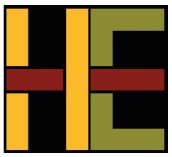
Benefit-Cost Evaluation of the 2004 Arizona Water Settlements Act (AWSA) Project Proposals



Harvey Economics

Report

November 4, 2014

Benefit-Cost Analyses of AWSA Proposals

Prepared for

NM Interstate Stream Commission
407 Galisteo Street
Bataan Memorial Building Room 101
Santa Fe, New Mexico 87504

Prepared by

Harvey Economics
469 South Cherry Street, Suite 100
Denver, Colorado 80246
720.889.2755 fax 720.889.2752
www.harveyeconomics.com
he@harveyeconomics.com

EXECUTIVE SUMMARY
Benefit-Cost Evaluation of the 2004 Arizona Water Settlements Act (AWSA) Proposals

In June 2014, Harvey Economics (HE) was contracted by the New Mexico Interstate Stream Commission (ISC) to conduct benefit-cost (BC) studies of certain prospective water development proposals (Proposals) which are pursuing funding under the Arizona Water Settlement Act (AWSA) of 2004. These proposals were selected by the ISC for consideration following a two-tier screening processes. This BC study is part of the evaluation process the ISC has undertaken to select which proposals might receive funding.

At the outset, the ISC staff and HE worked closely together to define the proposals as concretely as the applicants' information would allow and identify the nature of the benefits and beneficiaries. Considerable work was performed in evaluating and refining proposal information to more accurately assess benefits and costs of each proposal.

The watershed improvement proposals were set aside from the BC evaluation and evaluated in a general manner. The watershed proposals provide benefits and might have merit, but it is unclear if they increase long term water supplies for any specific locations. Furthermore, their contributions to dry year supplies are even more uncertain.

Table S-1 provides a summary of the optimized proposals, the type of benefits they offer, and potential dates each might come on line. The proposals vary greatly in terms of size, type of benefit, water yield, area of benefit and schedule. The benefits are distinguished as municipal, agricultural, recreational or environmental. The smaller proposals not requiring storage can be developed more quickly than the larger storage proposals since permitting and design efforts will be minimized.

Table S-1.
Summary of Proposal Concepts and Nature of Benefits

Proposal No.	Proposal Name	Nature of Proposal	Type of Benefits	Beneficiaries and Location	Additional Annual Yields and Other Benefits	Start Date for Benefits
1, 2, 3a	Southwest NM Regional Water Supply (SWRWS)	Diversion, conveyance, storage for new surface water supply	Municipal, agricultural, environmental, recreational	Multiple groups in Grant, Luna and Hidalgo counties	Ramps up to 10,000 AF	2034
3b	GBIC Irrigation Diversion Structure	Diversion structure replacement	Agricultural	Farmers and ranchers in the Cliff-Gila farming valley in Grant County	224 AF; avoided cost of replacement during flood events	2020
4	Deming Effluent Reuse	Expansion of wastewater reuse system	Municipal	City of Deming, Luna County	Avoids 410 AF per year of groundwater pumping	2018
5	Grant County Water Commission Wellfield and Pipeline	New wellfield, pipeline, storage	Municipal	Towns of Hurley and Silver City, City of Bayard, Village of Santa Clara in Grant County	943 AF	2018
6	Grant County Reservoir	New reservoir, pipeline and booster station	Recreational	Grant County residents and businesses	Recreational reservoir only	2035

Table S-1.
Summary of Proposal Concepts and Nature of Benefits (continued)

Proposal No.	Proposal Name	Nature of Proposal	Type of Benefits	Beneficiaries and Location	Additional Annual Yields and Other Benefits	Start Date for Benefits
11b	Catron County Ditch Improvement Component	New infiltration gallery diversion; conversion to pipe conveyance; storage ponds	Agricultural	Farmers and ranchers on ten ditch systems in Catron County	Reduced O&M costs Increased on-farm efficiency of 25%	2020
12	Luna Ditch Improvements	New weir and diversion structure, new pipeline	Agricultural	Luna Ditch Association near Luna, NM	Reduced O&M costs; avoided loss of supply, avoided costs of reconstruction	2019
13	Sunset/New Model Ditch Improvements	New pipeline	Agricultural	Farmers and ranchers in Virden Valley, NM	Avoided conveyance loss of 1,473 AF	2019
14	Pleasanton East-side Ditch	New pipeline	Agricultural	Farmers and ranchers in the vicinity of Pleasanton, NM	Improvement in canal efficiency of 15%	2021
15	GCC Municipal Conservation	Establishes an account from which to fund conservation programs	Municipal	Residents of Grant, Luna, Hidalgo and Catron County	Ramps up to 1,135 AF	2016

Note: These watershed proposals are addressed separately: Grant County SWCD Watershed Proposal, NMFIA Watershed Proposal, NMSU Watershed Proposal, Gila National Forest Watershed Proposal, Catron County Watershed Component Proposal.

Capital and operation and maintenance (O&M) costs and expenditure schedules were provided by proponents in the proposals, and ISC's engineering consultants. Expenditures which occur in the future are, like benefits, discounted back to present value in the benefit-cost analyses. All capital investment and operating cost figures are expressed in 2013 dollars or converted to 2013 dollars as required so that proposals are treated consistently.

The benefits of each proposal were calculated independently, based on available information relevant to the particular effects likely to occur and the characteristics of the region to be affected. For the sake of consistency, each type of benefit was calculated using the same method but tailored to each proposal. For example, additional agricultural water supplies produced similar benefits per acre-foot (AF). Construction benefits were included along with multiplier effects for agricultural and recreational benefits. The methods and assumptions, including the discount rate, are detailed in the body of the report and summarized in Table S-2.

Table S-2.
Benefit Quantification Methods

Benefit	Approach to Quantification
Agricultural	▪ Net agricultural revenue per AF of water; regional agricultural multipliers ▪ Reduced O&M costs
Environmental	▪ Similar water purchases for the purpose of supporting fish populations and other aquatic species and habitat
Municipal	▪ Average regional price per 1,000 gallons, plus estimated consumer surplus ▪ Avoided costs of developing additional supplies (next best alternative) ▪ Avoided purchase of developed supplies
Recreational	▪ Visitation based on data for comparable NM reservoirs ▪ Estimates of recreational spending per visitor day; regional recreational multipliers; additional consumer surplus estimates
Construction-Related Stimulus	▪ Application of regional output multiplier for the construction industry to capital expenditures

The benefits and costs of each proposal were calculated from the foregoing information. Net benefits are the subtraction of costs from benefits. The benefit-cost ratio is a comparison of total discounted benefits to total discounted costs over the entire proposal period. A ratio of 1.0 indicates that the benefits are equal to the costs. A ratio greater than one means that benefits outweigh costs, and a ratio of less than one reflects a proposal for which costs outweigh benefits. All dollars in this section are expressed in 2013 constant dollars.

Table S-3 displays the revised total benefits, total costs and benefit-cost ratios of the AWSA proposals analyzed as part of this study. (As this report was going to publication, HE received revised information about the Southwest Regional Water Supply proposal, and Table S-3 reflects the revised information.)

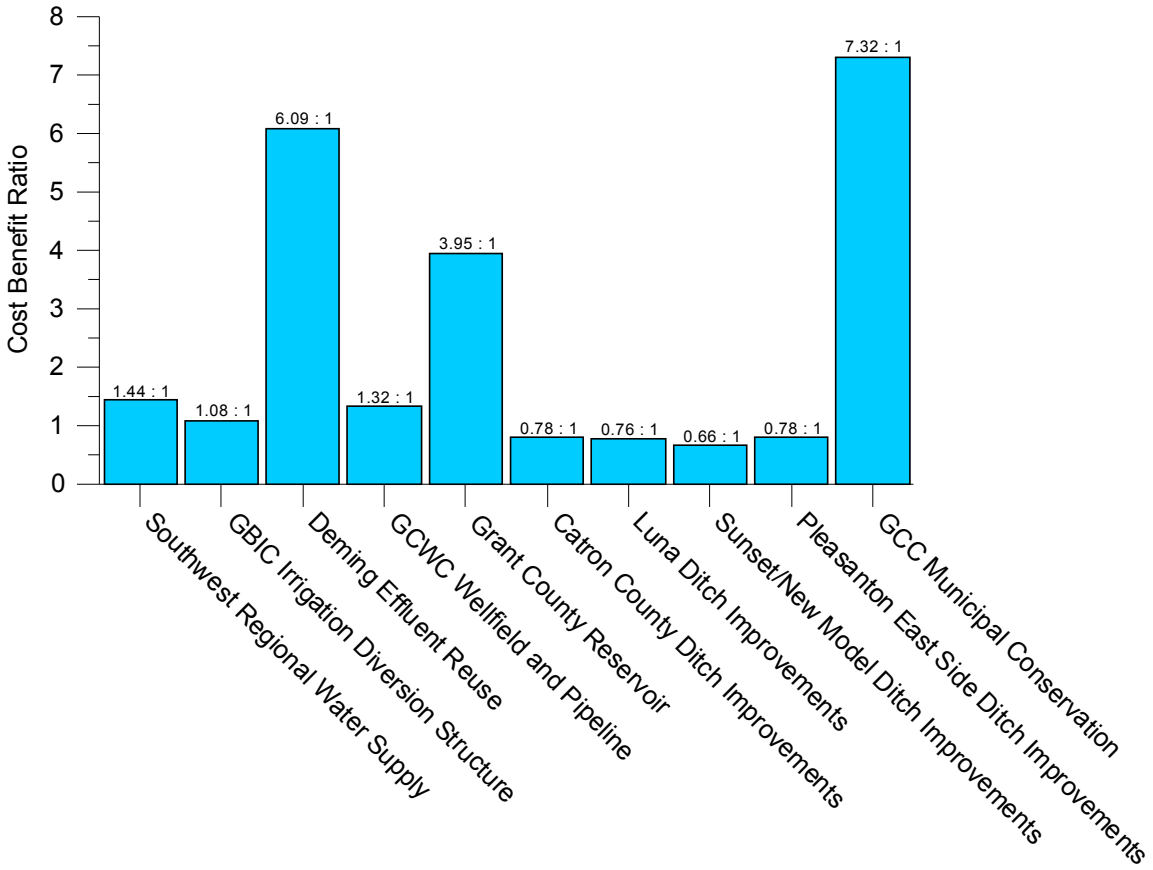
The benefit-cost ratios of the AWSA proposals range from a low of 0.66:1 (Sunset/ New Model Ditch Improvements) up to a high of 7.32:1 (Municipal Conservation). Two of the agricultural proposals (GBIC Irrigation Diversion Structure and Luna Ditch Improvements) also have qualitative environmental benefits associated with the preservation of riparian areas.

Table S-3.
Total Benefits, Total Costs and Benefit-cost Ratios of AWSA Proposals, including the Revised SWRWS Proposal Data

Proposal	Total Benefits (2014 - 2050)	Total Costs (2014 - 2050)	Benefit Cost Ratio
Southwest Regional Water Supply	$760.9	$528.9	1.44
GBIC Irrigation Diversion Structure	$2.7	$2.5	1.08
Deming Effluent Reuse	$36.1	$5.9	6.09
GCWC Wellfield and Pipeline	$38.6	$29.3	1.32
Grant County Reservoir	$63.5	$16.1	3.95
Catron County Ditch Improvements	$11.4	$14.5	0.78
Luna Ditch Improvements	$2.4	$3.2	0.76
Sunset/New Model Ditch Improvements	$18.9	$28.7	0.66
Pleasanton East Side Ditch Improvements	$4.2	$5.4	0.78
GCC Municipal Conservation	$75.7	$10.4	7.32

Note: All benefits and costs have been discounted back to 2013 present value dollars.
Source: Harvey Economics.

Figure S-1.
Benefit Cost Ratios for AWSA Proposals



Other Considerations

Beyond quantified benefits and costs, there are a host of other important aspects about the 15 AWSA proposals to consider:

- *Uncertainty.* The proponents of each proposal have expended efforts to reach this stage of the grant selection process, but detailed proposal planning has not been completed in most instances. Costs, construction plans, operational plans, yields, other results and effects are only generally known at this point. Each proposal is at a different stage in the development process, and some carry more uncertainty than others. Hence, the outcomes should be viewed generally.

- *Qualitative benefits and costs.* There are qualitative benefits and costs potentially associated with each of these proposals. For example, some of the proposals help preserve groundwater; this can be prudent water resource policy in areas with finite groundwater supplies. Water quality benefits may be evident with the watershed and other proposals. Certain proposals will reduce environmental impacts from periodic re-construction of water features.

- *Capital requirements.* Some of the proposals can be completely funded by the requested AWSA grant while others will require a large amount of additional financial support. At least one proposal SWRWS would require substantial funding to proceed. Access to funding will help determine whether the benefits can be realized.

- *Proposal feasibility*. Technical and financial feasibility for the proposals has not *been establis*hed for many of the proposals. Financing and payment for annual costs must be resolved before any of the proposals can move forward.

- *Type of benefit(s) resulting from each proposal.* The ISC may or may not view all benefit types (agriculture, environmental, municipal, recreation) as being equal. For example, recreational benefits in an area lacking recreation might be a priority.

- *Timing of proposal and readiness to go.* Several proposals include components which would not come on line or provide water for many years, or the completion schedule is uncertain due to permitting. Others would only need a short time to get built and start operating, and would provide water to beneficiaries relatively quickly.

- *Geographic area of benefit.* Certain proposals are site specific, with beneficiaries in a confined geographic area, while others benefit larger areas including the SW New Mexico region.

- *Watershed proposals.* These might have a host of merits, but due to uncertainties in water yield, as well as no description of beneficiaries of potential water yield, they are distinct from the other AWSA proposals.

Section 1. Introduction

The 2004 Arizona Water Settlement Act (AWSA) allocates to the State of New Mexico non-reimbursable federal funding for water development projects in New Mexico. Acting through the ISC, the State embarked upon a process of soliciting interested parties to submit proposals, a screening of those proposals, a second round of information submittals and further studies and evaluations of those proposals.

As part of the proposal evaluations process, the ISC contracted with Harvey Economics (HE) to prepare a benefit-cost (BC) study of the 15 proposals which passed the second round of ISC consideration (Tier 2). That contract was initiated in mid-June 2014. This report provides the results of that work.

Study Process

The ISC Staff directed HE to evaluate the final optimized proposals. Since the information submitted by the respective proposers was insufficient to perform the BC study, HE and the Staff worked closely together to develop assumptions about the respective proposals to perform the economic analysis. The results of that effort are set forth in Sections 2 and 3 of this report.

The watershed proposals were not sufficiently comparable to the other proposals to warrant the full, detailed BC analysis in part because of limited knowledge about long term water supplies for specific beneficiaries. This limitation is not conducive to a benefit-cost economic analysis. These proposals were given a generalized evaluation in this report.

HE developed a set of benefit and cost estimation methods that would treat like type of benefits consistently. The Study addressed agricultural, municipal, recreational and environmental benefits. Benefit quantification methods and assumptions were selected as appropriate to each specific proposal. These are described in Section 5.

HE applied the quantification methods to the proposal-specific information in Sections 2 and 3 to produce the benefit-costs results presented in Section 6. All benefits and costs are expressed in 2013 dollars.

Caveats and Limitations

HE's work scope was limited to the evaluation of each proposal based upon the information provided by the ISC, which included the various submittals and engineering studies along with any additional information or insight forthcoming from the Staff. HE gathered information, but interviews with Applicants or field visits were outside the scope and budget. For one proposal, Municipal Conservation, HE made extensive assumptions about benefits and costs, as no evaluation study was available.

The quantification methods were selected for consistency among the proposals. HE did not have the budget to develop unique quantification assumptions or methods for each proposal. The advantage of this approach is that the proposals were treated equivalently.

As this report was going to publication, HE received additional engineering information on the SWRWS. Updated analyses are provided in the report results and summary, but the limited budget did not allow for a full revision of the report. Obviously, additional information about any of the proposals might produce different benefit-cost results.

Section 2. Concept and Benefit Definition of the Project Proposals

This section provides a summary of each of the AWSA proposals and the nature of the benefits each would generate. Benefit-cost analyses necessarily begin with a specific and concrete understanding of the proposal under consideration. This includes an understanding of how each proposal would actually work as a project. From this understanding, HE has identified the type and nature of benefits which would accrue and to whom. This section represents a key foundational piece in the calculation and projection of proposal benefits.

Southwest New Mexico Regional Water Supply (SWRWS) (Proposals 1, 2, 3a)

The combined SWRWS Proposal is described in the *Gila River Diversion, Conveyance and Storage Alternatives* Preliminary Engineering Report (PER) and Appendices prepared by Bohannan Huston Incorporated (BHI) in April 2014. The PER presents four viable alternatives. The ISC staff directed HE to evaluate Alternative #2b. HE relied upon the PER and the Tier 2 information for this proposal, supplemented by additional information and insights from the ISC staff.

Overview. The SWRWS Proposal would divert, convey, and store a portion of the Gila River water in the Cliff-Gila Valley, with facilities located in Grant County, under the terms of the 2004 Arizona Water Settlements Act (AWSA).

Alternative #2b includes diversion of water from the Gila River between Turkey Creek and Mogollon Creek, and conveyance by gravity through a 108 inch tunnel from the diversion to buried pipelines leading to four storage sites at Winn, Pope, Sycamore and Dix Canyons. Total conveyance would be over 13 miles in length and would require pipelines ranging in size from 48 to 108 inches. Total Project storage would be 64,303 AF, with a minimum of 5,000 AF of water stored near the top of the Cliff-Gila valley (Winn Canyon). The 5,000 AF of water stored near the top of the Cliff-Gila valley would be used specifically for agricultural and environmental purposes.

The storage reservoirs would have the following characteristics:

- Sycamore Canyon: 558 surface acres, maximum depth of 150 feet
- Pope Canyon: 301 surface acres, maximum depth of 116 feet
- Winn Canyon: 275 surface acres, maximum depth of 125 feet
- Dix Canyon: 94 surface acres, maximum depth of 95 feet

Nature of Benefits. The SWRWS Proposal includes municipal water use in Grant and Luna counties; agricultural water use in Grant and Hidalgo counties; environmental benefits for Grant County, and recreational benefits for the larger region.

