conserved Water:** Adoption of guidelines for the storage and delivery of conserved Colorado River system and non-system water in Lake Mead, pursuant to applicable federal law, to increase the flexibility of meeting water use needs from Lake Mead, particularly under drought and low reservoir conditions.

One way to increase water deliveries during drought is through the augmentation and conservation of existing water supplies. The alternatives consider options for the creation of a system of storage credits in Lake Mead whereby system and non-system water may be conserved and stored in Lake Mead, with various limits on the maximum size, storage and delivery of the credit water. The alternatives range from an operational scenario that considers no new mechanism (status quo) to a maximum Lake Mead storage credit volume of 4.2 maf.

- 4) **Interim Surplus Guidelines:** Adoption of guidelines that would identify the conditions under which the Secretary may declare the availability of surplus water for use within the Lower Division states. The proposed federal action would modify the substance of the existing ISG and extend the term of the ISG from 2016 to 2026.

The ISG are due to expire in 2016. The alternatives range from termination of the permissive provisions of the existing ISG in 2007 to extension of the current provisions of the ISG through 2026. This element of the proposed federal action helps establish an operational strategy for the full range of reservoir operations through 2026.

Reclamation developed five action alternatives for analysis in this EIS. These alternatives include some formulation of each of these four operational elements and reflect input from Reclamation staff, the cooperating agencies, stakeholders, and other interested parties. Reclamation received two written proposals for alternatives that met the purpose and need of the proposed federal action; one proposal was received from the Basin States as revised on April 30, 2007 and another proposal was received from a consortium of environmental NGOs. These proposals were used by Reclamation to formulate two of the alternatives considered and analyzed in this EIS (Basin States Alternative and Conservation Before Storage Alternative, respectively). A third alternative (Water Supply Alternative) was developed by Reclamation and a fourth alternative (Reservoir Storage Alternative) was developed in coordination with NPS and Western. The No Action Alternative and these four action alternatives, analyzed in the Draft EIS (February 2007), were posted on Reclamation's website (<http://www.usbr.gov/lc/region/programs/strategies.html>) on June 30, 2006.

A fifth action alternative (Preferred Alternative) was developed after consideration of the comments received on the Draft EIS and further analysis. The Preferred Alternative was posted on Reclamation's website (same as above) on June 15, 2007. The preferred alternative is composed of operational elements identified and analyzed in the Draft EIS.

A description of each of the alternatives follows.

2.2 No Action Alternative

The No Action Alternative represents a projection of current conditions to the most reasonable future responses or conditions that could occur during the life of the proposed federal action without any action alternative being implemented. Thus, the No Action Alternative provides a baseline against which action alternatives can be compared.

Pursuant to the LROC, the Secretary makes a number of determinations at the beginning of each operating year through the development and execution of the AOP, including the water supply available to users in the Lower Basin and the annual release from Lake Powell. The LROC do not include specific guidelines for such determinations. Furthermore, there is no actual operating experience under very low reservoir conditions, e.g., there has never been a shortage determination in the Lower Basin. Therefore, in the absence of specific guidelines, the outcome of the annual determination in any particular year in the future cannot be precisely known. However, a reasonable representation of future conditions under the No Action Alternative is needed for comparison to each action alternative. The modeling assumptions used for this representation are consistent with assumptions used in previous environmental compliance documents for the ISG, the Colorado River Water Delivery Agreement, and the LCR MSCP (Section 1.8). The assumptions used in the No Action Alternative are not intended to limit or predetermine the decision in any future AOP determination.

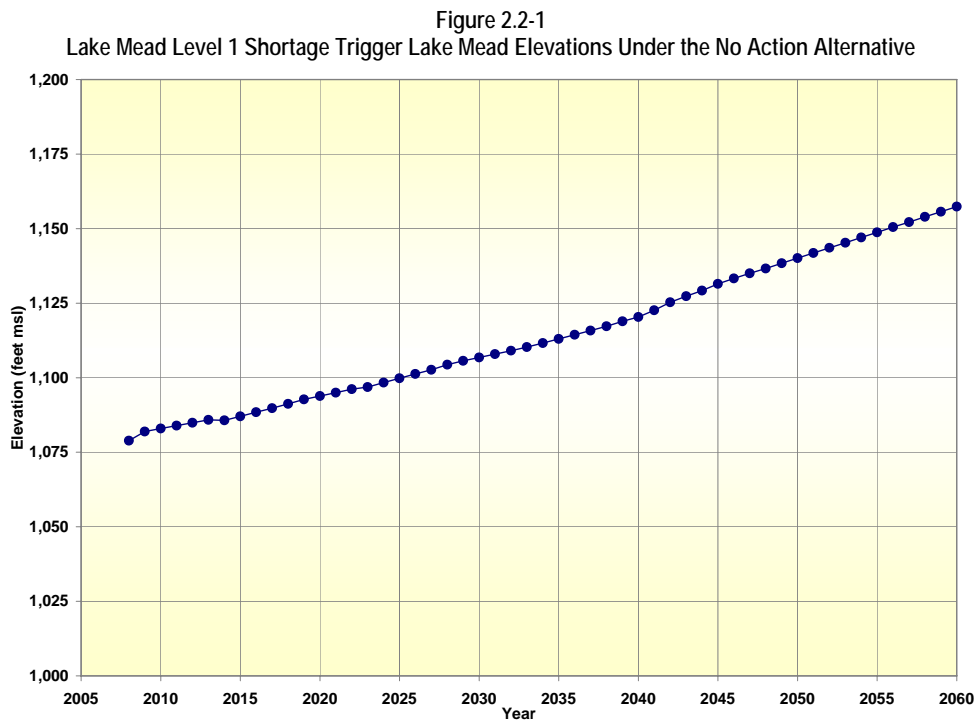
The formulation of the four operational elements of the proposed federal action for the No Action Alternative follows.

2.2.1 Shortage Guidelines

Each year, the Secretary makes a determination as to whether the consumptive use requirements of mainstream users in the Lower Division states will be met under a Normal, Surplus, or Shortage Condition, in accordance with the Consolidated Decree and the LROC as implemented through the AOP process. The LROC specify that the Secretary will consider all relevant factors in making a shortage determination and list some of the factors to be considered. However, there is no specific guidance as to exactly when, how, or to whom reductions in deliveries would be made. Therefore, it is impossible to know exactly how the Secretary might make a shortage determination in the future. Furthermore, conditions in the Colorado River Basin have been such that there has not been a need to declare a Shortage Condition and there is no actual operating experience with regard to shortage determinations.

To obtain a reasonable representation of future conditions under the No Action Alternative (while not representing official policy of the Department with regard to future determinations), the following assumptions were made:

- ◆ as in the modeling assumptions for previous Colorado River Basin environmental compliance documents, shortage trigger elevations (Figure 2.2-1) were used to prevent Lake Mead’s elevation from declining below 1,050 feet msl with approximately an 80 percent probability (known as a “Level 1 Shortage”, Appendix A). In a given year, a shortage (or reduction in deliveries) that ranges from approximately 350 to 500 thousand acre-feet (kaf) would be imposed when the projected January 1 Lake Mead elevation is below the shortage trigger elevation for that year; and
- ◆ if Lake Mead’s elevation continues to decline, additional reductions would be imposed to keep Lake Mead elevation above 1,000 feet msl. This approach essentially provides absolute protection of SNWA’s lower intake (elevation 1,000 feet msl) at Lake Mead and would reduce deliveries to water users (including SNWA) by amounts required to maintain Lake Mead elevation at or above 1,000 feet msl.



