Form to Submit Options to Resolve Future Supply and Demand Imbalances

The Study is entering Phase 4 (Development and Evaluation of Opportunities to Balance Supply and Demand). A key task in this phase is to identify various options to help address the range of supply and demand imbalances projected to occur in the Basin over the next 50 years. The nature, magnitude, timing, and regional impacts of these imbalances mean that no one option will address all needs; rather, a combination of options will likely need to be considered. The Study will not result in the selection or funding of a particular proposed option or set of options. Rather, the Study is intended to explore a broad range of options to help address future imbalances and the performance of those options across a range of future conditions. The Study will also lay the foundation for future development and implementation of the options identified. The Study is seeking your input regarding ideas for potential options to address these projected imbalances. Please refer to the report titled *Development and Evaluation of Opportunities for Balancing Water Supply and Demand: Request for Ideas* for more information regarding this phase.

How to Submit an Option

It is requested that this form be completed and submitted by February 1, 2012 to allow sufficient time for its consideration. After completing the form, please submit either electronically or in printed from in one of the following ways:

1. Via the Study website at: http://www.usbr.gov/lc/region/programs/crbstudy.html
2. E-mail to: ColoradoRiverBasinStudy@usbr.gov
3. U.S. mail to: Bureau of Reclamation,
   Attention: Ms. Pam Adams, LC-2721, P.O. Box 61470, Boulder City, NV 89006-1470
4. Facsimile transmission to: 702-293-8418

How to Complete this Form

Complete this form to the best of your ability. Depending on the specific details of the option being submitted, some of the requested information may not be applicable or available. When this is the case, please enter “not applicable” or “not available” in the relevant data field. If the requested information is unknown, please enter “unknown.” If there is additional information you would like to provide, please use the last field on the form titled “Other Information” to do so.

How Submitted Information Will be Used

The options received will be used to develop representative options to assess the impacts to Basin resources across a wide range of future water supply and demand scenarios. Representative options will be developed to encompass the full range of the options submitted, but in order to keep the analysis manageable not every submitted option will be analyzed. Representative options will then be used to develop portfolios to implement a particular management strategy to help resolve future supply and demand imbalances.

Providing Contact Information

Providing contact information is not required and options can be submitted anonymously. Anonymously submitted options will be treated in the same way as all other options. However, when attempting to properly characterize and evaluate the submitted options, it is possible that clarifying information may be needed. Therefore, although voluntary, you are encouraged to provide contact information. Before including your address, telephone number, electronic mail address, or other personal identifying information, you should be aware that while you can ask us to withhold your personal identifying information from public review by checking the box **"keep my contact information private,"** we cannot guarantee that we will be able to do so.

Option Submittal Form

Contact Information (optional): ☐ Keep my contact information private

Contact Name: _____ Title: _____

Affiliation: _____

Address: _____

Telephone: _____ E-mail Address: _____

Date Option Submitted: 1/27/2012

Option Name:

Agricultural Conservation and Efficiency

Description of Option:

This options calls for the implementation of a suite of agricultural conservation and efficiency strategies to decrease the agricultural sector's total demand for water and total consumptive use. These strategies include:

1. Efficient Irrigation Technology – shifting from flood to sprinkler and drip irrigation;
2. Improved Irrigation Scheduling - using local climate and soil information to help farmers irrigate more precisely to meet crop water needs;
3. Improved Salinity Management – using soil salinity assessments and crop salt-tolerance information to help farmers more precisely determine the volume required for leaching;
4. Regulated Deficit Irrigation – applying less water to crops during drought-tolerant growth stages to reduce crop consumptive use;
5. System Efficiency – lining canals and laterals, tailwater pump-back systems, real-time irrigation water scheduling and delivery, and regulatory reservoirs; and
6. Crop Shifting – farmers shift from more water-intensive crops (such as alfalfa) to less water-intensive crops.

Note that some of the six strategies listed above will reduce consumptive use, while others reduce demand for total applied water, with limited consumptive use savings. To avoid distracting arguments about the appropriate scale for determining water savings, this option assumes that onl

Location: Describe location(s) where option could be implemented and other areas that the option would affect, if applicable. Attach a map, if applicable.

The strategies listed above can be applied, in different combinations, throughout the basin and adjacent areas. The water savings achieved by these strategies will be in direct proportion to existing water use: areas with limited growing seasons and lower ET will realize lower savings than areas with long growing seasons, multi-cropping, and higher ET. Strategies 2-4 (above) may not be cost-effective in some areas with very short growing seasons or relatively low water use. For the ease of modeling simplicity, this proposed option assumes that the strategies are applied across the basin and adjacent areas, with resultant water savings as described below.

Quantity and Timing: Roughly quantify the range of the potential amount of water that the option could provide over the next 50 years and in what timeframe that amount could be available. If option could be implemented in phases, include quantity estimates associated with each phase. If known, specify any important seasonal (e.g,. more water could be available in winter) and/or frequency (e.g., more water could likely be available during above-average hydrologic years) considerations. If known, describe any key assumptions made in order to quantify the potential amount.

An estimated 2.3 million acres will be irrigated within the basin in 2015, and an additional 3.1 million acres will be irrigated in adjacent areas that year, with a combined water demand of 10.6 million acre-feet (MAF). A recent report (Cooley et al. 2010) calculated that 0.7 MAF of water could be conserved across 1.44 million acres, using only three of the six strategies (#s 1, 2, and 4) described above. This proposed option conservatively assumes that 0.7 MAF of water can be conserved across all 3.1 million acres of the adjacent areas, proportional to total exports, with the six strategies listed above. For modeling purposes, assume that these savings are achieved uniformly across the adjacent areas, proportional to current acreage. For example, an area with 10% of total adjacent area acreage presumably will enjoy water savings from this option of 10% of 0.7 MAF.