Specific communities within Grant and Luna counties that would use the available water supplies for municipal purposes have yet to be identified. However, the availability of additional water from this proposal could mean that individual cities or towns may avoid the costs of acquiring and developing other water supplies.

Agricultural entities in both the Cliff-Gila valley and the Virden Valley would benefit from additional water available to agriculture. Benefits of additional agricultural water would accrue to individual irrigators, as well as to the local and regional economies, including those businesses and industries that cater specifically to agricultural needs.

Environmental benefits for Grant County include enhancement of river flows and preservation of riparian and aquatic habitat. Environmental releases would be made from the upstream storage reservoir(s) that would supplement Gila River when the river is low. These releases would keep water in the river for fish and other aquatic species and would support riparian vegetation and wildlife species that use those areas for food or shelter.

Based on consultation with the ISC staff, recreational benefits at Sycamore Canyon Reservoir (the largest of the four) would be developed for extensive lake-related recreational activity, including motor boating, water skiing, other motorized water sports, other types of boating, camping, fishing, swimming, and other land-based activities. Facilities at this reservoir could include boat ramps, restrooms and picnic areas. It is also assumed that New Mexico State Parks would build and develop the recreational facilities at Sycamore Canyon and would fund that work from their own resources. A portion of these costs would be recovered through an access fee charged at that location.

The Pope Canyon and Winn Canyon reservoirs are assumed to have limited recreation, including no-wake boating, and have no developed facilities. It is assumed that there would be no recreational activity at Dix Canyon Reservoir; this is partially due to its small size and proximity to the other reservoirs.

Specific Characteristics. Following permitting and design, project construction would begin in 2024 and take place over a period of 10 years. Project yield would ramp up from about 5,000 AF in 2034 to about 10,000 AF by 2044. Based on the ISC staff estimates, project yield by location and use would be as follows:

- Grant County agriculture: 2,000 AF per year between 2034 and 2050
- Hidalgo County agriculture: 2,000 AF per year between 2034 and 2050
- Grant County environmental: 1,000 AF per year between 2034 and 2050
- Grant County municipal: 2,500 AF per year between 2039 and 2050

- Luna County municipal: 2,500 AF per year between 2044 and 2050

Recreation would be available at the three larger reservoirs immediately after completion of construction activities, beginning in 2034. Visitation to these reservoirs would ramp up over time between 2034 and 2050.

GBIC Irrigation Diversion Structure (Proposal 3b)

Information and details about the GBIC Diversion Structure Proposal were obtained from GBIC's November 1, 2010 proposal to the ISC, as well as information and insights from the ISC staff.[1]

Overview. The GBIC proposal is described in the *Gila River Diversion, Conveyance and Storage Alternatives* Preliminary Engineering Report (PER) and Appendices prepared by Bohannan Huston Incorporated (BHI) in April 2014. The PER includes the replacement of earthen diversion structures with one permanent diversion structure (grouted boulder weir). This diversion structure would be located in the Cliff - Gila Valley in Grant County.

The permanent diversion structure would not entail impoundments. Water flowing through this structure into the unlined Upper Gila, Fort West and Gila Farm ditches would be conveyed downstream for agricultural use.

Nature of Benefits. Periodic flooding events occur on the Gila River, generally resulting in some level of destruction to the existing earthen dams. The replacement of the earthen structures with more permanent structures would result in the avoidance of the construction and repair costs related to maintaining the earthen dams after a flood event. Therefore, a primary benefit of this proposal is GBIC's avoided costs related to repairing the earthen diversions.

Construction activities related to the repair of the existing earthen diversion structures also results in disturbance of riparian areas adjacent to these structures. The new permanent structure is assumed to require minimal repair. Therefore, additional proposal benefits include reduced disturbance to riparian areas and local waterways, resulting in the preservation of riparian vegetation, riparian habitat and aquatic habitat.[2]

There might be periods of time of avoided irrigation water curtailment which presently occurs during the reconstruction after a flood event. It is estimated that 224 AF per year, or 10 percent of GBIC's rights, would represent an additional supply as a result of this proposal.

Specific Characteristics. Post-flood construction and repair of the existing earthen diversion structures amount to an estimated average of $2,500 per year for each of the three ditches. Construction of the permanent diversion structure would occur over a two year

[1] The report, as obtained from the ISC website, does not include a cover page, but is identified as GBIC Master Report Revision 3.

[2] The GBIC proposal discusses a number of project benefits; however, that report describes a project that includes diversion, conveyance and storage components. The optimized GBIC proposal focuses mainly on the replacement of the earthen diversion structures and the benefits described here reflect that concept.

period between 2018 and 2019. Therefore, the avoided costs to GBIC from this proposal would amount to $7,500 per year from 2020 through 2050.[3] This estimate of benefits assumes that the permanent diversion structure would not require replacement at any point during the study period.

Deming Effluent Reuse (Proposal 4)

The Deming Effluent Reuse Proposal is described in the *Proposed Effluent Reuse Expansion* Preliminary Engineering Report (PER) prepared by Souder, Miller & Associates in November 2013. Additional information about the Proposal was obtained from the ISC staff.

Overview. The City of Deming, located in Luna County, is proposing an expansion of the existing wastewater recycle and reuse system. The existing system irrigates the City golf course and City-owned cemetery. Deming would like to expand the system in order to use recycled effluent water to irrigate certain City parks and recreational facilities. The expanded system would be completely located with the City of Deming.

In general, the system expansion would include new booster pumps at the wastewater treatment plant (WWTP); new connections to the existing reuse water main; additional storage at the golf course lakes; booster pumps at the golf course; installation of approximately 10,500 linear feet of additional reuse pipelines, upgrades to existing sprinkler systems and installation of new sprinkler systems.

A number of alternatives were considered in the PER. The project proposal includes the following components recommended for immediate implementation:

- Replace Booster Pumps to Golf Course Ponds at the WWTP;
- Treatment to Achieve NMED Class 1B Requirements Using Filters;
- Replace All Booster Pumps at the Golf Course;
- New Reuse Distribution Trunk Lines;
    - New Reuse Line for the High School Fields and Hooten Park,
    - New Reuse Line for Soccer Fields, Dog Park and Pop Warner Football Fields, and
- Upgrades to the Existing Sprinkler System at the Golf Course.

Under the proposed project, treated effluent would be pumped from the WWTP (upgraded treatment processes) to the golf course ponds for storage and then distributed to the fields and other facilities listed above. This is the same process used for the current reuse system. The

[3] GBIC is also responsible for annual ditch maintenance costs. These costs will occur regardless of the type of diversion structure in place.

main difference is that additional treated effluent would become available to irrigate additional City parks and fields.

Nature of Benefits. The parks and other recreational facilities to be irrigated with treated effluent under this proposal are currently irrigated using the City's potable groundwater supplies. Therefore, the project would not result in the irrigation of any additional City facilities not currently irrigated. However, the additional reuse of effluent water for park irrigation would allow Deming to reduce the amount of groundwater pumped on an annual basis and would avoid the costs of unnecessarily pumping and treating that water to meet potable standards.

Specific Characteristics. Appendix II of the PER provides information on peak month usage at each park or other facility to be irrigated under the expanded system. The data suggests that with an expanded system, as described above for the proposal, Deming would be able to reduce groundwater pumping by a maximum of about 410 AF per year; this assumes maximum water use in each month of a 6 month irrigation season. Project construction would be complete by 2018 and a reduction in groundwater pumping of 410 AF per year would occur in each year between 2018 and 2050.

Grant County Water Commission Wellfield and Pipeline (Proposal 5)

Background information and details about the Grant County Wellfield and Pipeline Proposal was obtained from the *Gila (Grant County) Water Utilization Alternative (Wellfield, Tanks and Piping)* Engineering Report prepared by William J. Miller Engineers, Inc. in December 2013 and from information supplied by the ISC staff.

Overview. The Grant County Water Commission has proposed the Wellfield and Pipeline Proposal to develop additional water supplies for the Town of Hurley, the City of Bayard, the Village of Santa Clara and the Town of Silver City, all located in northern Grant County. This Proposal includes the development of a wellfield, located immediately adjacent to the Grant County Airport. This wellfield would include two new wells (up to 1,500 feet deep), water treatment facilities and well controls (including two well pumps). From the wellfield, a 16-inch pipeline would be constructed to an 850,000 gallon storage tank and three booster pumps located north of the Grant County Airport. From this booster station, the pipeline would connect to existing water systems in Bayard, Santa Clara and Silver City. Hurley would receive water upstream of the booster station. The total length of the pipeline would be about 16.4 miles.

Nature of Benefits. The Wellfield and Pipeline Proposal would result in additional municipal supplies for the Town of Hurley, the City of Bayard, the Village of Santa Clara and the Town of Silver City. The Proposal would include the development of existing water rights (193.2 AF), and serve as a point of diversion for additional water rights, up to 750 AF,

currently pending.[4] The developed groundwater supplies would supplement the communities' existing supplies, except in the case of Hurley, which does not currently have it own water right or source of supply. The beneficiaries include the present and future residents and businesses of the four communities.

The economic benefits relate to the benefits that municipal water supplies would bring the communities of Hurley, Bayard, Santa Clara and Silver City. These would include the avoided costs of developing equivalent water supplies themselves. Without these water supplies, economic growth might be delayed or even precluded. These economic benefits will be examined in later sections of this report.

Specific Characteristics. Total Project water yield would eventually be 943.2 AF per year (193.2 AF of currently permitted water rights and 750 AF included in Silver City's water rights application). Project construction would be completed by late 2017, and the project would come on-line in 2018. In 2018, 193.2 AF would be available to the Town of Hurley on an annual basis through 2050. The remaining 750 AF would be developed over a period of 40 years (2018-2057). These supplies would become available in a linear increase over that period (0 AF in 2018, up to 750 AF in 2057). About 615 AF would be available by 2050.

The eventual 750 AF of water supply would be distributed among the four entities (Hurley, Bayard, Santa Clara and Silver City) based on the community allocation data presented in Table 2 of the PER. In each year (2019 through 2050), these communities would receive the following portions of the available 750 AF water supply: Hurley: 20.5 percent; Bayard: 10.5 percent; Santa Clara: 11.6 percent; and Silver City: 57.4 percent. It is possible these proportions would change as the proposal moves closer to fruition.

It is important to note that Hurley would receive the full 193.2 AF of water from 2018 through 2050 in addition to its portion of the eventual 750 AF of supplies.

Grant County Reservoir (Proposal 6)

Detailed information about the components, operation and purpose of the Grant County Reservoir Proposal was obtained from the *Grant County Tier 2 AWSA Application Review* Preliminary Engineering Report (PER) prepared by Bohannan Huston Incorporated (BHI) in December 2013 and from information supplied by the ISC staff. The PER includes several alternatives; the recommended alternative includes a 3,000 AF reservoir on Twin Sisters Creek. The ISC staff asked HE to evaluate BHI's recommended alternative.

Overview. Grant County is the proponent of this Proposal, which centers on the development of a 3,000 AF recreational reservoir located west of Fort Bayard and north of Santa Clara in Grant County. According to the PER, this location is easily accessible from US Highway 180.

[4] The Town of Silver City filed a water rights application for up to 750 AF per year on April 5th, 2013. The 750 AF would be offset by recharge to the regional aquifer from treated effluent discharged into San Vicente Arroyo.

The Proposal consists of a reservoir constructed on Twin Sisters Creek, a supply pipeline and a booster station. The reservoir would have a maximum water surface elevation of 6,090 feet and would be constructed by building an earthen dam across Twin Sisters Creek at a location west of the Fort Bayard Medical Center. The source of water for the reservoir is assumed to be from the SWRWS. The proposed reservoir site is located on land owned by the U.S. Forest Service and Fort Bayard.

Nature of Benefits. The PER describes a number of potential uses and benefits related to the development of a reservoir on Twin Sisters Creek, including recreation, municipal use, and groundwater recharge.

Incidental benefits of this Proposal include a small amount of seepage, about 60 AF per year, into the groundwater; this water might be available to certain communities for pumping and eventual M&I use. The PER also suggests that the Proposal would create riparian and wetland areas, which may be used as habitat by certain species, including some not currently found in the area.

The ISC staff indicated that the reservoir has some potential to be used for municipal storage at some point in the future. However, that is not part of the current plan, and there have been no specific discussions or agreements on the part of local communities in that regard. The reservoir also has the potential to act as a pass-through for the City of Deming's SWRWS water, but that idea has yet to be developed.

Given the uncertainty of the other benefits, the ISC staff directed HE to focus solely on the recreational aspects of the Proposal for this study. The beneficiaries will be local residents and other visitors to the reservoir who would have additional recreational opportunities available to them. In addition, local businesses in relative proximity to the reservoir may cater to recreational users.

Specific Characteristics. The physical characteristics of the reservoir, along with the specific amenities available at the site are key determinants of the interest in and demand for recreation at the Grant County reservoir. The 3,000 AF reservoir will have a surface area of about 125 acres and will have a maximum depth of about 85 feet (average reservoir depth will be about 24 feet). This location is easily accessible from Highway 180, which runs through Santa Clara.

Based upon discussions with the ISC staff, HE assumes that the reservoir would offer a variety of day-use activities, including wake-less boating (canoeing, kayaking and other small boats, but no motor boating), fishing, swimming and picnicking. HE also assumes that Grant County would pay for any recreational amenities developed at the reservoir (not included in the Proposal cost estimates) and that user fees at the reservoir would somewhat offset those costs.

Specific amenities have not been determined at this time, but could include such things as a swim beach, restrooms, fishing pier, picnic areas or trails. According to ISC staff, the reservoir would be part of a recreational plan for the region which would include a nearby recreational park with facilities for outdoor sports, such as an archery range. There are also

several existing ball fields and playgrounds in the area. These facilities will likely attract visitors to the reservoir and vice versa.

Ultimately, the benefits of this Proposal will be driven by the recreational visitation to the reservoir and the local spending of those visitors. Opportunities for recreating at the reservoir would begin in 2035 and are assumed to continue through 2050, the end of the study period.

The Grant County Reservoir would be constructed over a period of about 4 years and 2 months, between 2030 and 2034, following permitting, engineering and the completion of the SWRWS proposal. Without the reservoirs and pipelines included as part of that Project, the Grant County Reservoir Proposal is not a viable endeavor.

Catron County Ditch Improvements (Proposal 11b)

Background information and details about the Catron County Ditch Improvements Project was obtained from the *Catron County Modified San Francisco Watershed Restoration Proposal-final Tier 2* prepared by the proponents and from information supplied by the ISC staff.

Overview. The Proposal is located within the San Francisco River Watersheds. Catron County, New Mexico.

The Catron County Ditch Improvements Proposal is the portion of the Catron proposal involving the construction of infiltration gallery diversion structures as well as conversion of many of the open earthen irrigation ditches to pipe to convey irrigation water and improve transport systems. The Proposal includes pond construction to increase storage and improve regulation.

The diversion structures will make it possible to divert irrigation water following flood events and during elevated base flow levels. These structures will also prevent large debris and sediment from being diverted, which will keep the water transport systems (ditches or pipes) open and functioning. Conversion of the ditches will be especially important in areas where the existing irrigation ditches are located near the current stream channels and are prone to being filled with sediment or washed out during flood events.

Nature of Benefits. The benefits of the Catron County Ditch Improvements Proposal are agricultural and include increased irrigation efficiency and lower annual costs to maintain the irrigation system. The beneficiaries are present and future farmers and ranchers served by the ten ditch systems listed in the proposal.

Specific Characteristics. According to the ISC staff, the addition of ponds as part of the Catron County Ditch Improvements Proposal will result in an increase of on-farm efficiency/crop yield by an estimated 25%. There are approximately 1,140 irrigated acres in Catron County Ditch Improvements Proposal.

Another benefit of the proposal would be reduced O&M costs amounting to an estimated of approximately $5,000 per ditch per year or a total of $50,000 per year. This estimate is based

on cost calculations from the ISC staff and an estimate by the ISC staff that the proposal would save the given amount per ditch/year.

The Catron County Ditch Improvements permitting and design is assumed to begin in 2017 and construction will be complete in 2019, according to the ISC staff. The benefits will begin in 2020, after completion of construction activities, and will continue through 2050 on an annual basis.

Luna Ditch Improvements (Proposal 12)

Information about the components, operation and purpose of the Luna Ditch Improvements Proposal was obtained from the *Luna Ditch: Preliminary Engineering Assessment* prepared by Portage, Inc., January 2014. The Tier 2 Final Proposal prepared by the proponents in April 2011 was also used. Additional data and assumptions were obtained from the ISC staff.

Overview. The 1892 Luna Irrigation Ditch Association is the proponent of this proposal. The proposal entails modifications to improve performance of the existing Luna Ditch system. This would be accomplished by installing a permanent weir and river diversion structure, installing water transmission pipeline within the existing ditch, replacing the regulation structure where the North Side Ditch splits into two ditches, and improving other related infrastructure.

The Proposal is located in the vicinity of Luna, New Mexico. The North Side Ditch begins approximately 2 miles upstream of Luna and extends through town and beyond, amounting to approximately seven miles of open ditch.

Nature of Benefits. In its current condition, the Luna Ditch is adversely affected by large precipitation events, large variation in flow and inefficient conveyance. To maintain operation, an inordinate effort and expense is expended by the Ditch Association. This proposal will aid the Ditch Association by minimizing the negative effects of flooding which occurs periodically and by managing the water flow in the ditch with less effort and land disturbance. The benefits are agricultural in nature and will accrue to the ditch members in Catron County.

According to the ISC staff, the Luna Ditch Improvements Proposal consists of three types of benefits:

- Reduced O&M costs;
- Avoided loss of supply for 6 weeks; and
- Avoided costs of reconstruction.