In accordance with the Consolidated Decree, the CRBPA, and other key provisions of the Law of the River, the Secretary has the authority to determine and allocate shortages to the Lower Division states. Although some guidance exists with regard to how shortages would be allocated (e.g., PPR deliveries must be met without regard to state lines, California does not incur shortages until Arizona post-1968 contracts are reduced completely), there are no specific guidelines in place to further inform the Secretary's decision with respect to how shortages might be shared by the water users in Arizona, California and Nevada.

Furthermore, the determination of deliveries to Mexico is not a part of the proposed federal action. Any such determination would be made in accordance with the 1944 Treaty (Section 1.7.3).

Nevertheless, modeling assumptions with respect to the distribution of shortages to Lower Division states and water delivery reductions to Mexico are necessary in order to analyze the potential impacts to hydrologic and other environmental resources.¹ These modeling assumptions were applied to the No Action Alternative as well as the action alternatives, i.e., the modeling assumptions with regard to the distribution of shortages are identical under all alternatives.

It was assumed that shortages would be allocated to each Lower Division state and Mexico based on percentages of the total shortage being applied. The modeling assumptions for distribution of shortages used in this Final EIS are presented in Table 2.2-1. More detailed descriptions of these modeling assumptions are provided in Appendix A.

Table 2.2-1
Modeling Assumptions for Distribution of Shortages¹

Entity	Percentage of Total Shortage, Stage 1	Percentage of Additional Shortage, Stage 2 ²
Arizona	80.00	15 to 20
California	0.00	60 to 65
Nevada	3.33	3.33
Mexico	16.67	16.67
Total	100.00	100.00

1. *These modeling assumptions do not reflect policy decisions and are not intended to constitute an interpretation or application of the 1944 Treaty.*

2. *Shortage amounts presented in the Stage 2 column are incremental over the amount of shortages that would have already been allocated under Stage 1.*

¹ Reclamation's modeling assumptions are not intended to constitute an interpretation or application of the 1944 Treaty or to represent current United States policy or a determination of future United States policy regarding deliveries to Mexico. The United States will conduct all necessary and appropriate discussions regarding the proposed federal action and implementation of the 1944 Treaty with Mexico through the IBWC in consultation with the Department of State.

Shortages are first imposed under Stage 1 and would be applied to the most junior users within Arizona (those with post-1968 water rights, i.e., 4th and 5th priority rights within Arizona) and Nevada (primarily the SNWA). Stage 1 shortages would continue until deliveries to the post-1968 water rights holders in Arizona (including the CAP) are reduced to zero. The maximum amount of Stage 1 shortages during the period of analysis is dependent on the scheduled depletions for the post-1968 water rights holders and decreases over time from approximately 1.8 maf in 2008 to 1.7 maf in 2060.

After deliveries to the 4th and 5th priority rights within Arizona are reduced to zero, additional reductions are applied to Arizona, California, and Nevada. These shortages, referred to as Stage 2 shortages, continue to the maximum necessary to keep Lake Mead elevation above 1,000 feet msl.

2.2.2 Coordinated Reservoir Operations

The No Action Alternative assumes Lake Powell's operation would follow the current operating criteria as specified by the LROC and as implemented through the AOP process. Three factors affecting the annual releases from Lake Powell are: 1) the minimum objective release; 2) storage equalization; and 3) spill avoidance.

Pursuant to the LROC, the objective under current operational conditions is to maintain a minimum release of water from Lake Powell of 8.23 maf for the water year. Under the No Action Alternative, a minimum release of 8.23 maf is assumed to be made each water year unless storage equalization or spill avoidance are in effect.

Annual releases from Lake Powell greater than the minimum objective release occur when Upper Basin storage is greater than that required by 602(a) storage, and the storage in Lake Powell is forecast to be greater than the storage in Lake Mead at the end of that water year. Under these conditions, additional releases are made from Lake Powell to equalize the storage in Lake Mead with the storage in Lake Powell by the end of the water year.

The 602(a) storage requirement specifies the amount of storage in Upper Basin reservoirs necessary to assure deliveries to the Lower Basin in compliance with the Compact without impairment to the annual consumptive use in the Upper Basin. If the 602(a) storage requirement is not met, equalization does not occur. The LROC specifies that all relevant factors including historic stream flows, the most critical period of record, the probabilities of water supply, and estimated future depletions be considered when determining the 602(a) storage amount.

In 2004, an Interim 602(a) Storage Guideline was adopted that specifies that through 2016, the 602(a) storage requirement shall utilize a storage amount of not less than 14.85 maf which corresponds to an elevation of 3,630 feet msl for Lake Powell. Under the No Action Alternative, the determination of 602(a) storage is consistent with the storage criterion and the provisions of the Interim 602(a) Storage Guideline. The algorithm used to calculate the 602(a) storage requirement is presented in Appendix A.

Annual release volumes from Lake Powell greater than the minimum objective of 8.23 maf may also be made to avoid anticipated spills. An objective in the operation of Glen Canyon Dam is to attempt to safely fill Lake Powell each summer. When carryover storage from the previous year in combination with the current inflow forecast is projected to exceed Lake Powell's storage capacity, Reclamation schedules the release of the volumes of water needed to avoid spills. Subject to actual inflows, Lake Powell is operated to reach storage of about 23.8 maf in July (0.5 maf from full pool). In years when Lake Powell fills or nearly fills during the summer, additional releases in late summer and early winter are made to draw the reservoir down, so that there is at least 2.4 maf of vacant space in Lake Powell on September 30 for flood protection. Under the No Action Alternative, it is assumed that spill avoidance releases are made when necessary.

2.2.3 Storage and Delivery of Conserved Water

There is currently no mechanism in place for the storage and delivery of conserved system and non-system water in Lake Mead; therefore, the No Action Alternative assumes that none will exist during the interim period.

2.2.4 Interim Surplus Guidelines

The ISG specify ranges of Lake Mead elevations and operational conditions that are used to determine the availability of surplus water for each year during their effective term (through 2016). The elevation ranges are coupled with specific uses of surplus water so that if Lake Mead's elevation declines, the amount of surplus water is reduced. The Surplus, Normal, and Shortage conditions are described below:

2.2.4.1 Flood Control Surplus

If flood control releases are anticipated to be required given the current inflow forecast, the Secretary declares a Flood Control Surplus Condition for that year. The estimated annual amount of surplus water available for pumping and release from Lake Mead (in addition to 7.5 maf) varies over time (2002 to 2016) and ranges between 1.20 to 1.58 mafy. Under current practice, Mexico is allowed to schedule up to an additional 200 kaf pursuant to the 1944 Treaty during flood control years when water supplies exceed those required for use in the United States.

2.2.4.2 Quantified Surplus (70R Strategy)

If flood control releases are anticipated to be required assuming the 70th percentile inflow (the inflow value from the historical record that has not been exceeded more than 30 percent of the time), the Secretary declares a Quantified Surplus Condition for that year. The estimated annual amount of surplus water available for pumping and release from Lake Mead (in addition to 7.5 maf) varies over time (2002 to 2016) and ranges between 1.02 to 1.45 mafy.

2.2.4.3 Full Domestic Surplus (Lake Mead at or above Elevation 1,145 feet msl)

If the projected January 1 Lake Mead elevation is at or above 1,145 feet msl but below the elevation calculated by the 70R Strategy, the Secretary declares a Full Domestic Surplus Condition for that year. The projected annual amount of surplus water available for pumping and release from Lake Mead (in addition to 7.5 maf) varies over time (2002 to 2016) and ranges between 340 to 535 thousand acre-feet per year (kafy).