This option conservatively projects that an additional 0.1 MAF reduction in total irrigation demand within the basin itself (2% of total irrigation

Additional Information

Technical Feasibility: Describe the maturity and feasibility of the concept/technology being proposed, and what research and/or technological development might first be needed.

Existing, proven concepts and technologies.

Costs: Provide cost and funding information, if available, including capital, operations, maintenance, repair, replacement, and any other costs and sources of funds (e.g., public, private, or both public and private). Identify what is and is not included in the provided cost numbers and provide references used for cost justification. Methodologies for calculating unit costs (e.g., $/acre-foot or $/million gallons) vary widely; therefore, do not provide unit costs without also providing the assumed capital and annual costs for the option, and the methodology used to calculate unit costs.

Cooley et al. (2010) estimate total capital costs associated with 0.7 MAF of conserved water at $575 million, with an additional $47 million annually in operations and maintenance. More than 90% of the initial capital costs are associated with moving from flood to sprinkler and drip irrigation. They estimate capital costs for deficit irrigation at $45/acre, and an additional $25/acre for O&M, with a per-acre savings of 0.8 acre-feet. A recent study in California (Bali et al. 2010) found much greater water savings from summer deficit irrigation of alfalfa (as much as 1.9 acre-feet per acre), though these results are limited to periodic application to multi-year crops. The costs of crop shifting vary based on market conditions; typically, farmers shift crops based on market projections and expected rates of return, so the farmer assumes the risk. For the purposes of this option, assume that other

Permitting: List the permits and/or approvals required and status of any permits and/or approvals received.

Some of the strategies listed above may require permits or other approvals, depending on location. Most of the strategies, however, do not require any permits or approvals.

Legal / Public Policy Considerations: Describe legal/public policy considerations associated with the option. Describe any agreements necessary for implementation and any potential water rights issues, if known.

System and on-farm water conservation can raise important legal and policy considerations that vary by state, including possible forfeiture of rights to conserved water. Some states have enacted legislation maintaining irrigators' rights to water so conserved.

Implementation Risk / Uncertainty: Describe any aspects of the option that involves risk or uncertainty related to implementing the option.

This option assumes average levels of reduced water demand throughout the basin and adjacent areas, obscuring the uncertainty with the actual volume of water that may be conserved in any particular irrigation district or farm. This is intentional, as we lack the time and capacity to analyze conservation potential at that scale. Nonetheless, we have a great deal of confidence that, basin-wide, these average levels of water savings can be achieved.

Reliability: Describe the anticipated reliability of the option and any known risks to supply or demand, such as: drought risk, water contamination risk, risk of infrastructure failure, etc.

Agricultural conservation and efficiency are highly reliable, effective, and demonstrated means of reducing total demand for water. Two of the strategies listed also provide direct reductions in consumptive water use; the other strategies reduce consumptive use to a limited extent. The reliability of the strategies can vary over time, due primarily to variable meteorological and market conditions. When prices for a particular commodity are high, farmers will seek to maximize yields and will likely be less willing to consider strategies, such as deficit irrigation and crop shifting, that may reduce yields and revenue. However, on average, across the basin and adjacent areas and over the roughly fifty year planning period, the water savings projected by this option should be readily achievable.

Water Quality: Identify key water quality implications (salinity and other constituents) associated with the option in all of the locations the option may affect.

Most of the individual strategies listed above entail more precise irrigation methods, enabling a farmer to reduce the application of fertilizers, pesticides, and herbicides, in turn reducing the pollutant loadings in receiving water bodies. In some cases, concentrations of individual pollutants may be elevated, as the increased efficiency leads to diminished run-off, but this also means that total diversions will decrease, increasing the dilution capacity of existing streams.

Energy Needs: Describe, and quantify if known, the energy needs associated with the option. Include any energy required to obtain, treat, and deliver the water to the defined location at the defined quality.

Energy Required	Source(s) of Energy
Several of these strategies will require nominal amounts of additional energ	

Hydroelectric Energy Generation: Describe, and quantify if known, any anticipated increases or decreases in hydroelectric energy generation as a result of the option.

Location of Generation	Impact to Generation
May lead to nominal increases in hydropower generation, to the extent that	

Recreation: Describe any anticipated positive or negative effects on recreation.

Locations	Anticipate Benefits or Impacts
May lead to nominal increases in recreation, to the extent that conserved w	

Environment: Describe any anticipated positive or negative effects on ecosystems within or outside of the Colorado River Basin.

Locations	Anticipated Benefits or Impacts
By reducing return flows, these strategies can adversely affect ecosystems tl	

Socioeconomics: Describe anticipated positive or negative socioeconomic (social and economic factors) effects.

Each of the listed strategies involves an increased demand for labor, meaning that each will result in additional jobs. Many of these are specialized jobs requiring particular skills, such as irrigation management and monitoring, though some are more general, such as general construction. By maintaining land in irrigation, these strategies generate water while preserving rural communities, effectively resulting in additional revenue to such communities. These are positive socioeconomic effects.

Other Information: Provide other information as appropriate, including potential secondary benefits or considerations. Attach supporting documentation or references, if applicable.

There are many examples of such strategies in practice, throughout the basin and adjacent areas, as described in the following references.

Bali, KM, et al. 2010. "Deficit Irrigation of Alfalfa in the Palo Verde Valley, California." Sponsored by the Metropolitan Water District of Southern California and the University of California Cooperative Extension. May. 34 pp.

Christian-Smith, J, et al. 2010. California Farm Water Success Stories. 2010. Pacific Institute. 74 pp. Available at http://www.pacinst.org/reports/success_stories/success_stories.pdf.