The reconstruction of the diversion structure occurs three times in a typical year. Ditch rehabilitation is required 12 times a year. The Tier 2 Final Proposal suggested that there are a number of secondary benefits, including water conservation from increased efficiency of the system, benefits to amphibians, and riparian dependent species within the natural riparian

area downstream, increased fire protection and recreation benefits. The water conservation benefits will be captured in the agricultural benefits in subsequent chapters. The secondary benefits are uncertain due to unknown net stream flow effects at different points downstream, given the relatively small amount of water saved by the Luna Ditch Improvements Proposal.

Specific Characteristics. The reduction in O&M costs relate to the servicing of unlined ditches and re-establishing diversion points. The avoided loss of supply would amount to an estimated 20% of flows, according to the ISC staff. Luna ditch irrigates approximately 27 acres per year with an average of 250 AF. Reconstruction of diversion points is assumed to occur 12 times a year.

Construction will take place between 2016 and 2018. The benefits will begin in 2019, after completion of construction activities, and will continue through 2050 on a yearly basis.

Sunset/New Model Ditch Improvements (Proposal 13)

Information about the Sunset/New Model Ditch Improvements Proposal was obtained from the Tier 2 Criteria Final and the *Sunset Canal: Preliminary Engineering Assessment* and the *New Mexico Model Canal: Preliminary Engineering Assessment* (PEAs), prepared by Portage, Inc., January 2014. Additional information and assumptions were supplied by the ISC staff.

Overview. The Sunset/New Model Ditch Improvements Proposal will pipe both Sunset and New Model Canals to serve 2,236 acres of the Sunset and 315 acres of the New Model canals. Water for these canals is diverted from the Gila River and delivered to irrigated cropland within the Virden Valley. The primary objective is to reduce or eliminate conveyance loss.

The Sunset/New Model Ditch Improvements Proposal is located in Virden Valley, New Mexico. The Sunset Canal begins approximately 6.5 miles upstream of Virden and extends through town and into Arizona. Sunset is approximately 11 miles long. The New Model Canal begins approximately 2 miles upstream of Virden and extends along the south side of the Gila River and into Arizona. The New Model Canal is approximately 4.5 miles long.

Nature of Benefits. The proposal benefits stem from a reduction in conveyance losses and the avoided costs of system reconstruction during large precipitation events or high river flows. Conveyance loss comes from leaks in the canal, evaporation, and vegetation. Benefits will be agricultural in nature and will accrue to the farmers and ranchers on the canals.

Specific Characteristics. According to the Tier 2 Proposal, the two ditches diverted 14,741 AF in 2010, believed to be a relatively average flow year for the Gila River. Approximately 20% of water that is diverted from the river into the canals is considered conveyance loss, according to the proponents. Thus, conveyance losses in an average year amount to 2,946 AF/year. However, since the River has no water to divert in June and July, this benefit is reduced by 50%. Therefore, the avoided conveyance loss is 1,473 AF/year.

Another benefit is avoided cost of higher maintenance and cost of rebuilding from ditch washouts. Based on information obtained from Sunset board, reconstruction occurs up to two times a year, usually costing about $1,000 each time. Particularly severe instances can cost up to $20,000.

According to the ISC staff, permitting and design is assumed to begin by 2017 and construction will be complete in 2018. Benefits will begin in 2019, after completion of construction activities, and will continue through 2050 on an annual basis.

Pleasanton East-Side Ditch Improvements (Proposal 14)

Information about the components, operation and purpose of the Pleasanton East-Side Ditch Improvements Proposal was obtained from the *Pleasanton East-side Ditch: Preliminary Engineering Assessment* (PEA) prepared by Portage, Inc., January 2014. Additional information and assumptions were supplied by the ISC staff.

Overview. The Pleasanton East-Side Ditch Company Improvements Proposal is located in Pleasanton, New Mexico. The ditch begins approximately one mile upstream of Pleasanton and extends through the community and beyond, and includes approximately 3.5 miles of open ditch. Water is diverted from the San Francisco River and delivered to approximately 280 acres of irrigated cropland and 24 water rights holders within the valley between the river and Highway 180.

Nature of Benefits. Pleasanton proposes modifications for improving performance of the existing system. The improvements include installing a water transmission pipeline and/or ditch liner with new outlets and improving other associated infrastructure. The primary objectives are to conserve water by reducing conveyance loss. The agricultural benefits will accrue to water users on the Pleasanton East-side Ditch.

Specific Characteristics. According to the ISC staff, there will be an estimated net benefit of 9 percent increase in irrigation efficiency due to the improvements to the Pleasanton East-Side Ditch. The staff assumed that the proposal will increase canal efficiency from an estimated 75 percent to 90 percent. This improvement, along with an assumed on-farm efficiency of 55 percent, leads to overall irrigation efficiency increasing from 41 percent to 50 percent, or a net of 9 percent increase. The ISC staff provided flows for Pleasanton Ditch from 2008-2012. The average yearly diversion for this period was 4,220 AF.

Project construction for the Pleasanton East-Side Ditch Company Improvements is assumed to begin in 2017 and will be complete in 2020. The benefits will begin in 2021, after construction activities are complete, and will continue through 2050 on a yearly basis.

Municipal Conservation for Southwest New Mexico (Proposal 15)

Overview. The Gila Conservation Coalition (GCC) has proposed a broad-based water conservation program aimed at residential water users within the four-county region of Southwest New Mexico. The AWSA monies sought would be available for conservation

planning and then program implementation and management by municipal water suppliers within the four counties, presumably through an application process.

The planning, program selection and implementation would apparently be performed by those cities, towns, municipal water providers and other public water supply entities within the four-county region, as identified in Table 2.1.

Table 2.1
Public Water Supply Systems in Incorporated and Unincorporated Areas

County	Incorporated Areas	Unincorporated Areas
Catron County	Includes Village of Reserve	Includes Aragon, Homestead Land Owners Association, Mojave Academy, Pie Town MDWCA, Quemado Lake Water Association, Quemado Water Association, and Rancho Grande Water Association.
Grant County	Includes City of Bayard, Town of Hurley, Town of Silver City, and Village of Santa Clara	Includes Pinos Altos MDWCA, Tyrone Water System, Tyrone Water System, Arenas Valley MDWCA, Casas Adobes Water Company, Central Water System, Ft. Bayard Medical Center, Gila Mesa Association, Hachita Water System, Hanover MDWCA, Heights Water Users Association, Lake Roberts Subdivision, North Hurley MDWCA, Rosedale WUA, Trout Valley Property Association, and Whiskey Creek Mobile Ranch
Hidalgo County	Includes City of Lordsburg, Village of Virden	Includes Glen Acres Community Water System, Rodeo WUA, NM Tech Playas Training Center, Playas Townsite Water System
Luna County	Includes City of Deming, Village of Columbus	Includes Gunter's Mobile Home Rentals, Pecan Park MDWCA

Source: AMEC, SWNM Regional Water Supply Study, 2010.

According to the proposal proponents, the program would be administered by either a New Mexico state agency or the New Mexico Finance Authority. The total amount sought is $10.9 million, including program, planning and management costs.

How this Program will Work. The GCC proposal lists a number of specific conservation programs that might be considered in each county. These include water efficient technologies (water use appliances, including high efficiency toilets, clothes washing machines, and showerheads), increasing block rate structures, outdoor watering ordinances, and leak detection/repair.

In fact, the specific conservation programs each municipality and public water provider will pursue is unknown at this time. Typically, a water provider will conduct an evaluation of

various programs and their suitability for the provider's customer base. Specific terms of implementation, such as cost sharing with customers, timing, and likely participation rates will normally be considered, and then programs will be prioritized. From the GCC proposal, it appears some water utilities have made some progress in this planning and have implemented certain programs, but for the region as a whole, the specific programs, water savings and costs should be considered as examples at this point.

Nature of Benefits. Water resource and utility planners generally agree that successful water conservation produces direct benefits to utilities and their water customers in terms of avoided costs. That is, the reduced demand from conservation will mean that future water supplies and utility infrastructure can be delayed or will not need to be developed at all. In effect, utilities are "replacing" higher cost supplies and infrastructure with lower cost conservation programs. The beneficiaries of this proposal will be the water utility rate payers in the four-county region as well as the remaining residents in Southwest New Mexico.

Direct benefits. The direct benefit of conservation is the difference between the costs of conservation and the higher costs of developing "bricks and mortar" supplies, or the time value of delaying those expenditures.

In order to estimate the direct benefits of conservation, a water provider would typically want to know the:

- likely water savings from the suite of conservation programs;
- likely need for future water; and
- cost of conservation compared with the cost of future supplies and expanded capacity.

Regardless, the benefits will be driven by the amount of water saved.

Indirect or secondary benefits. The avoided direct costs can cause water utility revenues to decrease in the short term but typically will result in lower water utility bills for customers over the long term. These savings will mean higher disposable incomes for customers. However, utility expenditures will be less, reducing the economic stimulus attributable to the utilities' purchase of goods and services. Environmental effects from water resource development will be reduced. These avoided environmental costs will vary depending on whether the deferred or avoided supply expansion would come from groundwater or surface water or what type of capacity expansion. Indirect or secondary benefits of municipal water conservation are highly uncertain in part because the specific avoided costs are uncertain and in part because there can be offsetting effects, some of which are unintended.

Specific Characteristics. As suggested previously, projected water conservation savings from this GCC proposal are highly uncertain. For the purposes of this study, HE calculated water savings on the basis of the following steps and assumptions:

1) The water providers in incorporated communities and one half of the other organized water providers in each county will pursue the water conservation funding. Rural self-supplied water users will not participate.

2) A water efficient appliance program plus one other unspecified program will be undertaken by the water providers in each of the four counties. Conservation programs promoting water efficient appliances are relatively low cost per volume of water saved and attractive to utilities. Average program water savings and costs will be assumed for the other unspecified program.

3) The assumed water savings and costs per participant are based on the 2005 Water Conservation Alliance of Southern Arizona study of actual experience of 30 utilities and 42 water conservation programs between 1994 and 2003.[5]

4) HE assumes that the water conservation planning among the water providers will be performed in 2015 and that program implementation will begin in 2016 with sustained maximum participation reached in 2020.

5) The water providers will implement the conservation programs over a five-year period, after which they will reach saturation for customer participation. Although conservation programs can experience increased or decreased savings after implementation, HE is assuming that the savings once achieved will remain steady for 20 years. After that point, the water efficient appliances would be replaced at the homeowners' expense, ending those program savings.

6) Each of the conservation programs is assumed to achieve a customer base participation rate of 25 percent as a sustained maximum. For each of the five years of implementation, an additional 5 percent participation will be gained.

7) Customer base estimates are based upon the population estimates and projections offered in the 2010 AMEC study, corrected for the 2010 Census results.[6]

The calculations of water savings for the GCC water conservation proposal are provided in the following tables. Table 2.2 identifies the assumed water savings per participant for the water efficient appliances and the other two unspecified programs. Table 2.3 provides the projected households and program participants by county and for the region. Table 2.4 presents estimated water savings.

[5] Water Conservation Alliance of Southern Arizona, *Evaluation and Cost Benefit Analysis of Municipal Water Conservation Programs*, University of Arizona, 2005.
[6] AMEC, *Southwest New Mexico Regional Water Supply Study*, 2010.

Table 2.2
Water Savings per Participant Assumptions for Proposed Regional Water Conservation Proposal

Water Conservation Programs	Average Annual Savings Gallons (000) Per Participating Household
Water Efficient Appliances	
Toilet Rebates	7.4
Washing Machine Rebates	3.2
Subtotal	**10.6**
Other Prospective Programs	
Audits	8.7
Landscape Conservation Rebates	21.9
Rate Adjustments	14.3
Rate Surcharges	241.2
Rate Class Distinctions	3.5
Average	**57.9**

Source: Water Conservation Alliance of Southern Arizona, Evaluation and Cost Benefit Analysis of Municipal Conservation Programs, 2005

Table 2.3
Conservation Program Participation by Incorporated, Unincorporated and Domestic Self Supplied Households, 2010-2050, in the Four County Region

Year		Households				
		Total	% Available for Participation	Number Avail for Participation	% Participation in Conservation Programs	Number Participating in Conservation Programs
2016	Incorporated	14,410	100%	14,410	5%	720
	Unincorporated	3,638	50%	1,819	5%	91
	Domestic Self-supplied	0	0%	0	0%	0
	Total	18,048		16,229		811
2017	Incorporated	14,599	100%	14,599	10%	1,460
	Unincorporated	3,648	50%	1,824	10%	182
	Domestic Self-supplied	0	0%	0	0%	0
	Total	18,247		16,423		1,642
2018	Incorporated	14,788	100%	14,788	15%	2,218
	Unincorporated	3,658	50%	1,829	15%	274
	Domestic Self-supplied	0	0%	0	0%	0
	Total	18,446		16,617		2,493
2019	Incorporated	14,976	100%	14,976	20%	2,995
	Unincorporated	3,669	50%	1,834	20%	367
	Domestic Self-supplied	0	0%	0	0%	0
	Total	18,645		16,811		3,362
2020	Incorporated	15,165	100%	15,165	25%	3,791
	Unincorporated	3,679	50%	1,840	25%	460
	Domestic Self-supplied	9,611	0%	0	0%	0
	Total	28,455		17,005		4,251
2030	Incorporated	16,546	100%	16,546	25%	4,137
	Unincorporated	4,014	50%	2,007	25%	502
	Domestic Self-supplied	10,486	0%	0	0%	0
	Total	31,046		18,553		4,638
2040	Incorporated	17,960	100%	17,960	25%	4,490
	Unincorporated	4,357	50%	2,179	25%	545
	Domestic Self-supplied	11,382	0%	0	0%	0
	Total	33,700		20,139		5,035
2050	Incorporated	19,496	100%	19,496	25%	4,874
	Unincorporated	4,730	50%	2,365	25%	591
	Domestic Self-supplied	12,356	0%	0	0%	0
	Total	36,582				5,465

Source: AMEC, Southwest New Mexico Regional Water Study, 2010, and Harvey Economics, 2014.

Table 2.4
Projected Water Savings for the Proposed Conservation Program in the Four County Region 2016 - 2050

	Annual Water Savings (Gallons)			
Year	Water Efficient Appliances	Additional Program	Total	Total Regional Savings (AF)
2016	8,614,253	46,999,127	55,613,380	171
2017	17,434,424	95,121,732	112,556,156	345
2018	26,460,512	144,367,816	170,828,328	524
2019	35,692,517	194,737,377	230,429,894	707
2020	45,130,439	246,230,418	291,360,857	894
2030	49,239,885	268,651,437	317,891,322	976
2040	53,447,693	291,609,122	345,056,814	1059
2050	58,019,070	316,550,426	374,569,495	1150

Sources: Water Conservation Alliance of Southern Arizona, Evaluation and Cost Benefit Analysis of Municipal Water Conservation Programs, 2005; AMEC, Southwest New Mexico Regional Water Study, 2010; and Harvey Economics, 2014

Summary

The proposal objectives, implementation plans and likely benefits have been examined for each of the proposals remaining from the Tier 2 evaluation process. Table 2.5 provides a summary of the concepts and benefits for each proposal. The storage, diversion and water development proposals are diverse in scope and purpose, whereas the agricultural proposals are similar in that they intend to lower costs or increase the amount of water that reaches the farm headgates. The water conservation proposal is unlike the others in that it could extend existing supplies by reducing demand. This information will drive the benefits estimates provided in a subsequent section of this report.

Table 2.5
Summary of Proposal Concepts and Nature of Benefits

Proposal No.	Proposal Name	Nature of Proposal	Type of Benefits	Beneficiaries and Location	Additional Annual Yields and Other Benefits	Start Date for Benefits
1, 2, 3a	Southwest NM Regional Water Supply (SWRWS)	Diversion, conveyance, storage for new surface water supply	Municipal, agricultural, environmental, recreational	Multiple groups in Grant, Luna and Hidalgo counties	Ramps up to 10,000 AF	2034
3b	GBIC Irrigation Diversion Structure	Diversion structure replacement	Agricultural	Farmers and ranchers in the Cliff-Gila farming valley in Grant County	224 AF; avoided cost of replacement during flood events	2020
4	Deming Effluent Reuse	Expansion of wastewater reuse system	Municipal	City of Deming, Luna County	Avoids 410 AF per year of groundwater pumping	2018
5	Grant County Water Commission Wellfield and Pipeline	New wellfield, pipeline, storage	Municipal	Towns of Hurley and Silver City, City of Bayard, Village of Santa Clara in Grant County	943 AF	2018
6	Grant County Reservoir	New reservoir, pipeline and booster station	Recreational	Grant County residents and businesses	Recreational reservoir only	2035

Table 2.5
Summary of Proposal Concepts and Nature of Benefits (continued)

Proposal No.	Proposal Name	Nature of Proposal	Type of Benefits	Beneficiaries and Location	Additional Annual Yields and Other Benefits	Start Date for Benefits
11b	Catron County Ditch Improvement Component	New infiltration gallery diversion; conversion to pipe conveyance; storage ponds	Agricultural	Farmers and ranchers on ten ditch systems in Catron County	Reduced O&M costs Increased on-farm efficiency of 25%	2020
12	Luna Ditch Improvements	New weir and diversion structure, new pipeline	Agricultural	Luna Ditch Association near Luna, NM	Reduced O&M costs; avoided loss of supply, avoided costs of reconstruction	2019
13	Sunset/New Model Ditch Improvements	New pipeline	Agricultural	Farmers and ranchers in Virden Valley, NM	Avoided conveyance loss of 1,473 AF	2019
14	Pleasanton East-side Ditch	New pipeline	Agricultural	Farmers and ranchers in the vicinity of Pleasanton, NM	Improvement in canal efficiency of 15%	2021
15	GCC Municipal Conservation	Establishes an account from which to fund conservation programs	Municipal	Residents of Grant, Luna, Hidalgo and Catron County	Ramps up to 1,135 AF	2016

Note: These watershed proposals are addressed separately: Grant County SWCD Watershed Proposal, NMFIA Watershed Proposal, NMSU Watershed Proposal, Gila National Forest Watershed Proposal, Catron County Watershed Component Proposal.