2.2.4.4 Partial Domestic Surplus (Lake Mead at or above Elevation 1,125 feet msl)

If the projected January 1 Lake Mead elevation is at or above 1,125 feet msl and below 1,145 feet msl, the Secretary declares a Partial Domestic Surplus Condition for that year. The estimated annual amount of surplus water available for pumping and release from Lake Mead (in addition to 7.5 maf) varies over time (2002 to 2016) and ranges between 90 to 375 kafy.

2.2.4.5 Normal and Shortage Conditions (Lake Mead below Elevation 1,125 feet msl)

If the projected January 1 Lake Mead elevation is at or below 1,125 feet msl, the Secretary declares a Normal Condition or a Shortage Condition for that year.

Under the No Action Alternative, surplus determinations through 2016 would be as described above. After 2016, it is assumed that surplus determinations would only be based on the more conservative Quantified Surplus (70R Strategy) and Flood Control Surplus conditions. Further details of these modeling assumptions to represent the ISG are presented in Appendix A.

2.3 Basin States Alternative

The Basin States Alternative proposes a coordinated operation of Lake Powell and Lake Mead that would minimize shortages in the Lower Basin and avoid risk of curtailments of use in the Upper Basin. This alternative also provides a mechanism for promoting water conservation in the Lower Basin. The formulation of the four operational elements of the proposed federal action for the Basin States Alternative follows.

2.3.1 Shortage Guidelines

The Basin States Alternative provides discrete levels of shortage associated with specific Lake Mead elevations as presented below. This alternative provides criteria for shortages up to a maximum of 500 kaf at Lake Mead elevation of 1,025 feet msl.

The shortages modeled under the Basin States Alternative are as follows:

- ◆ when Lake Mead is projected to be below elevation 1,075 feet msl and at or above elevation 1,050 feet msl on January 1, a shortage of 333 kaf shall be imposed for that year;
- ◆ when Lake Mead is projected to be below elevation 1,050 feet msl and at or above elevation 1,025 feet msl on January 1, a shortage of 417 kaf shall be imposed for that year;
- ◆ when Lake Mead is projected to be below elevation 1,025 feet msl on January 1, a shortage of 500 kaf shall be imposed for that year; and
- ◆ when Lake Mead is below elevation 1,025 feet msl, the Secretary shall consult with the Basin States to discuss further measures that may be undertaken consistent with the Law of the River.²

The shortage amounts are expressed as reductions to water users in the Lower Division states. However, modeling of this and the other alternatives includes the assumption that deliveries to Mexico are also reduced.³ As such, the total shortage amounts modeled under this alternative are 400; 500; and 600 kaf, at elevations 1,075; 1,050; and 1,000 feet msl, respectively.

2.3.2 Coordinated Reservoir Operations

Under the Basin States Alternative, the annual Lake Powell release is based the volume of water in storage or corresponding elevation of Lake Powell and Lake Mead as described below.

2.3.2.1 Equalization

The Basin States Alternative provides an elevation schedule (Table 2.3-1) that would be used in determining when equalization releases would be made from Lake Powell.

² This alternative proposes that consultations between the Basin States and Reclamation be undertaken to define additional shortages needed when Lake Mead falls below elevation 1,025 feet msl and is projected to fall below 1,000 feet msl. The possible outcomes of such a consultation process are unknown; therefore, for modeling purposes it was assumed that shortages of 500 kaf would continue to be applied at Lake Mead elevations below 1,025 feet msl.

³ Reclamation's modeling assumptions are not intended to constitute an interpretation or application of the 1944 Treaty or to represent current United States policy or a determination of future United States policy regarding deliveries to Mexico. The United States will conduct all necessary and appropriate discussions regarding the proposed federal action and implementation of the 1944 Treaty with Mexico through the IBWC in consultation with the Department of State.

Table 2.3-1
Basin States Alternative
Lake Powell Equalization Elevations

Year	Reservoir Elevation (feet msl)
2008	3,636
2009	3,639
2010	3,642
2011	3,643
2012	3,645
2013	3,646
2014	3,648
2015	3,649
2016	3,651
2017	3,652
2018	3,654
2019	3,655
2020	3,657
2021	3,659
2022	3,660
2023	3,662
2024	3,663
2025	3,664
2026	3,666

When Lake Powell is at or above these specified elevations and when the volume of Lake Powell is projected to be greater than the volume of Lake Mead at the end of the water year, Lake Powell would release greater than 8.23 maf to equalize its volume with Lake Mead. Otherwise, 8.23 maf is released from Lake Powell.

2.3.2.2 Upper Elevation Balancing

When Lake Powell is below the elevations stated in Table 2.3-1 and is projected to be at or above 3,575 feet msl at the end of the water year, a release in the amount of 8.23 maf from Lake Powell would be made if the projected elevation of Lake Mead is at or above 1,075 feet msl at the end of the water year. If the projected end of water year elevation of Lake Mead is below 1,075 feet msl, the volumes of Lake Mead and Lake Powell would be balanced if possible, within the constraint that the release from Lake Powell would not be more than 9.0 maf and no less than 7.0 maf.

2.3.2.3 Mid-Elevation Releases

When Lake Powell elevation is projected to be below 3,575 feet msl and at or above 3,525 feet msl at the end of the water year, a release in the amount of 7.48 maf would be made if the projected end of water year elevation of Lake Mead is at or above 1,025 feet msl. If the projected end of water year elevation of Lake Mead is below 1,025 feet msl, a release of 8.23 maf from Lake Powell would be made.

2.3.2.4 Lower Elevation Balancing

When the projected end of water year elevation of Lake Powell is below 3,525 feet msl, Lake Mead and Lake Powell would be balanced if possible, within the constraint that the release from Lake Powell would not be more than 9.5 maf and no less than 7.0 maf.

2.3.3 Creation and Delivery of Intentionally Created Surplus

The Basin States Alternative includes the adoption of a mechanism to encourage and account for augmentation and conservation of water supplies, e.g., fallowing of land, lining of canals and other system efficiency improvements, and introduction of tributary and non-system water in the Lower Basin. The mechanism provides for the creation, accounting, and delivery of Intentionally Created Surplus (ICS). At the time the ICS is created, five percent of the ICS would be dedicated to the Colorado River system on a one-time basis. Additionally, ICS accounted for in Lake Mead longer than one year would be subject to annual evaporation losses of three percent per year. If flood control releases occur, ICS would be reduced on a pro-rata basis until no ICS remains, i.e., ICS would be released first.

The maximum amount of ICS that can be created during any year, the maximum cumulative amount of ICS that can be available at any one time, and the maximum amount of ICS that may be delivered in any one year under this alternative are presented in Table 2.3-2.

Table 2.3-2
Basin States Alternative
Volume Limitations of ICS

Entity	Maximum Annual ICS Creation (kaf)	Maximum Cumulative ICS (kaf)	Maximum Annual ICS Delivery (kaf)
Arizona	100	300	300
California	400	1,500	400
Nevada	125	300	300
Total	625	2,100	1,000

2.3.4 Interim Surplus Guidelines

The Basin States Alternative includes both a modification and an extension of the ISG. The ISG would be extended through 2026 and be modified by eliminating the Partial Domestic Surplus Condition, beginning in 2008, and limiting the amount of water available under the

Full Domestic Surplus Condition during the period 2017 through 2026.⁴ The elimination of the Partial Domestic Surplus Condition reduces the amount of surplus water that could be made available and leaves more water in storage to reduce the severity of future shortages.