Section 3.
Estimated Costs for the Project Proposals

Introduction

This section provides the direct cost information for each of the proposals. Capital costs, operating costs, and expenditure schedules are identified. This cost information underpins the benefit-cost analysis presented in later sections of this report.

Capital costs have been provided by the proponents in proposals, and ISC's engineering consultants in the preliminary engineering studies. These costs include the total initial investment to place the project in operation, and any major replacement costs scheduled prior to 2050. Capital costs include construction materials and supplies, labor, engineering design, state taxes and contingency allowances set by the ISC's engineering consultants for the proposals.

Operating costs were also provided by the ISC's engineering consultants for each proposal. These include all annual costs, such as maintenance, necessary to achieve the sustained operating objectives and related benefits.

All capital investment and operating cost figures are expressed in 2013 dollars or converted to 2013 dollars as required so that proposals are treated consistently. As directed by the ISC staff, HE assumed that the year of the engineering report equated to the year the cost data was expressed by the ISC's engineering consultants, unless specifically stated in the report.

The schedule for project development is important because expenditures which occur in the future will, like benefits, be discounted back to present value in the benefit-cost analyses presented later in this report. The construction schedules are based on information supplied by the ISC's engineering consultants, proponents and assumptions from the ISC staff. Permitting and design time periods vary substantially, depending on the nature of the proposal.

Southwest New Mexico Regional Water Supply (SWRWS) (Proposals 1, 2, 3a)

Capital and operating cost data for the combined SWRWS Proposal were obtained from the *Gila River Diversion, Conveyance and Storage Alternatives* Preliminary Engineering Report (PER) and Appendices prepared by Bohannan Huston Incorporated (BHI) in April 2014. The ISC staff directed Harvey Economics to evaluate Alternative #2b. Assumptions regarding construction schedules, capital and operating cost expenditure schedules were obtained from interviews with the ISC staff. Alternative #2b includes diversion of a portion of the Gila River water, conveyance between the diversion to four storage sites and the development of storage reservoirs located at Winn, Pope, Sycamore and Dix Canyons.

Capital Costs. The PER provides a total capital cost estimate for the SWRWS Proposal of $437,657,000 (in 2014 dollars). Detailed capital cost information for the Proposal can be found in the PER's Appendix G - Cost Estimates, Table G10: Cost Estimate for Alternative #2b. Table G10 indicates that the capital cost estimate of the SWRWS Proposal includes both construction expenses (materials, supplies, labor) and non-construction expenses (including design, surveying, permitting, environmental documentation, land acquisition and taxes). Construction expenses in Table G10 include a 30 percent contingency.

The PER reports capital costs in 2014 dollars. For purposes of comparison to other proposals, HE used the Bureau of Reclamation's (BOR) *Construction Cost Trends* indices to adjust the 2014 capital costs to 2013 dollars.[7] Total capital costs of the SWRWS Proposal are $431,883,000 in 2013 dollars.

Capital expenditures for the SWRWS Proposal are assumed to be made over a period of 20 years. Between 2014 and 2023 (a period of 10 years), engineering, design and permitting activities are assumed to require 10 percent of total capital costs, distributed evenly over that period. Construction work will begin in 2024 and take place over 10 years. Forty percent of capital costs will occur between 2024 and 2028 (distributed evenly over those first 5 years of construction) and the remaining 50 percent of estimated costs will occur between 2029 and 2033 (distributed evenly over the last 5 years of construction), at which point Project construction will be complete.

Operating Costs. Annual operations and maintenance (O&M) costs for the SWRWS Proposal can be found in Appendix G of the PER, Table G16: Estimated Annual Operations and Maintenance Costs. Annual O&M costs for the Project include parts and repairs; equipment; labor; electricity; training; and insurance. These costs amount to $2,219,800 each year (2014 dollars). Additional periodic O&M costs include sediment pond maintenance ($287,600 occurring once every 10 years) and road maintenance ($63,360 occurring once every 5 years).

In addition to O&M costs, this project requires annual pre-banking costs of $1 million per year.[8] Pre-banking costs are the costs related to conveyance of the exchange water, i.e., Central Arizona Project (CAP) water that must be banked prior to diversions.

The PER reports O&M costs in 2014 dollars, and the pre-banking cost estimate is also in 2014 dollars. HE used the BOR's *Construction Cost Trends* indices to adjust the 2014 operating and pre-banking costs to 2013 dollars.[9] In 2013 dollars, annual O&M costs are $2,190,500; periodic sediment pond maintenance costs are $283,800 once every 10 years; periodic road maintenance costs are $62,500 once every 5 years; and pre-banking costs are $986,800 per year.

---

[7] Bureau of Reclamation, *Construction Cost Trends*, 2012-2014, http://www.usbr.gov/pmts/estimate/cost_trend.html.
[8] According to interviews with the ISC staff.
[9] Bureau of Reclamation, *Construction Cost Trends*, 2012-2014, http://www.usbr.gov/pmts/estimate/cost_trend.html.

Annual O&M costs will begin 2029, about halfway through the construction period, and will continue through 2050. Sediment pond maintenance will occur twice throughout the study period, once in 2038 and again in 2048. Road maintenance activities will occur in 2033, 2038, 2043 and 2048. Pre-banking costs will begin in 2027 and will continue annually through 2050.

GBIC Irrigation Diversion Structure (Proposal 3b)

Capital and operating cost estimates for the GBIC Proposal were developed by BHI in August 2014.[10] Cost data was provided to HE via the ISC at that time. This Proposal includes the replacement of earthen diversion structures with a permanent concrete structure. Assumptions regarding construction and expenditure schedules were based on consultations with the ISC staff.

Capital Costs. Total capital costs of the GBIC Proposal are estimated at $1,766,000 (2014 dollars). The capital cost estimates includes construction expenses for the diversion and conveyance structures as well as expenses for related construction activities (surveying, materials testing, mobilization, demobilization). A 30 percent contingency is included in the construction cost estimate. The capital cost estimate also includes non-construction expenses, including design, permitting, environmental investigations, easement acquisition, construction management and other requirements.

Capital costs are reported in 2014 dollars. HE used the BOR's *Construction Cost Trends* indices to adjust the 2014 capital costs to 2013 dollars.[11] Total capital costs of the GBIC Proposal are projected to be $1,742,700 in 2013 dollars.

According to the ISC staff, the capital costs for the GBIC Proposal will occur over a 5 year period, from 2015 through 2019. Annual expenditures will range between about $100,000 and $650,000, with earlier expenditures focused on engineering and permitting work and later expenditures focused on construction activity. Actual construction of the GBIC Proposal will take place over a 2 year period in 2018 and 2019.

Operating Costs. Annual O&M costs for the GBIC Proposal are $36,250 in 2014 dollars. This estimate includes parts and repairs; equipment; labor; training; insurance and other smaller O&M items. After adjustment to 2013 dollars (using the BOR's Construction Cost Trends index), annual O&M costs amount to $35,800. O&M costs will begin in 2020, after completion of construction activities, and continue through 2050 on an annual basis.

Deming Effluent Reuse (Proposal 4)

Capital and operating cost data for the Deming Effluent Reuse Proposal was obtained from the *Proposed Effluent Reuse Expansion* Preliminary Engineering Report (PER) prepared by Souder, Miller & Associates in November 2013. The Proposal is an expansion of City's

[10] BHI, *Cost Estimate for GBIC Proposal (Diversion Structure and Conveyances)* and *Estimated Annual Operations and Maintenance Costs GBIC Proposal*, August 5, 2014.
[11] Bureau of Reclamation, *Construction Cost Trends*, 2012-2014, http://www.usbr.gov/pmts/estimate/cost_trend.html.

existing wastewater effluent recycle and reuse system for irrigation of City parks and other City owned facilities. Assumptions regarding construction schedules, expenditure schedules and the calendar year of cost data were obtained from the ISC staff.

Capital Costs. Total capital costs of the Deming Effluent Reuse Proposal are estimated to be about $4,121,000 (2013 dollars). Construction costs include a 15 percent contingency. Non-construction costs include state taxes and professional services, such as environmental reports, surveys, final engineering, legal work, and construction management.

Capital expenditures will occur over about 18 months in 2016 and 2017 and will amount to about $230,000 per month.

Operating Costs. Annual O&M costs for the Deming Effluent Reuse Proposal are $74,800 in 2013 dollars, as shown in Table 50 of the PER. These O&M costs will begin in 2018, upon completion of construction activities, and will continue through 2050 on an annual basis.

Grant County Water Commission Wellfield and Pipeline (Proposal 5)

Capital and operating cost data for the Wellfield and Pipeline Proposal was obtained from the *Gila (Grant County) Water Utilization Alternative (Wellfield, Tanks and Piping)* Engineering Report prepared by William J. Miller Engineers, Inc. in December 2013. The Wellfield and Pipeline Proposal addressed in this study includes the development of a well field, a 16 inch pipeline and booster station. Assumptions regarding construction schedules, expenditure schedules and the calendar year of cost data were obtained from the ISC staff.

Capital Costs. Total capital costs of the Proposal are estimated to be $16,423,700 (2013 dollars). Total capital costs are shown in Table 5 of the engineering report and include construction, engineering, the cost of two wells, and 15 percent contingency. Table 4 of the engineering report provides additional details related to specific Project construction activities and costs.

Permitting and design is assumed to begin by mid-2015 and construction will be complete in mid to late 2017, according to the engineering report. The Project duration will be 26 months, with construction activities occurring over the final 14 months of that period. An estimated 40 percent of capital expenditures will occur in the first 6 months of the Project (including the construction of the wells), beginning in mid-2015. The remainder of the capital costs will be distributed evenly over the following 20 months.

Operating Costs. Annual O&M costs for the Wellfield and Pipeline Proposal are projected to be $505,300 (2013 dollars), as shown in Table 6 of the engineering report. The O&M cost estimate includes wages and benefits; electricity; tools, equipment and parts; and various supplies. The O&M costs will begin in 2018, after completion of construction activities, and will continue through 2050 on an annual basis.

Grant County Reservoir (Proposal 6)

Capital and operating cost data for the Grant County Reservoir Proposal was obtained from the *Grant County Tier 2 AWSA Application Review* Preliminary Engineering Report (PER) prepared by Bohannan Huston Incorporated (BHI) in December 2013. The PER includes several alternatives; the recommended alternative includes a 3,000 AF reservoir on Twin Sisters Creek, at Site 2. NM ISC staff directed Harvey Economics to evaluate the PER's recommended alternative. Assumptions regarding construction schedules, expenditure schedules and calendar year of cost data were obtained from the ISC staff.

Capital Costs. Total estimated capital costs for the Grant County Reservoir Proposal are expected to amount to $18,063,500 (2013 dollars), as shown in Table IV-7 of the PER and in Appendix D, Table D6, Cost Estimate for the Recommended Project. This cost estimate includes construction activities, design, surveying, permitting, environmental investigations, land acquisition, construction management, as well as a 20 percent contingency factor.

This proposal is dependent upon the permitting, design and construction of the SWRWS Proposal. Therefore, design and permitting for the Grant Count Reservoir will be initiated once the regional water supply project is well along toward completion. Project construction is assumed to begin in 2030 and would occur over a period of 4 years and 2 months. Capital expenditures begin five years prior to the start of construction, in 2025, in order to account for permitting, design and other engineering work. Ten percent of total capital costs would be spent during those first five years; the remaining capital expenditures would be evenly distributed over the 4 year, 2 month construction period.

Operating Costs. Annual O&M costs of $105,300 (2013 dollars) and periodic O&M costs of $10,000 once every 10 years (2013 dollars) are assumed based upon Table IV-8 of the PER. The annual O&M costs include parts and repairs; equipment; labor; electrical costs; training and insurance. Periodic O&M costs are for sediment pond maintenance. Annual O&M costs will begin in 2035, after completion of construction activities, and will continue through 2050 on a yearly basis. Periodic O&M costs for pond maintenance will occur once in the study period, in 2044.

Catron County Ditch Improvements (Proposal 11b)

Capital cost data for the Catron County Ditch Improvements Proposal were obtained from the ISC staff. The ISC staff used the information provided by the proponents in the San Francisco Watershed Restoration Proposal Tier 2 as well as information in the Preliminary Engineering Assessments (PEAs) for both Glenwood North Lower Ditch and Mid Frisco/Keihne Ditch prepared by Portage, Inc,. in January 2014 to reach a capital cost estimate.

Assumptions regarding construction schedules, expenditure schedules, O&M costs and the calendar year of cost data were obtained from the ISC staff. The ISC staff received the O&M cost estimate, i.e., five percent of capital costs, from Portage.

Capital Costs. The Catron County Ditch Improvements Proposal addressed in this study is the portion of the larger Catron proposal which included watershed rehabilitation. This component involves the construction of infiltration gallery diversion structures as well as conversion of many of the open earthen irrigation ditches to pipe irrigation water transport systems. Total capital costs of the proposal are estimated to be about $6,684,800 (2013 dollars). Total capital costs were derived using the percent difference between the higher estimates from the proponents' proposal and the lower estimates from the two PEAs.

Permitting and design is assumed to begin in 2017 and construction will be complete in 2019, according to the ISC staff. The cost breakdown for the three years is projected to be $334,240 (5%), $1,336,960 (20%), and $5,013,602 (75%) respectively.

Operating Costs. Annual O&M costs for the Catron County Ditch Improvements Proposal are $334,200 (2013 dollars), or 5% of the total capital costs, according to the ISC's engineering consultant. The O&M costs will begin in 2020, after completion of construction activities, and will continue through 2050 on an annual basis.

Luna Ditch Improvements (Proposal 12)

Capital cost data for the Luna Ditch Improvements Proposal were obtained from the Tier 2 Final Report prepared by the proponents and the *Preliminary Engineering Assessment for Luna Irrigation Ditch* prepared by Portage, Inc. in January 2014. Assumptions regarding construction schedules, expenditure schedules, O&M costs and the calendar year of cost data were obtained from ISC staff. The ISC staff received the O&M cost estimate, i.e., five percent of capital costs, from Portage.

Capital Costs. The improvements for the Luna Ditch Improvements Proposal include installing a permanent weir and river diversion structure, installing water transmission pipeline within the existing ditch, replacing the regulating structure where the ditch splits into two ditches, and improving other associated infrastructure. Total estimated capital costs for the Luna Ditch Improvements Proposal amount to $1,438,700 (2013 dollars), as shown in Appendix C Alternative 1 in the PEA, plus the proponents' estimate of NEPA costs (P.5 of 11 in the Tier 2 Final Proposal). This cost estimate includes construction activities, design, surveying, permitting, environmental investigations, NEPA compliance, along with a 15 percent contingency factor.

Capital expenditures are assumed to begin in 2016; construction and will continue through 2018. Capital expenditures will be distributed as follows: $75,000 in 2016, $86,787 in 2017, and $1,276,926 in 2018.

Operating Costs. Based on engineering estimates, annual O&M costs will be 5% of total capital costs, or $71,900 (2013 dollars). Annual O&M costs will begin in 2019, after completion of construction activities, and will continue through 2050 on a yearly basis.

Sunset/New Model Ditch Improvements (Proposal 13)

Capital cost data for the Sunset/New Model Ditch Improvements were obtained from the *Preliminary Engineering Assessment for New Model and Sunset Canals* prepared by Portage, Inc. in January 2014. Assumptions regarding construction schedules, expenditure schedules, O&M costs and calendar year of cost data were obtained from the ISC staff. The ISC staff received the O&M cost estimate, i.e., five percent of capital costs, from Portage.

Capital Costs. The Sunset/New Model Ditch Improvements Proposal requires piping both Sunset and New Model Canals to serve 2,236 acres of the Sunset and 315 acres of the New Model canal. Total capital costs are estimated to be $12,903,000 (2013 dollars). Total capital costs are shown in Appendix C, Alternative 1 in both PEA reports and include construction, engineering, the cost of the pipelines, and 15 percent contingency. Table 1 in the engineering assessment provides additional details related to specific Project construction materials.

Permitting and design is assumed to begin by 2017 and construction will be complete in 2018, according to the ISC staff. A capital cost breakdown is as follows: Year 1: $670,798; and Year 2: $12,231,845. Year 1 costs entail surveying, engineering, testing, and inspection costs. Year 2 costs are for the construction itself.

Operating Costs. Annual O&M costs for the Sunset/New Model Ditch Improvements Proposal are $645,100 (2013 dollars), or 5 percent of capital costs based on engineering estimates. The O&M costs will begin in 2019, after completion of construction activities, and will continue through 2050 on an annual basis.

Pleasanton East-Side Ditch Improvements (Proposal 14)

Capital cost data for the Pleasanton East-Side Ditch Improvements Proposal was obtained from the *Preliminary Engineering Assessment for the Pleasanton Eastside Ditch* prepared by Portage, Inc. in January 2013. Assumptions regarding construction schedules, expenditure schedules, O&M costs and the calendar year of cost data were obtained from the ISC staff. The ISC staff received the O&M cost estimate, i.e., five percent of capital costs, from Portage.

Capital Costs. The Pleasanton East-Side Ditch Improvement Proposal proposes modifications for improving performance of the existing system. The improvements include installing a water transmission pipeline and/or ditch liner with new outlets and improving other associated infrastructure. Total estimated capital costs for this proposal amount to $2,536,000 (2013 dollars) as shown in Appendix C in the PEA. The PEA identifies 4 alternative cost scenarios. Alternative 4 was used because some ditch members want an open, concrete ditch in certain areas. The cost estimate includes general project costs, cleanout of structures along pipeline, construction activities, design, surveying, permitting, as well as a 15 percent contingency factor. Project construction is assumed to begin in 2017 and will be complete in 2020. Cost breakdown for the 4 years are $261,462 (Engineering), $1,074,153 (Phase 1), $376,599 (Concrete Ditch Liner), and $824,023 (Phase 2) respectively.

Operating Costs. Annual O&M costs are estimated to be 5% of the total capital costs or $126,800 (2013 dollars). Annual O&M costs will begin in 2021, after completion of construction activities, and will continue through 2050 on a yearly basis.

Municipal Conservation for Southwest New Mexico (Proposal 15)

The capital costs for the municipal conservation program were derived independently from the proponent submittals, similar to the conservation program benefit assumptions described in the previous report section. HE, at the direction from the ISC staff, determined that the proponent assumptions were inconsistent with the objectives of the benefit-cost study and the assumptions adopted for the other proposals. The up-front planning costs and the on-going administrative cost assumptions (operating costs) were drawn from the proponent proposal.

Capital Costs. The conservation program capital cost was estimated by developing assumptions for the cost per participant in the conservation program and applying that cost to a projected number of participants or households in the four-county area. Up-front planning costs of $150,000 comprise the first year costs, in accord with the proponents' proposal.

As described in the benefit concepts section previously, this study assumes that the conservation program will consist of toilet and washing machine rebate programs and one additional conservation program to be determined later. This third program could be some form of water rate modification, shower head give-aways, a landscape rebate, or a water audit. HE assigned the average cost of those programs to be the cost of the third program and added that to the cost of the other two programs to establish an assumption for total costs per participant in the GCC conservation program, as indicated in Table 3.1 below.

Table 3.1
Cost Assumptions per Conservation Program Participant

Conservation Program	Average Cost per Participant
Toilet Rebate	$421
Washing Machine Rebate	$769
Other Program (Average)	$748
Total Cost per Participant	**$1,938**

Note: Costs include funding by utility, outside entities and participants.

Source: Water Conservation Alliance of Southern Arizona, *Evaluation and Cost Benefit Analysis of Municipal Water Conservation Programs*, 2005.

The number of households projected to participate in the conservation programs was set forth in the previous benefit concepts section. HE developed these projections from household estimates and projections assuming those in incorporated communities and one half of those served by water providers in unincorporated communities would be available to participate.

HE then assumed that, beginning in 2016, five percent of the available participants would sign up for the three conservation programs, and an additional five percent would join for the succeeding four years until the program reached 25 percent total participation in the year 2020. Applying these projections to the cost assumption produces capital cost projections for the GCC conservation program, provided in Table 3.2

Table 3.2
Capital Costs of the Conservation Program Proposal

Year	Additional Participating Households/Year	Total Program Costs/Participant	Total Capital Costs (000's)/Year	Total Capital Costs (000's)/Year w/Contingency
2015	Ø	$0	$150	$165
2016	811	$1,938	$1,572	$1,729
2017	831	$1,938	$1,610	$1,771
2018	850	$1,938	$1,647	$1,812
2019	870	$1,938	$1,686	$1,855
2020	889	$1,938	$1,723	$1,895
Totals	**4,251**		**$8,388**	**$9,227**

Notes: (1) Additional participating households are new entrants to the conservation programs each year for the four county area until saturation is reached in 2020.

(2) Total program costs include the costs of participating in the toilet rebate, the washing machine rebate and one other undesignated program.

(3) 2015 expenditures relate to program planning.

Capital costs include program planning, presumed to be expended in 2015. A 10 percent contingency has been added to the conservation program to account for both cost and other uncertainties. Hence, total capital costs, expressed in 2013 dollars, are $9,227,000.

Although the conservation program is expected to continue after 2020, it is assumed that these costs would be paid for by local water providers, perhaps in concert with the State of New Mexico.

Operating Costs. According to the proposal proponents, the conservation program would be administered by either the New Mexico Finance Authority or a state agency. The proposal estimates the administrator's annual administrative costs to be three percent of capital costs. This would result in operating costs ranging from $53,000 to $57,000 a year for the five program years. After that time, any continuing program costs would be met by local water providers, presuming the programs were successful.

Summary

This section provides the assumptions for capital costs, capital expenditure schedules, and annual operating and maintenance costs for each of the proposals, as summarized in Tables 3.3 and 3.4, respectively. These assumptions are based on information supplied by the proponents and supplemented by the ISC staff, and the ISC's engineering consultants. These data will be applied as costs in the benefit-cost calculations later in this report.

Table 3.3
Capital Expenditure and Schedule Summary for Proposals

	Proposal Name	Total Capital Costs (2013 dollars)	Capital Expenditure Start Date	Capital Costs Time Period	Years of Construction Costs	Year Operation Begins
1, 2, 3a	Southwest NM Regional Water Supply (SWRWS)	$431,833,000	2014	2014 - 2033	2024 - 2033	2034
3b	GBIC Irrigation Diversion Structure	$1,742,700	2015	2015 - 2019	2018 - 2019	2020
4	Deming Effluent Reuse	$4,121,000	2015	2016 - 2017	2017	2018
5	Grant County Water Commission Wellfield and Pipeline	$16,423,700	2015	2015 - 2017	2016 - 2017	2018
6	Grant County Reservoir	$18,063,500	2025	2025 - 2034	2030 - 2034	2035
11b	Catron County Ditch Improvement	$6,684,800	2017	2017 - 2019	2018 - 2019	2020
12	Luna Ditch Improvements	$1,438,700	2016	2016 - 2018	2018	2019
13	Sunset/New Model Ditch Improvements	$12,903,000	2017	2017 - 2018	2017 - 2018	2019
14	Pleasanton East Side Ditch Improvements	$2,536,000	2017	2017 - 2020	2018 - 2020	2021
15	GCC Municipal Conservation	$9,376,000	2015	2015 - 2020	2016 - 2020	2016

Note: These watershed proposals are addressed separately: Grant County SWCD Watershed Proposal, NMFIA Watershed Proposal, NMSU Watershed Proposal, Gila National Forest Watershed Proposal, Catron County Watershed Component Proposal.

Table 3.4
Operation and Maintenance Cost Summary for the Proposed Proposals

	Proposal Name	Annual O&M Costs (2013 dollars)	Periodic Costs	Start Date of O&M Costs
1, 2, 3a	Southwest NM Regional Water Supply (SWRWS)	$2,190,500	$986,800 per year pre-banking costs starting in 2027; $283,800 once every 10 years; $62,500 once every 5 years	2027
3b	GBIC Irrigation Diversion Structure	$35,800	None identified	2020
4	Deming Effluent Reuse	$74,800	None identified	2018
5	Grant County Water Commission Wellfield and Pipeline	$505,300	None identified	2018
6	Grant County Reservoir	$105,300	$10,000 once every 10 years (2044)	2035
11b	Catron County Ditch Improvement	$334,200	None identified	2019
12	Luna Ditch Improvements	$71,900	None identified	2019
13	Sunset/New Model Ditch Improvements	$64,100	None identified	2019
14	Pleasanton East Side Ditch Improvements	$126,800	None identified	2021
15	GCC Municipal Conservation	$53,000 to $57,000	None identified	2016

Note: These watershed proposals are addressed separately: Grant County SWCD Watershed Proposal, NMFIA Watershed Proposal, NMSU Watershed Proposal, Gila National Forest Watershed Proposal, Catron County Watershed Component Proposal.

Section 4. Watershed Proposal Concepts, Benefits and Costs

The ISC received five watershed restoration or improvement proposals which are addressed in this section. These watershed proposals are fundamentally different than any of the other AWSA proposals in a number of respects:

- Increased water supply is a corollary or incidental effect of the watershed proposals.
- The watershed proposals do not focus on meeting a specific water demand or shortage.
- It is not clear where any water increase that is realized would be delivered.
- The watershed improvements benefits are short term.

Because of the differences, the costs and benefits of the watershed proposals are described in a broader and more generalized manner than the other proposals, in keeping with their more holistic nature. Given their uncertainty, HE did not analyze specific costs and benefits of each proposal. In this section, we have provided a brief background and an abbreviated description and cost estimate of each of the watershed proposals. Our consideration of the watershed proposals concludes with an examination of the typical benefits of watersheds.

Watershed Background and Proposal Description

Watersheds are defined areas in which all water resources eventually drain into a single waterway, which could be a stream, wetlands, aquifer, lake, or ocean. All lands lie within a defined watershed; each is different, typically with diverse stakeholders and complex physical characteristics.

In recent years, taking a "watershed approach" to environmental issues has provided a more holistic look at the interaction of natural and human events and the resulting impacts to the environment, including our water supplies. Watershed health can be impacted by natural events such as wildfire, drought and flooding. Human activity, such as urbanization, power generation, agriculture, recreation, and resource extraction (i.e. mining), also results in environmental changes within watersheds. It is generally the cumulative effects of natural and human activities that create significant negative impacts within a watershed.[12]

Proposal 7. Grant County Soil and Water Conservation District Watershed Proposal. This proposal is located in the Gila National Forest on lands managed by the U.S. Forest Service within the Gila River Basin. The proposed action is to thin overly dense forest and woodland cover which would decrease evapo-transpiration and water interception by the deep root systems of

[12] Elliot, William J.; Miller, Ina Sue; Audin, Lisa. Eds. 2010. Cumulative watershed effects of fuel management in the western United States. Gen. Tech. Rep. RMRS-GTR-231. Fort Collins, CO: U.S. Department of Agriculture, Forest
Service, Rocky Mountain Research Station.

the cleared trees. It is expected that this would then increase recharge water to alluvial storage and the stream base flow to the Gila River and Mangas Creek, a major tributary of the Gila. The proposers also expect that the proposal will reduce the likelihood of catastrophic wildfire in the area and the resulting negative impacts such as erosion and degradation of water quality.

Water Yield. Using a formula that estimates the average water yield increase relative to thinning ponderosa pine, the proposers estimate that treatment at the Stiver Canyon site could increase yield by 380 acre feet per year. This increase yield would presumably continue over 8 years for a total increase of about 3,000 acre feet of water. Thinning at the Burro Mountain site would produce an additional 40 acre feet of yield over the 10 year post treatment time frame. In total, the proponents project that close to 3,100 additional acre feet of yield would result from the Grant County SWCD Proposal.

Cost. Proposal funding is requested for ten years, with the initial year used for planning, design and installation of monitoring equipment. Total proposal costs are estimated by the proponents to be $1,391,500. If the costs and project yields occur as anticipated by the proponent, the cost per acre-foot would be about $450.

Proposal 8. New Mexico Forest Industry Association Watershed Proposal. This proposal is located in a remote location in the Gila National Forest, Quemado District. This watershed encompasses 2,560 acres and thinning would take place over about 1,150 acres. The thinning would be achieved by both mechanical means and prescribed burning. These actions are expected to reduce the chance of catastrophic wildfire, enhance the overall health of the watershed and may provide additional surface water downstream for agricultural use. By thinning the forest of overstock, proposers assert that water yield in the San Francisco Basin would be increased.

Water Yield. According to the proponents, the proposed thinning would provide additional surface runoff and subsurface recharge. The project will span ten years, with thinning being completed in year three. After thinning is completed, the project will continue for seven years. Increased yield is projected to be 173 acre-feet per year, for a total increase of about 1,211 acre-feet of the life of the project.

Cost. Total proposal costs are estimated at $2,270,000, with administrative, operations and maintenance costs of $1,047,000. If project yields are as projected, the cost would be about $1,900 per acre-foot.

Proposal 9. New Mexico State University Watershed Proposal. This proposal would thin mixed-conifer forest and piñon-juniper woodlands in the Luero Mountains on lands administered by the State Land Office. This plan would utilize silvicultural[13] principals to improve the health of the watershed. The tree densities in the area are high and one aspect of this work would include thinning, which would reduce losses from evapo-transpiration (ET). It is also expected that this work would reduce the chance of high intensity crown fires, which have many negative impacts to watersheds. There is also an emphasis within the proposal on gathering data to further understanding

[13] Silviculture is the art and science of controlling the establishment, growth, composition, health and quality of forests and woodlands to meet the diverse needs and values of landowners and society on a sustainable basis. http://www.fs.fed.us/forestmanagement/silviculture/. Accessed August 2014.

of the hydrologic response to the use of the silvicultural treatments. The treatment area will include 1,500 acres of mixed-conifer and ponderosa pine forest and 500 acres of piñon-juniper woodland.

Water Yield. According to the proponent, this watershed restoration proposal will potentially increase the water yield. Although the project timeline is ten years, proposers expect that benefits and water yield increases will continue for an additional five years after project completion. The ten-year projected water savings from the thinning of the mixed-conifer forest is projected to be 2,129 acre-feet. Thinning the piñon-juniper woodlands is projected to save and additional 202 acre-feet for a project total of 2,331 acre-feet. Over the 15-year period, water yield is projected to be 2,968 acre-feet.

Cost. The total cost of the ten year project is estimated at $2,170,223. Proponents offer indirect cost recovery of $303,121 as a form of cost sharing. If the projected water savings are realized, the cost would be $931 per acre-foot over the ten-year project time frame.

Proposal 10. Gila National Forest Watershed Proposal. This proposal includes two distinct areas within the Gila National Forest, the Snow Canyon Watershed and the Burro Unit Treatment Areas. The high-elevation Snow Canyon Watershed is a popular recreational area that has suffered high severity fires in recent years that damaged about 15,000 acres, or about half of the watershed. This proposal is a landscape-scale watershed restoration designed to mitigate the impacts from these fires. The principal expected benefits of this proposal are hazardous fuels reduction, riparian restoration, and source water protection. Additional economic benefits may also accrue from this action. The Burro Unit Treatment Areas proposal involves prescribed burning of about 67,000 acres and vegetation thinning on 7,000 acres to reduce the potential for catastrophic wildfire. The Mangas Valley, Corral Canyon and Thompson Canyon watersheds are within the project area. The negative impacts of catastrophic wildfire include degradation of water quality and land impacts, such as erosion. Both of these projects seek to achieve functional watershed status to the various treatment areas. The proposers note that it cannot be predicted if that functional status will produce an increase in total water yield.

Water Yield. Increased water yield from these projects has not been projected, although the proposers note that there may be increased water supply to some local streams or aquifers from the Snow Canyon proposal.

Cost. The Snow Canyon Project is a 5-year effort that is projected to cost $1,005,940. Funding requested from AWSA is $312,000. The Burro Unit Treatment Area projects will cost $7,400,000 over 10 years; 40 percent of the cost, $2,950,000 has been requested.

Proposal 11a. Catron County Watershed Proposal. Two recent fires, (Wallow Fire 2011 and Whitewater/Baldy Fire 2012) in the project area have increased runoff due to the absence of vegetation. This will result in increased stream flow from precipitation that will be lost to evaporation, percolation, ET or run-off. The proposed action is for upland restoration of lands that are critical to watershed function for downstream users. This effort will restore the vegetation to the fire damaged area which will filter and retain sediments and slow runoff. This restoration will impact the Gila/San Francisco River flows within Catron County.

Water Yield. The water yield associated with Proposal 11a, is increased stream flow into the San Francisco Basin. Proponents estimate those increased flows to be about 28,129 acre-feet of water per year. These flows will occur with or without the project; however, proponents assert that without the project, the sedimentation of the run-off will make it unusable for agricultural diversion.

Cost. The proponents project that the total cost of proposals 11a and 11b will be $12,090,967, with costs for 11a being $7.4 million over a 5 year period. According to the proponent's assertions as to cost and yield, the resulting per acre-foot cost would be $52.90 per acre-foot.

While the proponents estimate water yield due to thinning based on studies in other locations, those same studies emphasize that water yield from thinning is highly site specific. Further, in Appendix F of *The 2003 Jemez y Sangre Water Plan* by Daniel B Stevens & Associates, various past studies found little to no water yield increases in some areas and minimal yields in areas with ponderosa pine forests.

Typical Benefits of Watershed Restoration and Improvement

The negative impacts of watershed degradation are as varied as the topography of the U.S. The existing and potential impacts of this degradation in New Mexico include erosion of topsoil, reduction in fish populations, increased pollutants in waterways and increased water treatment costs, loss of wetlands, catastrophic wildfire, loss of habitat, increased presence of non-native, invasive species, and reduced bio-diversity.[14]

New Mexico has adopted a Forest and Watershed Health Plan, developed by the New Mexico Department of Energy, Minerals, and Natural Resources (EMNRD) in response to its unhealthy ecosystems.[15] This plan adopts a collaborative approach that includes government at all levels, tribes, private landowners, businesses and other stakeholders. Because these efforts are fairly recent and improvements take place over years or even decades, the ultimate level of success of these efforts are unknown.

Endeavors to protect the environment, such as fire suppression, can frequently have unintended negative consequences. Efforts to prevent forest fires has resulted in an accumulation of dead wood which acts as fuel, resulting in hotter fires that create a myriad of impacts to the burn area and downstream.

There are a myriad of benefits that may be achieved through improvement of watershed health, but the specific improvements depend on the physical characteristics of a given watershed and on the specific methods of restoration. These benefits will likely lead to a variety of economic benefits, depending on the types of action taken. Some specific examples of the watershed restoration actions and their benefits likely from these proposed watershed improvements in New Mexico include:

1) Removal of excess fuel in the form of live and dead vegetation can reduce the risk of forest fire, and if there are fires, they are more likely to be lower temperature fires that do

[14] Jemez Watershed Restoration Action Strategy. Prepared by the Jemez Watershed Group. October 2004, revised August 2005.
[15] *The New Mexico Forest and Watershed Health Plan; An Integrated Collaborative Approach to Ecological Restoration*. New Mexico Forest and Watershed Health Planning Committee. December 2004.

not cause the extensive damage seen in crown fires. A reduction in high temperature fires will result in reduced erosion, sedimentation and property losses.

2) Removal of excessive growth may also increase water yields as fewer trees transpire less water from groundwater supplies.

3) Removal of invasive species will improve biodiversity and wildlife habitat, which may lead to improve recreational opportunities and resulting economic benefits.[16]

Watershed restoration activities generally include a specific action with a desired outcome. However, the benefits of restoration tend to have a cascading effect. For example, efforts to improve water quality to reduce treatment costs may also lead to improved recreational opportunities and increased expenditures, which will likely create economic benefits and costs to local communities. These complex interactions and the long-term nature of restoration projects make quantification of benefits uncertain.

[16] *The New Mexico Forest and Watershed Health Plan; An Integrated Collaborative Approach to Ecological Restoration*. New Mexico Forest and Watershed Health Planning Committee. December 2004.