2.4 Conservation Before Shortage Alternative

The Conservation Before Shortage Alternative was developed by a consortium of environmental NGOs, including Defenders of Wildlife, Environmental Defense, National Wildlife Federation, Pacific Institute, Sierra Club, Sonoran Institute, The Nature Conservancy, and the Rivers Foundation of the Americas. The Conservation Before Shortage Alternative includes voluntary, compensated reductions in water use to minimize involuntary shortages in the Lower Basin and avoid risk of curtailments of use in the Upper Basin. This alternative also provides a mechanism for promoting water conservation in the Lower Basin by expanding the ICS mechanism.

The formulation of the four operational elements of the proposed federal action for the Conservation Before Shortage Alternative follows.

2.4.1 Shortage Guidelines

Although the Conservation Before Shortage Alternative does not include stepped, involuntary shortages, it does include voluntary conservation levels similar to the Basin States Alternative shortage levels described in Section 2.3. These voluntary conservation levels are described below.

This alternative provides a shortage strategy that would absolutely protect Lake Mead elevation of 1,000 feet msl whereby water deliveries would be reduced by the amount required to maintain Lake Mead elevations at or above 1,000 feet msl.

2.4.2 Coordinated Reservoir Operations

The Conservation Before Shortage Alternative assumes the same coordinated reservoir operations as the Basin States Alternative described in Section 2.3.

⁴ During 2017 through 2026, the distribution of Domestic Surplus water would be limited as follows: 1) for use by MWD, 250 kafy in addition to the amount of California's basic apportionment available to MWD; 2) for use by SNWA, 100 kafy in addition to the amount of Nevada's basic apportionment available to SNWA; and 3) for use in Arizona, 100 kafy in addition to the amount of Arizona's basic apportionment available to Arizona contractors.

2.4.3 Storage and Delivery of Conserved Water

The conservation triggers proposed under this alternative are as follows:

- ◆ when Lake Mead is projected to be below elevation 1,075 feet msl and at or above elevation 1,050 feet msl on January 1, the Secretary will seek the conservation of 400 kaf of water;
- ◆ when Lake Mead is projected to be below elevation 1,050 feet msl and at or above elevation 1,025 feet msl on January 1, the Secretary will seek the conservation of 500 kaf of water; and
- ◆ when Lake Mead is projected to be below elevation 1,025 feet msl on January 1, the Secretary will seek the conservation of 600 kaf of water.

Under the Conservation Before Shortage Alternative, ICS would be generated by activities similar to those described for the Basin States Alternative (Section 2.3). In addition, participation in the ICS mechanism would be expanded to include other entities.

The maximum amount of ICS that can be created during any year, the maximum cumulative amount of ICS that can be available at any one time, and the maximum amount of ICS that may be delivered in any one year under this alternative are presented in Table 2.4-1. ICS that is assumed to be created by other entities is shown in Table 2.4-1 as “Unassigned.”

Table 2.4-1
Conservation Before Shortage Alternative
Volume Limitations of ICS

Entity	Maximum Annual ICS Creation (kaf)	Maximum Cumulative ICS (kaf)	Maximum Annual ICS Delivery (kaf)
Arizona	100	300	300
California	400	1,500	400
Nevada	125	300	300
Unassigned	825	2,100	600
Total	1,450	4,200	1,600

2.4.4 Interim Surplus Guidelines

The Conservation Before Shortage Alternative assumes the same modifications to and extension of the term of the ISG as described under the Basin States Alternative (Section 2.3).

2.4.5 Funding Mechanisms

There are two other aspects of the Conservation Before Shortage proposal that are unique to the Conservation Before Shortage Alternative: a funding mechanism for the voluntary conservation program, and a recommendation that a portion of the conserved water be used to benefit the environment. The details of the modeling assumptions used to simulate the ICS mechanism, including water for environmental purposes, are presented in Appendix M.

The Conservation Before Shortage proposal describes potential funding sources that include a Federal government contribution for the cost of all conservation agreements up to the volume of the bypass flow that the Secretary has not otherwise replaced in the year that a conservation trigger becomes effective, and responsibility for half of the cost of any additional agreements required to generate the proposed voluntary, conserved water. A second component of the funding mechanism would be a “Power Pool Protection Fund” which proposes that a percentage of the funding for the proposed voluntary conservation program be derived from a conditional surcharge on power rates under existing or renewed contracts for hydropower produced at Hoover Dam, depending upon the storage in Lake Mead. A third component of the funding mechanism would be “Temporary Cost Recovery/Delivery Surcharges”, requiring that the cost of some portion of the conservation agreements, including those with Colorado River users in Mexico, be funded through a conservation surcharge imposed on a per-acre-foot basis on water deliveries to all Lower Basin contractors.

The viability of the Conservation Before Shortage program funding proposal is not known at this time. The Department currently does not have the authority to implement all facets of this proposal and additional legislation would be necessary to gain such authority.

2.5 Water Supply Alternative

The Water Supply Alternative is intended to maximize water deliveries at the expense of retaining water in storage in the reservoirs for future use. This alternative would implement shortages only when sufficient water to meet entitlements is not available in Lake Mead.

The formulation of the four operational elements of the proposed federal action for the Water Supply Alternative follows.

2.5.1 Shortage Guidelines

Under the Water Supply Alternative, shortages would not be imposed until Lake Mead nears elevation 895 feet msl (top of the dead pool). Near that elevation, releases would be limited to the amount of water available. However, when Lake Mead elevation drops below 1,000 feet msl, SNWA would be unable to take water through its lower intake.

2.5.2 Coordinated Reservoir Operations

When Lake Powell is projected to be above elevation 3,575 feet msl at the end of the water year, the operation of Lake Powell would be the same as under the No Action Alternative unless Lake Mead elevation is below 1,075 feet msl. When Lake Powell elevation is projected to be below elevation 3,575 feet msl at the end of the water year or Lake Mead elevation is projected to be below elevation 1,075 feet msl at the end of the water year, the volumes of Lake Powell and Lake Mead would be balanced if possible, within the constraint that the release from Lake Powell would not be more than 9.5 maf and no less than 7.0 maf.

2.5.3 Storage and Delivery of Conserved Water

The Water Supply Alternative does not include a mechanism for the storage and delivery of conserved system and non-system water in Lake Mead.

2.5.4 Interim Surplus Guidelines

Under this alternative, the existing ISG would be extended through 2026.

2.6 Reservoir Storage Alternative

The Reservoir Storage Alternative was developed in coordination with the cooperating agencies and other stakeholders, primarily Western and NPS. This alternative would keep more water in storage in Lake Powell and Lake Mead to benefit power and recreation interests by reducing water deliveries and by increasing shortages. This alternative also provides a mechanism for promoting water conservation in the Lower Basin.

The formulation of the four operational elements of the proposed federal action for the Reservoir Storage Alternative follows.

2.6.1 Shortage Guidelines

The Reservoir Storage Alternative is similar to the Basin States Alternative in that it provides discrete levels of shortage associated with specific Lake Mead reservoir elevations (Section 2.3). However, shortages in this alternative begin at a higher Lake Mead elevation and the shortages amounts are larger so that more water would be retained in storage and higher Lake Powell and Lake Mead elevations would be maintained. The Reservoir Storage Alternative does not contain provisions that would protect the Lake Mead elevation of 1,000 feet msl.

The shortages modeled under this alternative are as follows:

- ◆ when Lake Mead is projected to be below elevation 1,100 feet msl and at or above elevation 1,075 feet msl on January 1, a shortage of 500 kaf shall be imposed for that year;
- ◆ when Lake Mead is projected to be below elevation 1,075 feet msl and at or above elevation 1,050 feet msl on January 1, a shortage of 667 kaf shall be imposed for that year;
- ◆ when Lake Mead is projected to be below elevation 1,050 feet msl and at or above elevation 1,025 feet msl on January 1, a shortage of 883 kaf shall be imposed for that year; and
- ◆ when Lake Mead is projected to be below elevation 1,025 feet msl on January 1, a shortage of 1,000 kaf would be imposed for that year.

The volumes of shortages are expressed as reductions to water users in the Lower Division states. However, modeling of the Reservoir Storage Alternative and the other alternatives includes the assumption that deliveries to Mexico are also reduced.⁵ As such, the total shortage amounts modeled under this alternative are 600; 800; 1,000; and 1,200 kaf at elevations 1,100; 1,075; 1,050; and 1,025 feet msl, respectively.

2.6.2 Coordinated Reservoir Operations

When Lake Powell is projected to be above elevation 3,595 feet msl at the end of the water year, the operation of Lake Powell would be the same as under the No Action Alternative. Elevations of Lake Powell that trigger releases that are less than the minimum objective release of 8.23 maf are tied to critical recreation elevations at Lake Powell as follows:

- ◆ when Lake Powell is projected to be below elevation 3,595 feet msl and above elevation 3,560 feet msl at the end of the water year, a release in the amount of 7.80 maf from Lake Powell would be made; and
- ◆ when Lake Powell is projected to be below elevation 3,560 feet msl at the end of the water year, the volumes of Lake Powell and Lake Mead would be balanced if possible, within the constraint that the release from Lake Powell would not be more than 9.5 maf and no less than 7.8 maf.

⁵ Reclamation's modeling assumptions are not intended to constitute an interpretation or application of the 1944 Treaty or to represent current United States policy or a determination of future United States policy regarding deliveries to Mexico.

2.6.3 Storage and Delivery of Conserved Water

Under the Reservoir Storage Alternative, storage credits would be generated by activities similar to those described under the Basin States Alternative (Section 2.3). In addition, participation in the storage and delivery mechanism would be expanded to include other entities. At the time the storage credits are created, ten percent of the conserved water would be dedicated to the Colorado River system on a one-time basis.

The maximum amount of storage credits that can be created during any year, the maximum cumulative amount of storage credits that can be available at any one time, and the maximum amount of storage credits that may be delivered by each entity in any one year under this alternative are presented in Table 2.6-1. Storage credits that are assumed to be generated by other entities are shown in Table 2.6-1 as “Unassigned.”

Table 2.6-1
Reservoir Storage Alternative
Volume Limitations of Storage and Delivery Mechanism

Entity	Maximum Annual Storage of Conserved System or Non-system Water (kaf)	Maximum Total Storage of Conserved System or Non-system Water (kaf)	Maximum Annual Delivery of Conserved System or Non-system Water (kaf)
Arizona	100	300	300
California	400	1,500	400
Nevada	125	300	300
Unassigned	475	950	950
Total	1,100	3,050	1,950

2.6.4 Interim Surplus Guidelines

Under the Reservoir Storage Alternative, the permissive provisions of the existing ISG are terminated in 2007 and surplus determinations revert to the Quantified Surplus and Flood Control Surplus conditions from 2008 through 2026.

2.7 Preferred Alternative

The Preferred Alternative incorporates operational elements identified in the Basin States and Conservation Before Shortage alternatives. It proposes a coordinated operation of Lake Powell and Lake Mead that would minimize shortages in the Lower Basin and avoid risk of curtailments of use in the Upper Basin and adopts the ICS mechanism for promoting water conservation in the Lower Basin.

The formulation of the four operational elements of the proposed federal action for the Preferred Alternative follows.

2.7.1 Shortage Guidelines

The Preferred Alternative, similar to the Basin States Alternative, assumes discrete levels of shortage associated with specific Lake Mead elevations as described below. This alternative

provides criteria for shortages up to a maximum of 500 kaf at Lake Mead elevation of 1,025 feet msl.

The shortages modeled under the Preferred Alternative are as follows:

- ◆ when Lake Mead is projected to be below elevation 1,075 feet msl and at or above elevation 1,050 feet msl on January 1, a shortage of 333 kaf shall be imposed for that year;
- ◆ when Lake Mead is projected to be below elevation 1,050 feet msl and at or above elevation 1,025 feet msl on January 1, a shortage of 417 kaf shall be imposed for that year;
- ◆ when Lake Mead is projected to be below elevation 1,025 feet msl on January 1, a shortage of 500 kaf shall be imposed for that year; and
- ◆ when Lake Mead is below elevation 1,025 feet msl, the Secretary shall undertake appropriate consultation, including with the Basin States, to discuss further measures that may be undertaken consistent with the Law of the River.⁶

The volumes of shortages are expressed as reductions to water users in the Lower Division states. However, modeling of this and the other alternatives includes the assumption that deliveries to Mexico are also reduced.⁷ As such, the total shortage amounts modeled under this alternative are 400; 500; and 600 kaf at elevations 1,075; 1,050; and 1,025 feet msl, respectively.

2.7.2 Coordinated Reservoir Operations

The Preferred Alternative assumes the same coordinated reservoir operations as the Basin States and Conservation Before Shortage alternatives described in Sections 2.3 and 2.4, respectively.

⁶ This alternative proposes that appropriate consultations be undertaken to define additional shortages needed when Lake Mead falls below elevation 1,025 feet msl. The possible outcomes of such a consultation process are unknown; therefore, for modeling purposes it was assumed that shortages of 500 kaf would continue to be applied at Lake Mead elevations below 1,025 feet msl.

⁷ Reclamation's modeling assumptions are not intended to constitute an interpretation or application of the 1944 Treaty or to represent current United States policy or a determination of future United States policy regarding deliveries to Mexico. The United States will conduct all necessary and appropriate discussions regarding the proposed federal action and implementation of the 1944 Treaty with Mexico through the IBWC in consultation with the Department of State.

2.7.3 Creation and Delivery of ICS

The Preferred Alternative is similar to the Basin States and Conservation Before Shortage alternatives. It includes the adoption of a mechanism to encourage and account for augmentation and conservation of water supplies. The mechanism provides for the creation, accounting, and delivery of ICS. At the time the ICS is created, five percent of the ICS would be dedicated to the Colorado River system on a one-time basis. Additionally, ICS accounted for in Lake Mead longer than one year would be subject to annual evaporation losses of three percent per year. If flood control releases occur, ICS would be reduced on a pro-rata basis until no ICS remains, i.e., ICS would be released first.

The maximum amount of ICS that can be created during any year, the maximum cumulative amount of ICS that can be available at any one time, and the maximum amount of ICS that may be delivered in any one year under the Preferred Alternative are presented in Table 2.7-1. ICS that is assumed to be created by other entities is shown in Table 2.7-1 as “Additional Amounts.”

Table 2.7-1
Preferred Alternative
Volume Limitations of ICS

Entity	Maximum Annual ICS Creation (kaf)	Maximum Cumulative ICS (kaf)	Maximum Annual ICS Delivery (kaf)
Arizona	100	300	300
California	400	1,500	400
Nevada	125	300	300
Total ¹	625	2,100	1,000
Additional Amounts	625	2,100	1,000
Total ²	1,250	4,200	2,000

1 It is anticipated that the ICS mechanism will be implemented to allow a maximum cumulative amount of ICS that would be available at any one time of up to 2.1 maf.

2 The analysis of potential effects in this Final EIS includes a maximum cumulative amount of ICS that would be available at any one time of up to 4.2 maf.

2.7.4 Interim Surplus Guidelines

The Preferred Alternative assumes the same modifications to and extension of the term of the ISG as described under the Basin States and Conservation Before Shortage alternatives (Sections 2.3 and 2.4, respectively).