Section 5. Methods for Benefit and Cost Quantification of the Proposals

Introduction

This section describes the approach, methods and assumptions for quantifying the benefits and costs presented in the next section of this report. As described in Sections 2 and 3, there are certain types of benefits and costs which will occur with each of the proposals.

Whereas economic principles must guide benefit-cost analysis, the particular circumstances of an action or group of actions under consideration shape the quantification approach. HE selected a quantification approach that would provide an unbiased treatment for each proposal by applying a consistent method for similar types of benefits and costs. For example, a common approach was taken for quantifying the benefit of additional municipal supplies, except in instances in which a particular proposal warranted modification of that approach, given its unique circumstances. In those instances, HE adapted these categorical quantification methods for certain proposals where individual circumstances warranted special treatment. This section describes both the categorical benefit quantification method and the exceptional quantification methods which were adopted, and why that was necessary.

The types of benefits or categories include construction, agriculture, recreation, municipal and environmental. The quantification method and assumptions for each are addressed in this section in turn. The exceptions and special quantification assumptions for individual proposals are also described by benefit category. The majority of proposals have multiple economic benefits either within categories (i.e., avoided costs plus new water) or among several different categories (i.e., agricultural and recreational). All of the quantified benefits for each proposal are summed to arrive at total benefits in the next report section.

The quantification of costs was mostly provided in Section 3, but certain additional steps and assumptions have been applied in preparation for the benefit-cost analysis.

Qualitative benefits and costs were identified in the previous two sections. They are no less important than the quantified effects; they simply are not amenable to meaningful or reliable dollar translation. They will be recognized in the benefit-cost analyses in the next report section. Incidental or very small effects were also identified in Section 2; they will not be carried forward.

Direct, Secondary and Total Economic Benefits

In addition to the direct benefits of each proposal, described below, secondary (indirect and induced) benefits will also accrue to the regional economy as companies and households spend money and additional dollars circulate throughout the region. Such secondary effects are not always accounted for in benefit-cost analyses, but they will be included here since the ISC is to make decisions on applying AWSA funding for expenditures within the

southwestern part of the State. This represents an economic stimulus which is noteworthy and can be accounted for in this economic study.

Indirect and induced effects are defined as follows:

Indirect effects: changes in sales, income and employment within a region for businesses or industries supplying goods and services to the industry directly affected;

Induced effects: increased sales, income and employment within a region generated by household spending of the income earned in supporting industries.

These secondary economic benefits are estimated through the application of industry and region specific multipliers. HE obtained regional multipliers for the following industries from the New Mexico Economic Development Department: agriculture (Agriculture, Forestry, Fishing and Hunting, North American Industry Classification System (NAICS) Code 11); construction (Construction, NAICS Code 23) and recreation (Other Amusement and Recreation Industries, NAICS Code 7139).[17] The multipliers are provided in Table 5.1, below.

Table 5.1
Region and Industry Specific Output Multipliers

Industry	Regional Output Multipliers
Agriculture, Forestry, Fishing and Hunting	1.3017
Construction	1.3034
Other Amusement and Recreation	1.2450

Note: Regional output multipliers reflect Catron, Grant, Hidalgo and Luna counties.
Source: New Mexico Economic Development Department.

Although earnings and employment multipliers exist, only the output multiplier was appropriate in this study to avoid double counting. These multipliers were applied to the direct benefits of specific components (i.e. agricultural or recreational benefits) within each proposal in order to estimate the secondary and total economic benefits related to that industry. Output multipliers were not applied to municipal economic effects because direct, indirect and induced effects are already accounted for in the quantification methodology HE adopted. Multipliers were also not adopted for environmental benefits since those benefits are non-monetary values. The total economic benefit of each proposal includes both the direct and secondary effects of each benefit type to the extent they are likely to occur.

[17] More detailed multipliers for the agricultural industry results in separation of crop production from animal production. More detailed multipliers for the construction industry are not available. Other Amusement and Recreation Industries multipliers eliminate the majority of non-outdoor recreation activities.

Quantification of Construction Benefits

Detailed information about the capital costs of each proposal are provided in Section 3 of this report. Those costs include both the purchase of necessary equipment, materials and supplies as well as the cost of labor required to permit, design and construct the facilities called for in each proposal. These expenditures will represent an economic stimulus to the southwest New Mexico region as well as the State itself, instigated by AWSA monies coming from outside the State. Using the region-specific construction industry multipliers obtained from the New Mexico Department of Economic Development, HE estimated the total economic output (sales of goods and services) generated by each of the proposal activities.

Construction related benefits will be short-term and temporary in nature. The benefits to economic output (sales), employment and earnings generated by the development of each proposal accrue in each year in which capital expenditures occur, but do not continue after all capital costs have been expended.

Agricultural Benefits

Agricultural benefits will occur with the implementation of a number of the AWSA proposals. Benefits to agricultural water users will accrue in different ways:

1. Additional water applied to irrigable lands or increased efficiency—SWRWS, GBIC Irrigation Diversion Structure, Catron County Ditch Improvements, Sunset/ New Model Ditch Improvements, Luna Ditch Improvements, Pleasanton East-Side Ditch

2. Reduced operation and maintenance costs for irrigation systems-- Catron County Ditch Improvements, Luna Ditch Improvements

3. Avoided capital outlays for facility re-construction-- GBIC Irrigation Diversion Structure, Luna Ditch Improvements, Sunset/ New Model Ditch Improvements

These economic benefits will also be subject to multiplier effects as additional agricultural income circulates through the regional economy.

Additional irrigation water. Additional irrigation water will lead to more water applied to irrigated acres. The additional water will increase crop yields, producing incremental income for agricultural producers. Since southwest New Mexico has a livestock focus, it is assumed that much of the increased crop production (mainly hay) will go to cattle. Incremental gains in crop and livestock sales will bring an economic stimulus to the area.

HE gathered data on total farm sales from irrigated farms (including crops/ pasture and livestock) and then made a calculation of the value of farm sales per acre for irrigated farms in New Mexico, which was approximately $117 per acre. Statewide, an average of 2.1 acre-feet of water is applied per irrigated acre.[18] HE divided the revenue per irrigated acre by the average irrigation amount per acre to obtain an estimate of the revenue per acre foot of new

[18] Data on agricultural water use per irrigated acre is not available at the regional or local levels. The statewide average was obtained from the USDA Farm and Ranch Irrigation Survey (2008). That survey is conducted every five years; data from the 2013 survey have not yet been released.

water provided by any of the proposals. This value is about $56 per acre. The data for these calculations are shown in Table 5.2.

Table 5.2
Estimated Revenue Produced Per Acre-Foot of New Agricultural Water for New Mexico, 2013

	New Mexico
Value of Farm Sales Per Acre for Irrigated Farms	$117.32
Total Water Applied per Irrigated Acre (AF/ac)	2.1
Net Revenue per AF of Agricultural Water	$55.87

Note: Net revenue per AF accounts for both crop/pasture and livestock production.
Sources: USDA, Census of Agriculture and Farm and Ranch Irrigation Survey; Harvey Economics.

The data used to develop these estimates were obtained from the Farm and Ranch Irrigation Survey (2008) and the Census of Agriculture (2012) both available from the U.S. Department of Agriculture (USDA).[19,20] The calculation of net revenue per AF of agricultural water was adjusted to 2013 dollars using the US Bureau of Reclamation Construction Cost Trends index.[21]

The agricultural benefits of applicable proposals are calculated as the revenue per acre-foot of water applied to the total number of acre-feet each proposal will supply to agriculture in each year through 2050.

[19] Farm and Ranch Irrigation Survey (2008), National Agricultural Statistics Service, U.S. Department of Agriculture.
[20] 2012 Census of Agriculture – County Data, New Mexico. National Agricultural Statistics Service, U.S. Department of Agriculture.
[21] US Bureau of Reclamation, Construction Cost Trends, http://www.usbr.gov/pmts/estimate/cost_trend.html.

Reduced operations and maintenance (O&M) costs. The physical improvements to irrigation infrastructure called for in several proposals will mean a decline in some portion of total O&M costs, which is termed an avoided cost in economic terms. In essence, the farmers and ranchers will have more net income with reduced expenses. The ISC staff, working with HE, provided an estimate of what the diminished annual costs would be for each proposal. These benefits are described for individual projects in Section 3.

Avoided capital outlays. For several proposals, the new irrigation system facilities would mean that periodic re-construction due to flooding events would not result in wash-outs of existing infrastructure. This is an avoided cost. From an economic standpoint, the benefit of this avoided cost to farmers and ranchers functions the same as reduced O&M costs. The ISC staff, working with HE, provided an estimate of what the diminished annual costs would be for each proposal. These benefits are described for individual projects in Section 3.

Recreation Benefits

Recreational benefits will be generated from the Southwest NM Regional Water Supply (Proposal 1, 2, 3a) and the Grant County Reservoir (Proposal 6). It is assumed that one of the reservoirs in Proposal 1, 2, 3a would accommodate motorized boating (Sycamore Canyon); the remaining two recreational reservoirs in that proposal, as well as the Grant County reservoir, would allow only wakeless boating. The local and regional economic benefits from expenditures on recreation will be driven by two factors: (1) the number of visitors to each of those reservoirs and (2) visitor spending levels. These are projected by reservoir for both proposals.

Non-expenditure benefits will also result from the development of these reservoirs. This occurs in the form of what economists refer to as "consumer surplus." That is, visitors to these reservoirs experience an enjoyment or benefit which exceeds what they actually pay in cash outlays to go fishing, for example. Economists have several means for measuring this.

HE researched recreational studies from other locations and applied those estimates of consumer surplus to the proposed Southwest New Mexico reservoirs, adopting a technique known as "benefit transfer". The transferred estimates of consumer surplus are in addition to estimates of regional visitor spending.

Estimates of reservoir visitation. Estimates of visitation to the four applicable reservoirs included in the two projects mentioned above were based on visitation at comparable existing recreational lakes in New Mexico.[22] HE gathered information about reservoir size, annual visitation and available activities for other recreational lakes from New Mexico State Parks and from the New Mexico Department of Game and Fish.[23] The identification of comparable lakes was based on reservoir size (number of surface acres); activities and amenities; and the general type of location, i.e. accessibility, rural area, etc.

At Pope Canyon, Winn Canyon and the Grant County reservoir, all visitation is assumed to be for non-motorized recreational activity, including trail sports, biking, camping, fishing and non-motorized boating, based on input from the ISC staff. HE assumed that the majority of recreation at these reservoirs would be focused on fishing (50 percent); smaller amounts of visitation would be for non-motorized boating, camping and trail sports and only minimal usage would be for biking. For the Sycamore Canyon reservoir, total visitation was broken into motorized boating and non-motorized recreational activity. HE assumed that 20 percent of reservoir visitation at Sycamore Canyon would be for motorized boating and 80 percent would be for non-motorized activities.

Table 5.3 presents a list of the reservoirs identified as comparable to those in Proposal 1, 2, 3a and Proposal 6.

[22] Together, these projects include five reservoirs; however, it is assumed that the smallest reservoir in Project 1, 2, 3a, Dix Canyon, will not have any recreational activity.
[23] New Mexico State Parks, personal communication; and New Mexico Department of Game and Fish, personal communication.

Table 5.3
Selected Characteristics of Comparable Reservoirs

Reservoir	Location	Surface Acres	Activities	Annual Visitor Days	Useful as Comparable?
El Vado Lake	Northern NM	3,200 max; 942 current	Motorized and non-motorized	49,700	Yes, El Vado and Heron in combination (Sycamore). These lakes are adjacent to one another and are located away from major highways.
Heron Lake	Northern NM	5,950 max; 1,755 current	Motorized and non-motorized	111,629	
Storrie Lake	East of Santa Fe	1,149 max; 333 current	Motorized and non-motorized	99,800	Yes; Sycamore
Eagle Nest Lake	NE of Santa Fe	2,400 max; 925 current	Motorized and non-motorized	179,300	Yes; Sycamore
Bill Evans Lake	SW NM	63	Non-motorized	34,000	Yes; wakeless lakes
Lake Roberts	SW NM	58	Non-motorized	36,000	Yes; wakeless lakes
Clayton Lake	NE NM	170 max; 73 current	Non-motorized	34,320	Yes; wakeless lakes

Notes: Annual visitor days for Bill Evans Lake and Lake Roberts reflect angler days only.

Sources: New Mexico State Parks; New Mexico Department of Game and Fish; Harvey Economics.

Using the data presented in Table 5.3, HE estimated the annual visitation to each of the proposed reservoirs assumed to be open to recreation. In doing so, HE took into account the fact that all four of these reservoirs would be located in relative proximity within Grant County; this reduces the total visitation at any one reservoir because of the other opportunities and choices faced by potential visitors in the same area.

- *Sycamore Canyon:* HE estimated 90,000 annual visitor days at the Sycamore Canyon reservoir each year based on visitation data for El Vado Lake, Heron Lake, Storrie Lake and Eagle Nest Lake State Parks. El Vado and Heron Lakes are larger in size than the Sycamore Canyon reservoir would be; however, they are located in a relatively remote area (not directly adjacent to a major highway). In addition, the fact that they are adjacent to each other mirrors the situation in Proposal 1, 2, 3a, which would result in multiple recreational reservoirs in relative proximity. Storrie Lake

may be the most comparable to Sycamore Canyon given its current size and, although it is located on I-25, it is more than an hour's drive from Santa Fe. Eagle Nest Lake is also larger than the proposed Sycamore reservoir, but is located away from I-25 in a more remote location. In estimating visitation to Sycamore Canyon, HE also took into account visitation at other lake State Parks in New Mexico.[24] Other lakes in various locations around the state experienced visitation ranging from between 23,000 visitor days to 87,000 visitor days (Bluewater, Sumner, Santa Rosa, Conchas and Brantley Lakes). Visitation at very large lakes (Elephant Butte, Caballo, Ute and Navajo Lakes) ranges from about 205,000 to almost 690,000 visitor days per year; these large lakes cannot be considered comparables for Sycamore given their size and the extensive amenities available at most locations. Taking into account all of the information discussed above, the estimate of 90,000 visitor days at Sycamore seems reasonable given the size of the reservoir and the variety of activities that may occur there.

- *Pope and Winn Canyons:* HE estimated a total of 45,000 visitor days per year at each of these reservoirs based on visitation data for Bill Evans Lake, Lake Roberts and Clayton Lake. Bill Evans Lake and Lake Roberts are both located in southwest New Mexico, relatively close to the proposed reservoir sites, and allow only non-motorized boating or electric trolling motors. Annual visitor days reported for those lakes include angler days only; the New Mexico Department of Fish and Game does not collect data on other recreational activities at these locations. Clayton Lake State Park is located in the northeastern corner of the state, about 95 miles east of I-25; only trolling motors are allowed on the lake. Based on fact that visitation to Bill Evans Lake and Lake Roberts reflects anglers only and given the location of Clayton Lake, the estimate of 45,000 visitor days to Pope and Winn Canyons appears reasonable.[25]

- *Grant County:* HE used the same approach for the Grant County reservoir as for the Pope and Winn Canyon reservoirs. Therefore, total visitor days for the Grant County reservoir are also estimated to be 45,000 per year.

In total, HE estimated 225,000 visitor days of recreational activity at these four reservoirs each year. The SWRWS (Proposal 1, 2, 3a) would result in 180,000 recreational visitor days each year; the Grant County Reservoir (Proposal 6) would include 45,000 recreational visitor days each year. Visitation to each reservoir is assumed to ramp up over time in a linear fashion until reaching the ultimate visitation estimates in 2050.

Recreational expenditures. The *Economic Contributions of Outdoor Recreation: Technical Report on Methods and Findings* provided detailed information about per person

[24] Lakes managed by the New Mexico Department of Game and Fish were too small to be considered comparables to Sycamore Canyon and did not offer the recreational opportunities assumed for that reservoir.

[25] Quemado Lake is a 130 surface acre lake managed by the Department of Game and Fish and located south of Highway 60 in the Gila National Forest. This lake might have been a good comparable for Pope and Winn Canyons; however, visitation data is unavailable for that location.

per trip spending activity, by type of activity, for the State of New Mexico.[26] That report included data on participation and expenditures for both non-motorized activities (including trail sports, biking, camping and non-motorized boating) and motorized activities, but did not include specific expenditure data for fishing activities.

Angler spending data was obtained from the *2011 National Survey of Fishing, Hunting and Wildlife-Associated Recreation* for the State of New Mexico, conducted by the US Fish and Wildlife Service.

Using assumptions of participation by activity type and expenditure data from the aforementioned reports, HE estimated average per visitor day expenditures for visitors recreating at the wakeless reservoirs and for visitors recreating at the Sycamore Canyon reservoir. Expenditures by Pope Canyon, Winn Canyon and Grant County reservoir visitors are about $71 per visitor day in 2013 dollars.[27] Expenditures by Sycamore Canyon visitor are estimated to be about $88 per activity day in 2013 dollars; the greater per visitor day expenditures at Sycamore Canyon reflects the addition of motor boating at that location and the higher expenditures related to that activity.[28]

Non-expenditure benefits. In addition to direct expenditures, estimates of consumer surplus were gathered by type of activity from the report *Updated Outdoor Recreation Use Values on National Forests and Other Public Lands*.[29] Consumer surplus data taken from that report was specifically for the Intermountain region, which includes New Mexico. Values from this report were inflated to 2013 dollars using the Bureau of Reclamation's Construction Cost Trends index.[30]

Together, the direct expenditures and the consumer surplus estimates produce estimates of the total benefit, or value, of a recreational visitor day. All data on direct expenditures and consumer surplus were inflated to 2013 dollars using the Bureau of Reclamation's Construction Cost Trends index.[31] Table 5.4 provides the direct expenditure and consumer surplus data used in this study.

---

[26] Southwick Associates, *Economic Contributions of Outdoor Recreation: Technical Report on Methods and Findings,* prepared for the Outdoor Industry Association, March 15, 2013.
[27] Data was adjusted to 2013 dollars using the US Bureau of Reclamation's Construction Cost Trends index.
[28] Data was adjusted to 2013 dollars using the US Bureau of Reclamation's Construction Cost Trends index.
[29] US Department of Agriculture, Forest Service, General Technical Report PNW-GTR-658, *Updated Outdoor Recreation Use Values on National Forests and Other Public Lands,* John Loomis, October 2005.
[30] US Bureau of Reclamation, Construction Cost Trends, http://www.usbr.gov/pmts/estimate/cost_trend.html.
[31] US Bureau of Reclamation, Construction Cost Trends, http://www.usbr.gov/pmts/estimate/cost_trend.html.