2.7.5 Preferred Alternative Summary and Conclusions

The Preferred Alternative is the most reasonable and feasible alternative among those considered and analyzed in the Final EIS. The potential environmental effects of this action alternative, as well as the No Action Alternative and the four other action alternatives have been fully analyzed in the Final EIS. The environmental effects of the Preferred Alternative are well within the range of anticipated effects of the alternatives presented in the Draft EIS and do not affect the environment in a manner not already considered in the Draft EIS.

Reclamation has determined that the four key operational elements described and evaluated in the Draft EIS and selected to formulate the Preferred Alternative best meet all aspects of the purpose and need for the proposed federal action as discussed below. Additionally, Reclamation has developed draft operational guidelines (Appendix S) for how the Preferred Alternative may be implemented during the interim period. These guidelines may be revised and refined prior to adoption in the ROD.

- 1) **Shortage Guidelines:** The Preferred Alternative defines discrete levels of shortage volumes associated with Lake Mead reservoir elevations. This will provide water users and managers in the Lower Basin with greater certainty with regard to when, and by how much, water deliveries will be reduced in drought and other low reservoir conditions.
- 2) **Coordinated Reservoir Operations:** The Preferred Alternative proposes coordinated operations of Lake Powell and Lake Mead throughout the full range of operational elevations. Better management of these reservoirs at higher elevations has a direct impact on available storage, thereby affecting the likelihood and severity of potential future shortages.
- 3) **Creation and Delivery of ICS:** The Preferred Alternative proposes a mechanism to encourage and account for augmentation and conservation of water supplies and thereby minimize the likelihood and severity of potential future shortages. This mechanism provides for the creation, accounting, and delivery of ICS.

Under the Preferred Alternative, the maximum cumulative amount of ICS that could be available at any one time is 2.1 maf. This amount could be increased up to 4.2 maf in future years. Depending on the severity of drought and low reservoir conditions, it may be desirable to facilitate greater conservation. As appropriate, the Secretary will enter into agreements to deliver ICS.

At the time the ICS is created, five percent of the ICS would be dedicated to the Colorado River system on a one-time basis. This system assessment will benefit the system and enhance the water in storage in Lake Mead and would be available to meet future needs.

The draft interim operational guidelines (Appendix S) set forth Reclamation's concepts for the creation of ICS, verification, water accounting procedures, and any necessary forbearance agreements required to deliver ICS as contemplated under the Preferred Alternative. Although the guidelines for this element are interim and will expire in 2026, some of the conservation projects established under the guidelines could be permanent in duration.

- 4) **Interim Surplus Guidelines:** The draft interim operational guidelines (Appendix S) would extend the ISG, providing for an operational strategy for the full range of reservoir operations through 2026. The ISG would also be modified by eliminating the Partial Domestic Surplus Condition, beginning in 2008, and by limiting the amount of water available under the Full Domestic Surplus Condition during the

period 2017 through 2026. The elimination of the Partial Domestic Surplus Condition reduces the amount of surplus water that could be made available and leaves more water in storage to reduce the severity of future shortages.

2.8 Summary Comparison of Alternatives

Summary comparisons of the alternatives identified and analyzed in the Final EIS are provided in Table 2.8-1 as a matrix of alternatives and their formulation for each of the four operational elements of the proposed federal action. Table 2.8-2 provides a comparison of the alternatives under the Coordinated Reservoir Operations element of the proposed federal action for Lake Powell. Table 2.8-3 provides a comparison of the alternatives under the Shortage Guidelines element of the proposed federal action for Lake Mead.

Table 2.8-1
Matrix of Alternatives

Alternatives	Shortage Guidelines to Reduce Deliveries from Lake Mead (elevation in feet msl)	Coordinated Reservoir Operations (Lake Mead & Lake Powell) (elevation in feet msl)	Lake Mead Storage and Delivery of Conserved System and Non-system Water	Interim Surplus Guidelines (ISG) for Deliveries/Releases from Lake Mead
No Action	<ul style="list-style-type: none"> Determination made through the AOP process, absent shortage guidelines Reasonably represented by a two-level shortage strategy - probabilistic protection of Lake Mead elevation 1,050 and absolute protection of Lake Mead elevation 1,000 	<ul style="list-style-type: none"> Minimum objective release of 8.23 maf from Lake Powell unless storage equalization releases are required Operation at low reservoir levels reasonably represented by a 8.23 maf release from Lake Powell down to Lake Powell dead pool 	<ul style="list-style-type: none"> No water management mechanism for storage and delivery of conserved system and non-system water 	<ul style="list-style-type: none"> No modification or extension of the ISG which end in 2016 After 2016, determination made through the AOP process, absent surplus guidelines; reasonably represented by the spill avoidance (referred to as the 70R) strategy
Basin States	<ul style="list-style-type: none"> Shortages (i.e., reduced deliveries in the United States) of 333, 417, and 500 kaf from Lake Mead at elevations 1,075, 1,050, and 1,025 respectively¹ Initiate efforts to develop additional guidelines for shortages if Lake Mead falls below elevation 1,025 (Note: includes consultation with Basin States) 	<ul style="list-style-type: none"> Under high reservoir conditions, minimum objective release of 8.23 maf from Lake Powell unless storage equalization releases are required Under lower reservoir conditions, either reduce Lake Powell release or balance volumes depending upon elevations at Lake Powell and Lake Mead 	<ul style="list-style-type: none"> Creation, accounting, and delivery of ICS Maximum total ICS of 2.1 maf System assessment of 5% when ICS is created 	<ul style="list-style-type: none"> Modification of ISG to eliminate Partial Domestic Surplus condition Extension of the modified guidelines through 2026
Conservation Before Shortage	<ul style="list-style-type: none"> Shortages are implemented in any given year when necessary to keep Lake Mead above SNWA's lower intake at elevation of 1,000 (absolute protection of elevation 1,000) 	<ul style="list-style-type: none"> Under high reservoir conditions, minimum objective release of 8.23 maf from Lake Powell unless storage equalization releases are required Under lower reservoir conditions, either reduce Lake Powell release or balance volumes depending upon elevations at Lake Powell and Lake Mead 	<ul style="list-style-type: none"> Prior to shortage, conservation of different volumes of water tied to Lake Mead elevation Creation, accounting, and delivery of ICS Water for environmental uses Maximum total ICS of up to 4.2 maf System assessment of 5% when ICS is created 	<ul style="list-style-type: none"> Modification of ISG to eliminate Partial Domestic Surplus condition Extension of the modified guidelines through 2026
Water Supply	<ul style="list-style-type: none"> Release full annual entitlement amounts until Lake Mead is drawn down to dead pool (elevation 895) 	<ul style="list-style-type: none"> Minimum objective release of 8.23 maf from Lake Powell unless storage equalization releases are required Balancing if Lake Powell is below elevation 3,575 or Lake Mead is below elevation 1,075 	<ul style="list-style-type: none"> No water management mechanism for storage and delivery of conserved system and non-system water 	<ul style="list-style-type: none"> Extension of the existing ISG through 2026
Reservoir Storage	<ul style="list-style-type: none"> Shortages (i.e., reduced deliveries in the United States) of 500, 667, 833, and 1,000 kaf from Lake Mead at elevations 1,100, 1,075, 1,050, and 1,025 respectively¹ 	<ul style="list-style-type: none"> Minimum objective release of 8.23 maf from Lake Powell if Lake Powell is above elevation 3,595 unless storage equalization releases are required 7.8 maf release from Lake Powell between Lake Powell elevations of 3,560 and 3,595 Balancing below Lake Powell elevation 3,560 	<ul style="list-style-type: none"> Storage and delivery of conserved system and non-system water Maximum total storage of conserved system and non-system water of 3.05 maf System assessment of 10% of stored conserved system and non-system water 	<ul style="list-style-type: none"> Provisions of existing ISG terminate after 2007, and during period from 2008-2026, surplus determinations are limited to 70R and F food Control conditions
Preferred Alternative	<ul style="list-style-type: none"> Shortages (i.e., reduced deliveries in the United States) of 333, 417, and 500 kaf from Lake Mead at elevations 1,075, 1,050, and 1,025 respectively¹ Initiate efforts to develop additional guidelines for shortages if Lake Mead falls below elevation 1,025 (Note: includes consultation) 	<ul style="list-style-type: none"> Under high reservoir conditions, minimum objective release of 8.23 maf from Lake Powell unless storage equalization releases are required Under lower reservoir conditions, either reduce Lake Powell release or balance volumes depending upon elevations at Lake Powell and Lake Mead 	<ul style="list-style-type: none"> Creation, accounting, and delivery of ICS Maximum total ICS in Lake Mead of up to 4.2 maf System assessment of 5% when ICS is created 	<ul style="list-style-type: none"> Modification of ISG to eliminate Partial Domestic Surplus condition Extension of the modified guidelines through 2026