Table 5.4
Expenditures and Consumer Surplus, by Activity Type, 2013 dollars

Activity	Expenditure per person per day	Consumer Surplus	Total Value
Trail Sports	$59.93	$54.75	$114.67
Biking	$43.57	$262.14	$305.70
Camping	$163.82	$49.34	$213.15
Non-motorized boating	$58.61	$96.20	$154.81
Fishing	$63.18	$70.44	$133.61
Motorized boating	$146.07	$76.28	$222.35

Sources: Southwick Associates; US Fish and Wildlife Service; USDA Forest Service; Bureau of Reclamation; Harvey Economics.

These per day value estimates were applied to the estimates of annual reservoir visitation for each reservoir through 2050 and summed for the relevant proposal to estimate the total recreational benefit for each proposal.

Municipal Benefits

The economic contribution of water in a municipal setting is quite different than the economic contribution from water applied to crops or utilized for recreational purposes. Economic activity within a town or a city could not occur without water, and so in a sense, the economic contribution of water is equal to the gross output of goods and services within that town or city. This fact also applies to agriculture and recreation.

However, water is a necessary but insufficient resource (or input, as economists would say) for creating the full complement of economic output for a city. The net benefit or contribution from water would be a highly complex calculation, requiring attribution from each input.

For the purposes of this study, HE has assumed that the municipal benefits are equal to the price municipal consumers are willing to pay for water, plus an amount of consumer surplus. Certainly, consumers must benefit from the use of municipal water at a minimum of the amount they are paying. In fact, consumer surplus can be estimated as the highest rate paid in the region, compared to the average rate.

In general, the development of municipal water supplies may support the growth and economic development of an area, reduce certain operating costs or avoid specific capital projects, including the purchase of alternative supplies. Proposal-specific approaches to the evaluation of the economic benefits of water for municipal purposes are described below.

Southwest NM Regional Water Supply. One assumed element of the SWRWS proposal is municipal water supply of 2,500AF for Grant County and 2,500AF for Luna County. This water is unspecified as to use by specific communities. Because of the lack of specific knowledge regarding which entitles would make use of this water, HE has assumed that the economic contribution of municipal water supplies in these counties would be the amount municipal consumers might pay for that water plus consumer surplus. The average

sales price per 1,000 gallons for municipalities in Catron, Grant, Luna and Hidalgo Counties is assumed to be $4.44 based on a review of existing water rates, plus a consumer surplus of $1.41 per 1,000 gallons.[32] Thus, the total economic benefit is assumed to be $1,908 per AF.

The date at which municipal consumers in Grant and Luna counties might need that water is highly uncertain. Demand projections between 2034 (when the project will come on line) and 2050 suggest an increase of less than 1,500 AF in incremental need.[33] However, by 2034, municipalities in these counties might be anxious to switch from existing supplies to a more sustainable future supply. For this study, HE has assumed that the desire to substitute supplies will be evident in 2034 and the full amount of municipal supply available from this project will be subscribed and sold.

Total economic benefit will therefore be equal to 5,000 AF per year times the economic benefit value of $1,908 per AF.

Deming Effluent Reuse. This project would result in an annual reduction of 410 AF of groundwater pumped from the aquifer by the City of Deming, as described in Section 2. The value of that water to Deming can be measured by the cost to the City of developing an incremental 410 AF of supply. In other words, that supply of water (410 AF) will be available to Deming for municipal purposes when needed and the City would avoid the cost of developing that water in the future.

In the short term, the City would reduce its groundwater use, but eventually will likely seek a more sustainable, surface water supply if available.

Since Deming's eventual benefit will be reduced need for surface water, Deming's avoided costs of developing additional water supplies were calculated based on the per AF costs of that surface water development.

HE identified the SWRWS proposal as an example of municipal water development project that could be available to Deming. That proposal has a total capitalized cost (capital costs plus annual operating costs brought back to 2013 dollar values) of about $504,576,000 for the eventual development of 10,000 AF per year, which amounts to about $2,970 per AF.[34] HE applied the $2,970 per AF cost of an alternative water supply to Deming's 410 AF reduction in groundwater pumping to calculate the municipal water benefits to Deming.

Grant County Water Commission Wellfield and Pipeline. The Wellfield and Pipeline proposal would result in new water supplies of about 943 AF available to the communities of Hurley, Santa Clara, Bayard and Silver City. For Hurley, the water developed as part of this project would replace the current water supply, purchased from

[32] New Mexico Environment Department, *Municipal Water and Wastewater User Charge Survey for 2011 Rates*, April 2012. The data in this document were adjusted to reflect 2013 dollars using the Bureau of Reclamation's Construction Cost Trends index.
[33] Based on calculations made by Harvey Economics, using some data from the Census Bureau and *Southwest New Mexico Regional Water Study*, 2010, prepared by AMEC.
[34] This calculation is based on the development of 10,000 AF per year between 2034, when the project would come on-line, and 2050, the end of the study period.

Freeport-McMoRan Copper and Gold, Inc. Therefore, for that 193 AF, the value of the proposal's water would be equal to the avoided costs of purchasing water from the mining company, on a per AF basis. Based on the contracted 2018 purchase price of $2.00 per 1,000 gallons of water, Hurley would avoid about $652 per AF for in water purchases.[35]

For the other three entities, this water would supplement existing groundwater supplies. The value of that water would then be measured as the additional amount consumers might pay for that water, plus consumer surplus, or $1,908 per AF. This figure is applied to 750 AF to estimate the annual benefit for the combination of Santa Clara, Bayard and Silver City.

GCC Municipal Conservation. This proposal will produce water savings in the four-county region of an estimated 1,150 AF by 2050, as described in Section 2. Typically, conservation savings are viewed as the avoided cost of the next increment of water supply development. Although groundwater has been and will continue to be used in SW New Mexico, it is not considered a sustainable, long term base supply to meet growth. Therefore, HE assumed that the avoided cost will be reduced requirement for the SWRWS. That amount is assumed to be the cost of the SWRWS proposal, or about $2,970 per AF.

Environmental Benefits

The SWRWS Proposal (Proposals 1, 2, 3a) includes 1,000 AF of water available for environmental purposes in Grant County. According to the Tier 2 proposal submitted by the proponents, this water will be dedicated to supporting and improving riparian and aquatic habitat for fish and other aquatic species in the Gila River. The water designated for environmental purposes would be used to maintain river flows during dry periods. This type of economic benefit does not result in monetary expenditures, but economists recognize that these types of flows have a value. In this instance, the economic value of Gila River environmental water flows was estimated from other water transactions for which the purpose was support of various fish populations:

- *Silvery minnow in New Mexico* – Between 1997 and 2011, the Bureau of Reclamation paid a total of $29 million for 428,284 acre-feet (about $68 per AF) of excess San Juan-Chama water to support the endangered silvery minnow during dry periods.[36]

  Most recently in 2013, the Bureau agreed to lease 40,000 acre-feet of water from the Albuquerque Bernalillo County Water Utility Authority for $100 an acre-foot to insure streamflow for the silvery minnow.[37]

[35] The 2009 Water Sales Agreement between Hurley and Freeport-McMoRan was obtained from the ISC staff in September 2014.
[36] Fleck, J. (January 24, 2011). Sipping the Surplus. *Albuquerque Journal.* Retrieved from http://www.abqjournal.com.
[37] Domrzalski, D. (June 4, 2013) Why federal officials got a bargain on water leased from ABCWUA. Retrieved from http://www.bizjournals.com/albuquerque/news/2013/06/04/why-feds-got-bargain-abcwua-water-lease.html.

- *Colorado Pikeminnow* – In 2006, the Bureau supported Upper Colorado River Endangered Fish Recovery Program (Recovery Program) contributed $13.5 million to the expansion of Elkhead Reservoir in the Yampa River Basin of Colorado in exchange for an annual allowance of 5,000 AF of water to be released when necessary to protect the Colorado pikeminnow and the razorback sucker. Assuming 20 years of water releases at that amount, the Recovery Program paid an average of $135 per AF. [38]

- *In-stream Flows* – A study concerning environmental water markets, examined water exchanges for in-stream flows in the western U.S. between 1987 and 2007. Over the 20 year period of the study, more than 10 million acre-feet of water were exchanged for more than half a billion dollars, or about $50 per acre-foot (2007 dollars). In 2007, the last year for which data was provided, about 1 million acre-feet of water was exchanged for about $90 million, or $90 per acre-feet. These exchanges included private parties and state and federal agencies for short-term, long-term and permanent water transfers. [39]

In order to more accurately compare these data points, the per AF dollar amounts reflected in these transactions were adjusted as necessary to 2013 dollars using the US Bureau of Reclamation Construction Cost Trends index.[40] Applicable data points included the 2013 transaction for Silvery minnow in New Mexico, the transaction to support Colorado Pikeminnow and the 2007 transaction for in-stream flows. Applicable data points ranged from $100 per AF up to $169 per AF; these data points were averaged to estimate the value of environmental releases for the purposes of this study, or $125 per AF per year. That value amount was then applied to the 1,000 AF of environmental water available to the Gila River as part of the SWRWS Proposal.

Cost Calculations

The proposal costs, which included initial capital costs, annual operating costs, and replacement costs, were provided in Section 3. These were all expressed in 2013 dollars. Similar to the benefits, these costs were placed in a schedule over time and discounted back to present value as described below.

It is possible that certain proposals will also produce negative impacts which might carry negative economic aspects. Since this is a benefit-cost analysis and not an impact analysis, such negative economic aspects are not considered here. Once all impacts of a proposal are more thoroughly evaluated, these negative aspects might be reconsidered for a refined benefit-cost study.

[38] Elkhead Factsheet. September 2006. http://www.crwcd.org/media/uploads/Elkhead_fact_sheet_9_06.pdf.
[39] Scarborough, B. *Environmental Water Markets: Restoring Streams Through Trade.* PERC Policy Series No. 46. 2010.
[40] US Bureau of Reclamation, Construction Cost Trends, http://www.usbr.gov/pmts/estimate/cost_trend.html.

Discount Rate

Even though benefits and costs are expressed in 2013 dollars, removing the effects of inflation, those benefits and costs take place at different points in the future. Economists have long recognized that a dollar at some distant point in the future is worth less than a dollar one would receive next year. To bring future dollars into equivalency with current dollars, a real discount rate (exclusive of inflation) has been derived and applied in this benefit-cost analysis.

The Federal government recently determined that the discount rate for water projects should be set at 3.75 percent.[41] However, this discount rate is applied to future costs and benefits that are inflated, whereas this BC study has already adjusted all dollar figures to 2013 constant dollars. Therefore, this BC study must utilize a discount rate which excludes inflation. In fact such a discount rate does exist; the U.S. Treasury sells a certain type of bond, Treasury Inflation-Protected Securities (TIPS), which rewards the owner with an interest rate, plus the annual inflation rate. That interest rate, segregated from inflation, is known as the "real" interest rate and will serve as our discount rate for this study.

The determination of a real discount rate in this instance is equal to the TIPS bond rate.[42] These US bonds offer an interest rate above the prevailing inflation rate. As of September 26, 2014, this rate was 1.09 percent for a 30-year term. Since AWSA monies originally came from the Federal government, this Federal interest rate provides a preferred basis for the discount rate. Given study time horizon of 2050, long-term bonds are the appropriate term.

[41] https://www.federalregister.gov/articles/2013/03/18/2013-06177/change-in-discount-rate-for-water-resources-planning.

[42] Daily Treasury Real Yield Curve Rates. US Department of the Treasury. www.treasury.gov Accessed September, 2014.

Section 6. Benefits and Costs of the AWSA Proposals

This section of the report presents the results of the benefit-cost analysis conducted for each of the AWSA proposals. The calculations of benefits are based upon the information set forth in Section 2, and the calculations of cost are based on the data provided in Section 3. The methods and assumptions for deriving the benefits and costs are found in Section 4. The estimation of benefits and costs is accomplished by simply applying the proposal-specific data to the methods and assumptions.

In addition to the benefits directly related to project operation and water use, the pre-construction (design, planning, permitting) and construction activities included in each of these proposals would result in economic stimulus throughout the state. Since the AWSA proposals would be funded with Federal monies (which eventually become State funds), supplemented by borrowings, the construction expenditures would be "new money" to the southwest region of New Mexico and the State itself. Hence, the expenditures of these monies would produce a benefit in the form of economic stimulus.

The purchase of materials and supplies, as well as labor, may occur outside of the four county region of Catron, Grant, Hidalgo and Luna counties, but are assumed to occur within the state of New Mexico.

For each proposal, the following information is provided: (1) estimates of the proposal benefits, by benefit category; (2) the assumptions of capital, operating and other proposal costs; and (3) a calculation of the net benefits of the proposal and the benefit-cost ratio. The benefit-cost ratio is a comparison of total discounted benefits to total discounted costs over the entire proposal period. A ratio of 1.0 indicates that the benefits are equal to the costs, a ratio greater than one means that benefits outweigh costs and a ratio of less than one reflects a proposal for which costs outweigh benefits.

All dollars in this section are expressed in 2013 constant dollars.

Southwest New Mexico Regional Water Supply (SWRWS) (Proposals 1, 2, 3a)

As described in Section 2, the construction and operation of the SWRWS would result in a number of benefits, including up to 4,000 AF of water available to agriculture, up to 5,000 AF of water for municipal use and up to 1,000 AF of water for environmental purposes (maintaining Gila river flows for aquatic species), as well as the creation of three recreational reservoirs.[43] The total estimated benefits of the SWRWS proposal amount to about $733.4 million through 2050, as shown in Table 6-1.

[43] A fourth reservoir, Dix Reservoir, would also be developed as part of this proposal; however, recreation will not be a component of that reservoir.

Table 6-1.
Estimated Benefits of the Southwest NM Regional Water Supply Proposal

Benefit Category	Time Period	Total Benefit Amount
Economic Stimulus of Construction	2014 - 2033	$480,231,000
Agricultural	2034 - 2050	$3,616,000
Environmental	2034 - 2050	$1,560,000
Municipal	2039 - 2050	$63,818,000
Recreational	2035 - 2050	$184,209,000
Total		**$733,434,000**

Note: All benefit estimates have been discounted back to 2013 present value dollars.
Source: Harvey Economics.

After than the construction stimulus, recreational benefits are by far the largest of the applicable benefit categories for the SWRWS. The $184.2 million of recreational benefits are the result of spending by visitors at the three recreational reservoirs and visitors consumer surplus values.[44] The $63.8 million of municipal benefits accrue to Grant and Luna counties. Agricultural benefits in Grant and Hidalgo Counties ($3.6 million) and environmental benefits to Grant County ($1.6 million) are relatively small benefits of the SWRWS proposal.

Total costs of the SWRWS proposal are presented in Table 6-2. Including capital expenditures, annual O&M expenditures and annual pre-banking costs, the total cost of the proposal amounts to about $423.3M through 2050.

Table 6-2.
Costs of the Southwest NM Regional Water Supply Proposal

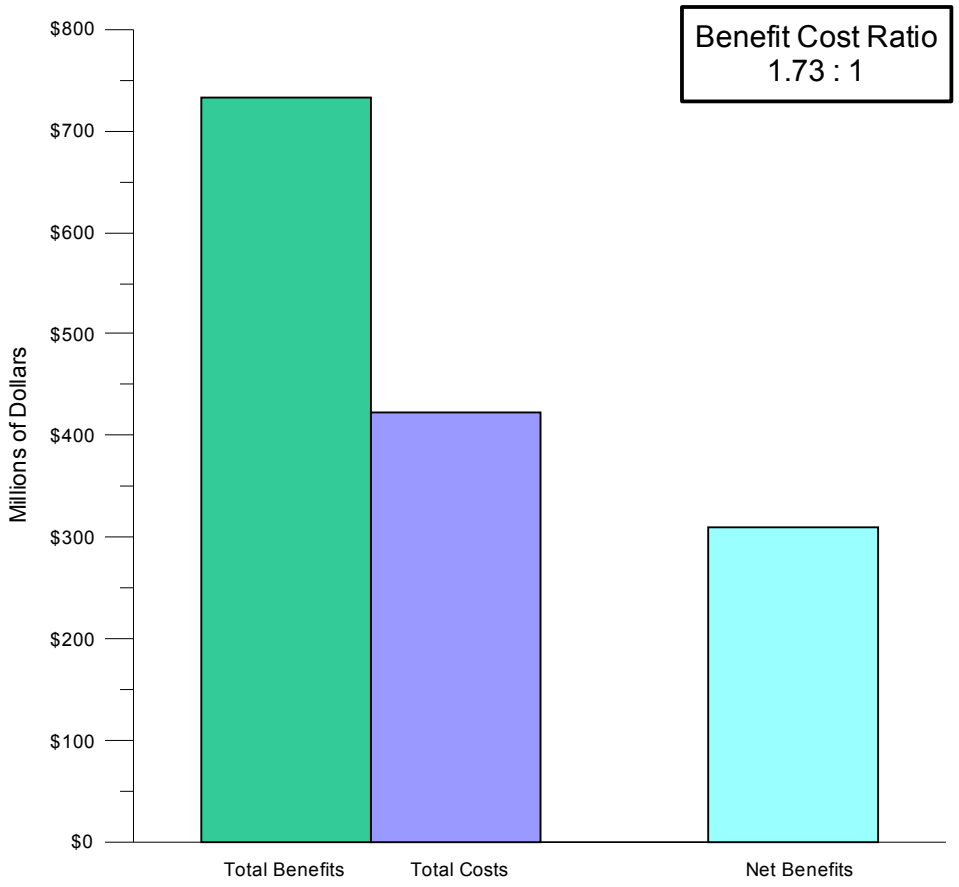
Cost Category	Time Period	Total Cost Amount
Capital Expenditures	2014 - 2033	$368,451,000
O&M Expenditures	2029 - 2050	$36,840,000
Other Expenditures	2027 - 2050	$18,014,000
Total		**$423,305,000**

Note: All costs have been discounted back to 2013 present value dollars.
Source: Harvey Economics.