¹ These are amounts of shortage (i.e., reduced deliveries in the United States). As in the Draft EIS, the Final EIS includes modeling assumptions that identify water deliveries to Mexico pursuant to the 1944 Treaty.

Table 2.8-2
Lake Powell
Comparison of Alternatives
Coordinated Reservoir Operations Element of the Proposed Federal Action

Lake Powell Elevation (feet msl)	No Action Alternative	Basin States Alternative	Conservation Before Shortage Alternative	Water Supply Alternative	Reservoir Storage Alternative	Preferred Alternative	Lake Powell Storage (maf)
3,700	Equalize, avoid spills or release 8.23 maf	Equalize, avoid spills or release 8.23 maf	Equalize, avoid spills or release 8.23 maf	Equalize, avoid spills or release 8.23 maf	Equalize, avoid spills or release 8.23 maf	Equalize, avoid spills or release 8.23 maf	24.3
Equalization	602(a)	Upper Equalization Line	Upper Equalization Line	602(a)	602(e)	Upper Equalization Line	Equalization
3,595	Release 8.23 maf	Release 8.23 maf; if Lake Mead < 1,075 feet msl, balance contents with a min/max release of 7.0 and 9.0 maf	Release 8.23 maf; if Lake Mead < 1,075 feet msl, balance contents with a min/max release of 7.0 and 9.0 maf	Release 8.23 maf; if Lake Mead < 1,075 feet msl, balance contents with a min/max release of 7.0 and 9.5 maf	Release 8.23 maf	Release 8.23 maf; if Lake Mead < 1,075 feet msl, balance contents with a min/max release of 7.0 and 9.0 maf	11.3
3,575					Release 7.8 maf	Release 7.48 maf; if Lake Mead < 1,025 feet msl, release 8.23 maf	9.5
3,560		Release 7.48 maf; if Lake Mead < 1,025 feet msl, release 8.23 maf	Release 7.48 maf; if Lake Mead < 1,025 feet msl, release 8.23 maf	Balance contents with a min/max release of 7.0 and 9.5 maf			8.3
3,525					Balance contents with a min/max release of 7.8 and 9.5 maf		5.9
3,490		Balance contents with a min/max release of 7.0 and 9.5 maf	Balance contents with a min/max release of 7.0 and 9.5 maf			Balance contents with a min/max release of 7.0 and 9.5 maf	4.0
3,370							0

Table 2.8-3
Lake Mead
Comparison of Alternatives
Coordinated Reservoir Operations Element of the Proposed Federal Action

Lake Mead Elevation (feet msl)	No Action Alternative	Basin States Alternative	Conservation Before Shortage Alternative	Water Supply Alternative	Reservoir Storage Alternative	Preferred Alternative	Lake Mead Storage (maf)
1,220	Flood Control or 70R Surplus	Flood Control or 70R Surplus	Flood Control or 70R Surplus	Flood Control or 70R Surplus	Flood Control or 70R Surplus	Flood Control or 70R Surplus	25.9
1,200	Full Domestic Surplus (through 2016)	Domestic Surplus	Domestic Surplus	Full Domestic Surplus	Normal Operations	Domestic Surplus	22.9
1,145	Partial Domestic Surplus (through 2016)	Normal Operations	Normal Operations	Partial Domestic Surplus	Normal Operations	Normal Operations	15.9
1,125	Normal Operations	Normal Operations	Normal Operations	Normal Operations	Normal Operations	Normal Operations	13.9
1,100	Normal Operations	Normal Operations	Normal Operations	Normal Operations	Normal Operations	Normal Operations	11.5
1,075	Shortage 80 percent Protection of elevation 1,050 feet msl	Shortage 333 kaf ¹	Voluntary Conservation		Shortage 500 ¹ kaf		9.4
1,050		Shortage 417 kaf ¹			Shortage 667 ¹ kaf	Shortage 333 kaf ¹	7.5
1,025		Shortage 500 kaf ¹ and Consultation ²			Shortage 833 ¹ kaf	Shortage 417 kaf ¹	5.8
1,000	Shortage Absolute Protection of elevation 1,000 feet msl	Shortage Absolute Protection of elevation 1,000 feet msl	Shortage Absolute Protection of elevation 1,000 feet msl		Shortage 1,000 ¹ kaf	Shortage 500 kaf ¹ and Consultation ²	4.3
895							0

¹ These are amounts of shortage (i.e., reduced deliveries in the United States). As in the Draft EIS, the Final EIS includes modeling assumptions that identify water deliveries to Mexico pursuant to the 1944 Treaty.

² If Lake Mead falls below elevation 1,025, the Department will initiate efforts to develop additional guidelines for shortages at lower Lake Mead elevations.

2.9 Summary of Potential Effects

Table 2.9-1 presents a summary of the potential effects of the alternatives. Chapter 4 contains detailed descriptions of these effects.

Table 2.9-1
Summary of Potential Effects of the Alternatives

Final EIS Section	Environmental Consequences by Resource, Year and Value	Alternatives							Preferred Alternative	
		No Action	Basin States	Conservation Before Shortage	Water Supply	Reservoir Storage				
4.3	Hydrologic Resources									
	Probability of Glen Canyon annual release volumes \geq 7.5 maf, 2009 to 2060	99.96%	96.66%	96.66%	97.9%	100%			96.39%	
	Probability of Glen Canyon annual release volumes \geq 8.23 maf, 2009 to 2060	99%	96.32%	96.38%	96.33%	93.79%			96.64%	
	Lake Powell March elevation, probability of water levels \leq 3,490 feet msl 2026	1.0%	0%	0%	9.0%	0%			0%	
	Lake Mead July elevation, probability of water levels \leq 1,050 feet msl 2026	30%	23%	23%	29%	9%			21%	
4.4	Hoover Dam annual release, 2026 50 th percentile values	9.04 maf	9.17 maf	9.11 maf	9.39 maf	8.68 maf			9.16 maf	
	Water Deliveries									
	Probability of involuntary shortage, 2026	49%	35%	7%	12%	37%			41%	
	Probability of voluntary and involuntary shortage, 2026	49%	35%	36%	12%	37%			41%	
	Probability of normal deliveries, 2026	34%	26%	25%	47%	45%			19%	
4.5	Probability of surplus, 2026	17%	39%	39%	41%	18%			40%	
	Water Quality									
	Temperature at Little Colorado River, July 2026, 50 th percentile	12 °C	12 °C	12 °C	13 °C	12 °C			12 °C	
	Salinity downstream of Parker Dam, 2026	621 mg/L	625 mg/L	625 mg/L	633 mg/L	615 mg/L			625 mg/L	
	Salinity at Imperial Dam, 2026	740 mg/L	747 mg/L	751 mg/L	760 mg/L	735 mg/L			747 mg/L	
4.6	Air Quality									
	Lake Powell 2025, 10 th percentile exposed shoreline	17,000 acres	17,000 acres	17,000 acres	22,000 acres	14,000 acres			17,000 acres	
	Lake Mead 2025, 10 th percentile exposed shoreline	89,000 acres	82,000 acres	83,000 acres	90,000 acres	73,000 acres			82,000 acres	

Table 2.9-1
Summary of Potential Effects of the Alternatives

Final EIS Section	Environmental Consequences by Resource, Year and Value	Alternatives							Preferred Alternative
		No Action	Basin States	Conservation Before Shortage	Water Supply	Reservoir Storage			
4.7	Visual Resources								
	Lake Powell maximum height of calcium carbonate ring, 10 th percentile, 2025	148 feet	148 feet	148 feet	192 feet	128 feet	148 feet	148 feet	148 feet
	Lake Mead maximum height of calcium carbonate ring, 10 th percentile, 2025	218 feet	197 feet	199 feet	221 feet	170 feet	195 feet	195 feet	195 feet
4.8	Biological Resources ¹								
	Effects on Vegetation and Wildlife								
	Lake Powell and Lake Mead	-	None to minor positive	None to minor positive	Minor negative	Minor positive	Minor positive	Minor positive	Minor positive
	Glen Canyon Dam to Lake Mead	-	Minor negative	Minor negative	Minor negative	Minor negative	Minor negative	Minor negative	Minor negative
	Hoover Dam to NIB	-	None to minor negative	None to minor negative	None to minor positive	None to minor negative	None to minor negative	None to minor negative	None to minor negative
	NIB to SIB	-	None	Moderate positive	None	Moderate positive	Moderate positive	None	None
	Effects on Special Status Species								
4.9	Cultural Resources								
	Number of Lake Powell sites potentially exposed, 10 th percentile	194 sites	190 sites	190 sites	227 sites	193 sites	190 sites	190 sites	190 sites
	Probability of exposing 32 Lake Mead sites ≤ elevation 1,080 feet msl, 2026	45%	45%	46%	48%	23%	47%	47%	47%
	Indian Trust Assets ¹								
4.10	Water rights affected	-	None	None	None	None	None	None	None
	Trust land affected	-	None	None	None	None	None	None	None

Table 2.9-1
Summary of Potential Effects of the Alternatives

Final EIS Section	Environmental Consequences by Resource, Year and Value	Alternatives							Preferred Alternative
		No Action	Basin States	Conservation Before Shortage	Water Supply	Reservoir Storage			
4.11	Electrical Power Resources								
	Glen Canyon Powerplant								
	Average annual generation and percent change from No Action Alternative value	4,247,880 MWh	(0.08)%	(0.07)%	(2.57)%	0.78%		0.08%	
	Average monthly capacity and percent change from No Action Alternative value	606 MW	(0.15)%	(0.13)%	(2.72)%	0.79%		0.03%	
	Average total economic value and percent change from No Action Alternative value	\$7,350,000,000	0.02%	0.04%	(2.25)%	0.88%		0.19%	
	Hoover Powerplant								
	Average annual generation and percent change from No Action Alternative value	3,127,523 MWh	(0.22)%	(0.05)%	(2.39)%	9.07%		1.4%	
	Average monthly capacity and percent change from No Action Alternative value	1,191 MW	0.31%	0.58%	(2.56)%	11.52%		2.31%	
	Average total economic value and percent change from No Action Alternative value	\$7,223,000,000	0.08%	0.34%	(2.51)%	10.63%		2.38%	
	Davis and Parker Powerplants								
	Average annual generation and percent change from No Action Alternative value	1,639,687 MWh	(0.56)%	(0.69)%	0.11%	(1.07)%		(0.68)%	
	Average monthly capacity and percent change from No Action Alternative value	331 MW	0%	0%	0%	0%		0%	
	Average total economic value and percent change from No Action Alternative value	\$2,268,000,000	(0.53)%	(0.73)%	0.31%	(1.54)%		(0.81)%	
	Headgate Rock Powerplant								
Average annual generation and percent change from No Action Alternative value	77,482 MWh	(1.21)%	(1.71)%	(0.28)%	(1.7)%		(1.5)%		
Average monthly capacity and percent change from No Action Alternative value	not applicable	not applicable	not applicable	not applicable	not applicable		not applicable		
Average total economic value and percent change from No Action Alternative value	\$103,000,000	(1.29)%	(2.02)%	(0.17)%	(2.31)%		(1.83)%		

Table 2.9-1
Summary of Potential Effects of the Alternatives

Final EIS Section	Environmental Consequences by Resource, Year and Value	Alternatives							Preferred Alternative
		No Action	Basin States	Conservation Before Shortage	Water Supply	Reservoir Storage			
4.12 Recreation Lake Powell	Probability of closure, Wahweap and lower Bullfrog launch ramps, 2026	7%	9%	9%	23%	3%			8%
	Probability of navigation closures, Castle Rock, Gregory Butte, 2026	28%	36%	36%	52%	24%			32%
	Effects on sport fish	--	None	None	None	None			None
	Lake Mead								
	Probability of closure, Pearce Bay launch ramp, 2026	74%	76%	75%	78%	66%			74%
	Probability of closure, Echo Bay launch ramp, 2026	30%	23%	23%	29%	9%			21%
4.13 Transportation	Probability of navigation difficulties, upper Lake Mead, 2026	73%	73%	73%	76%	64%			72%
	Probability of Lake Powell ferry closure, end of September 2026	5%	7%	7%	17%	3%			7%
	Effects on Laughlin River taxis and tour boats	--	None	None	Minor positive	Minor negative			None
	Effects on Lake Havasu ferry service	--	None	None	None	None			None

Table 2.9-1
Summary of Potential Effects of the Alternatives

Final EIS Section	Environmental Consequences by Resource, Year and Value	Alternatives						
		No Action	Basin States	Conservation Before Shortage	Water Supply	Reservoir Storage	Preferred Alternative	
4.14	Socioeconomics and Land Use							
	Probability of 500,000 af shortage with loss of 561 jobs and \$18,000,000 in income, and \$5,900,000 in tax revenues in agricultural sector in Arizona, 2026	34%	15%	1%	--	--	24%	
	Probability of 500,000 af shortage with loss of 397 jobs and \$12,300,000 in income, and \$4,200,000 in tax revenues in agricultural sector in Arizona, 2060	54%	54%	50%	51%	53%	52%	
	Agricultural production and resulting effects on employment, income, and tax revenues in California and Nevada	--	None	None	None	None	None	None
	Recreation spending at Lake Powell	--	Same	Same	Decrease	Increase	Increase	
	Recreation spending at Lake Mead (LMNRA)	--	Same	Same	Same	Increase	Increase	
	Change in river recreation economic activity							
	Lake Powell to Lake Mead	--	None	None	None	None	None	None
	Downstream of Lake Mead	--	None	None	None	None	None	None
	Change in economic activity in Municipal & Industrial sector							
	Arizona	--	None	None	None	None	None	None
	California	--	None	None	None	None	None	None
	Nevada	--	None	None	None	None	None	None
4.15	Environmental Justice	--	None	None	None	None	None	None

Note: (1) "None" after a hyphen in the No Action Alternative column means no difference between the action alternative and the No Action Alternative.