The estimated benefits of the SWRWS proposal outweigh the total proposal costs; net benefits of this proposal amount to about $310.1 million. The benefit-cost ratio of the SWRWS proposal is 1.73:1. Figure 6-1 illustrates the total benefits, total costs and the benefit-cost ratio of the SWRWS proposal.

[44] Estimates of recreational benefits include the direct and secondary effects of visitor spending. Secondary (indirect and induced) effects are defined in Section 4. Consumer surplus is also discussed in Section 4; it is the value of a visitor's experience, above and beyond actual expenditures.

Figure 6-1.
Net Benefits and Benefit-Cost Ratio of the Southwest NM Regional Water Supply Proposal



Note: All benefits and costs have been discounted back to 2013 present value dollars.
Source: Harvey Economics.

GBIC Irrigation Diversion Structure (Proposal 3b)

The GBIC Irrigation Diversion Structure proposal includes improvements that would result in increased water flows to irrigators (estimated at about 224 AF per year), as well as reduced annual operations and maintenance costs. The benefits of this proposal are focused on the agricultural sector. In addition to the construction period stimulus ($2.2 million), the GBIC proposal includes about $584,000 of benefits to irrigators through 2050. The total quantified benefits of this proposal are about $2.7 million; detail is provided in Table 6-3.

Table 6-3.
Estimated Benefits of the GBIC Irrigation Diversion Structure Proposal

Benefit Category	Time Period	Total Benefit Amount
Economic Stimulus of Construction	2015 - 2019	$2,159,000
Agricultural	2020 - 2050	$584,000
Environmental	2020 - 2050	Qualitative
Municipal	NA	$0
Recreational	NA	$0
Total		**$2,743,000**

Notes: (1) This proposal will result in qualitative environmental benefits associated with riparian are preservation.
(2) All benefit estimates have been discounted back to 2013 present value dollars.

Source: Harvey Economics,

The GBIC proposal would also reduce the disturbance of riparian areas with the completion of the new, stable structures. Additional proposal benefits include reduced disturbance to riparian areas and local waterways, resulting in the preservation of riparian vegetation, riparian habitat and aquatic habitat. Since the area affected and the frequency of disturbance are unknown, this benefit cannot be quantified, but is no less important than the quantified benefits.

Total costs of the GBIC proposal include about $1.7 million in capital expenditures and about another $880,000 in O&M costs through 2050 for a total of $2.5 million, as shown in Table 6-4.

Table 6-4.
Costs of the GBIC Irrigation Diversion Structure Proposal

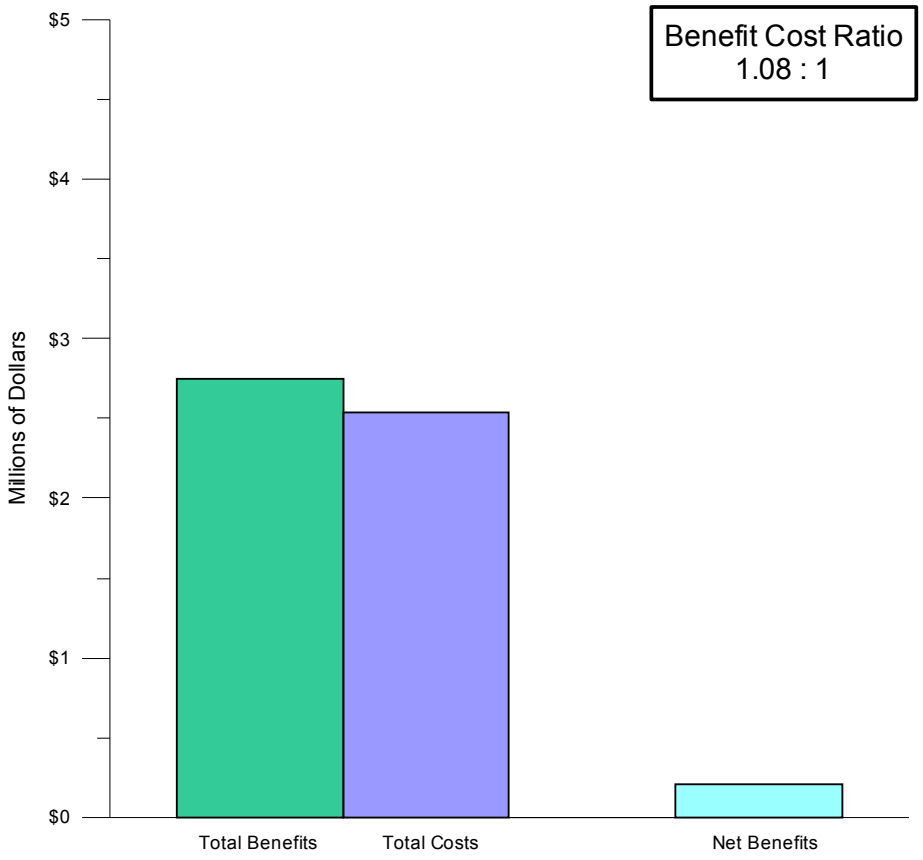
Cost Category	Time Period	Total Cost Amount
Capital Expenditures	2015 - 2019	$1,656,000
O&M Expenditures	2020 - 2050	$878,000
Other Expenditures	NA	$0
Total		**$2,534,000**

Note: All costs have been discounted back to 2013 present value dollars.

Source: Harvey Economics.

Total estimated benefits of the GBIC proposal are slightly greater than total proposal costs. Net benefits of this proposal are about $208,000. The GBIC proposal has a benefit-cost ratio of 1.08:1. Figure 6-2 illustrates the total benefits, total costs and the benefit-cost ratio of the GBIC proposal.

Figure 6-2.
Net Benefits and Benefit-Cost Ratio of the GBIC Irrigation Diversion Structure Proposal



Note: All benefits and costs have been discounted back to 2013 present value dollars.
Source: Harvey Economics.

Deming Effluent Reuse (Proposal 4)

The Deming Effluent Reuse proposal would result in reduced groundwater pumping for the City of Deming, in the amount of 410 AF per year. That water may eventually be used to meet a portion of the City's other municipal demands, i.e. future residential, commercial or industrial water demands. The benefits of the Deming proposal are municipal in nature. Total proposal benefits are estimated to be about $36.2 million through 2050, including municipal benefits ($31.0 million) and construction stimulus ($5.2 million). Table 6-5 offers information about the benefits of the Deming proposal.

Table 6-5.
Estimated Benefits of the Deming Effluent Reuse Proposal

Benefit Category	Time Period	Total Benefit Amount
Economic Stimulus of Construction	2016 - 2017	$5,162,000
Agricultural	NA	$0
Environmental	NA	$0
Municipal	2018 - 2050	$30,988,000
Recreational	NA	$0
Total		**$36,150,000**

Note: All benefit estimates have been discounted back to 2013 present value dollars.
Source: Harvey Economics,

The Deming proposal's municipal benefits comprise the majority of total benefits due in part to the number of years in which the reduced groundwater pumping would occur and in part to the estimated value of municipal water for the City, an avoided cost of acquiring other supplies. The construction period is relatively short (about 18 months) and municipal benefits would occur each year for a period of 33 years.

Total proposal costs amount to about $5.9 million, including capital expenditures and annual O&M costs. These costs are displayed in Table 6-6.

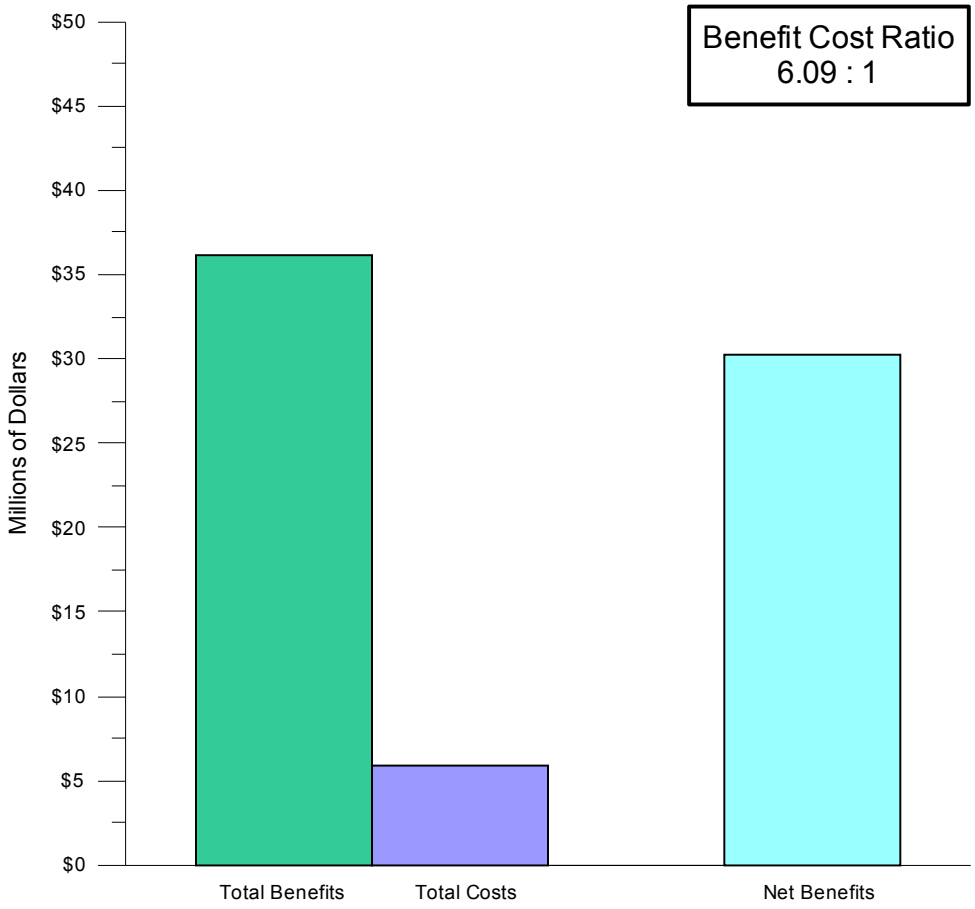
Table 6-6.
Costs of the Deming Effluent Reuse Proposal

Cost Category	Time Period	Total Cost Amount
Capital Expenditures	2016 - 2017	$3,960,000
O&M Expenditures	2018 - 2050	$1,976,000
Other Expenditures	NA	$0
Total		**$5,936,000**

Note: All costs have been discounted back to 2013 present value dollars.
Source: Harvey Economics.

The benefits of Deming's proposal are about six times greater than the total costs, as evidenced by the benefit-cost ratio of 6.09:1. Net benefits of the proposal amount to about $30.2 million. The total benefits, total costs and the benefit-cost ratio of the Deming Effluent Reuse proposal are depicted in Figure 6-3.

Figure 6-3.
Net Benefits and Benefit-Cost Ratio of the Deming Effluent Reuse Proposal



Note: All benefits and costs have been discounted back to 2013 present value dollars.
Source: Harvey Economics.

Grant County Water Commission Wellfield and Pipeline (Proposal 5)

The Grant County Wellfield and Pipeline proposal would result in the eventual development of 943 AF of water available to the Town of Hurley, the City of Bayard, the Village of Santa Clara and the Town of Silver City. That water would be used for a variety of municipal purposes within those communities. In addition to the construction stimulus, the benefits of the Wellfield and Pipeline proposal are municipal in nature. Total proposal benefits amount to an estimated $38.6 million, as presented in Table 6-7.

Table 6-7.
Estimated Benefits of the Wellfield and Pipeline Proposal

Benefit Category	Time Period	Total Benefit Amount
Economic Stimulus of Construction	2015 -2017	$20,758,000
Agricultural	NA	$0
Environmental	NA	$0
Municipal	2018 -2050	$17,889,000
Recreational	NA	$0
Total		**$38,647,000**

Note: All benefit estimates have been discounted back to 2013 present value dollars.
Source: Harvey Economics.

The municipal benefits of the Wellfield and Pipeline proposal depend on the amount of water available to the four communities in each year through 2050 (the new water supplies ramp up over time), as well as the value of that water to each of those communities. For example, the benefit of the water to Hurley is based on the avoided purchase of water from a private company, while the value of municipal water to the other communities is based on an estimate of retail water value and additional consumer surplus.

Table 6-8 includes information about the costs of the Wellfield and Pipeline proposal. Capital expenditures are estimated to be about $15.9 million while total O&M costs add up to about $13.4 million through 2050. Total proposal costs are $29.3 million.

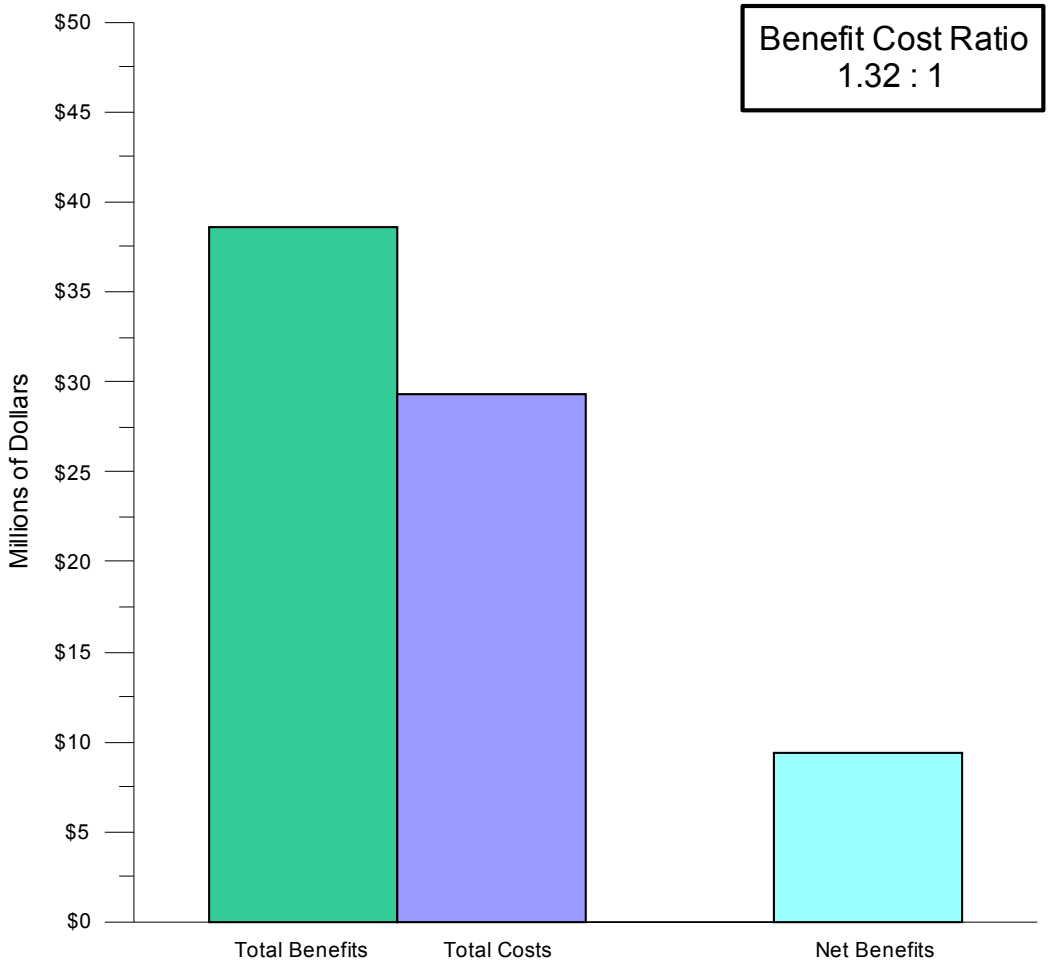
Table 6-8.
Costs of the Wellfield and Pipeline Proposal

Cost Category	Time Period	Total Cost Amount
Capital Expenditures	2015 -2017	$15,926,000
O&M Expenditures	2018 -2050	$13,351,000
Other Expenditures	NA	$0
Total		**$29,277,000**

Note: All costs have been discounted back to 2013 present value dollars.
Source: Harvey Economics.

The benefits of the Wellfield and Pipeline proposal are greater than the total proposal costs; the proposal has a benefit-cost ratio of 1.32:1. Net benefits of the proposal are about $9.4 million. The total benefits, total costs and the benefit-cost ratio of the Wellfield and Pipeline proposal are illustrated in Figure 6-4.

Figure 6-4.
Net Benefits and Benefit-cost Ratio of the Wellfield and Pipeline Proposal



Note: All benefits and costs have been discounted back to 2013 present value dollars.
Source: Harvey Economics.

Grant County Reservoir (Proposal 6)

The Grant County Reservoir proposal includes the development of one reservoir for the sole purpose of creating additional recreational opportunities in the region. The Grant County Reservoir would be about 125 surface acres in size and would offer wake-less boating in addition to a number of other non-motorized recreational activities. Visitation to the reservoir is expected to ramp up over time between 2035 and 2050. Total proposal benefits amount to about $63.5 million and include both the construction stimulus ($19.3 million) and recreational benefits ($44.1 million). Table 6-9 provides a summary of the benefits of the Grant County Reservoir proposal.

Table 6-9.
Estimated Benefits of the Grant County Reservoir Proposal

Benefit Category	Time Period	Total Benefit Amount
Economic Stimulus of Construction	2025 - 2034	$19,344,000
Agricultural	NA	$0
Environmental	NA	$0
Municipal	NA	$0
Recreational	2035 - 2050	$44,146,000
Total		**$63,490,000**

Note: All benefit estimates have been discounted back to 2013 present value dollars.
Source: Harvey Economics.

Table 6-10 includes information about the total capital and O&M costs of the Grant County Reservoir proposal. Together, capital and O&M costs amount to a total of about $16.1 million.

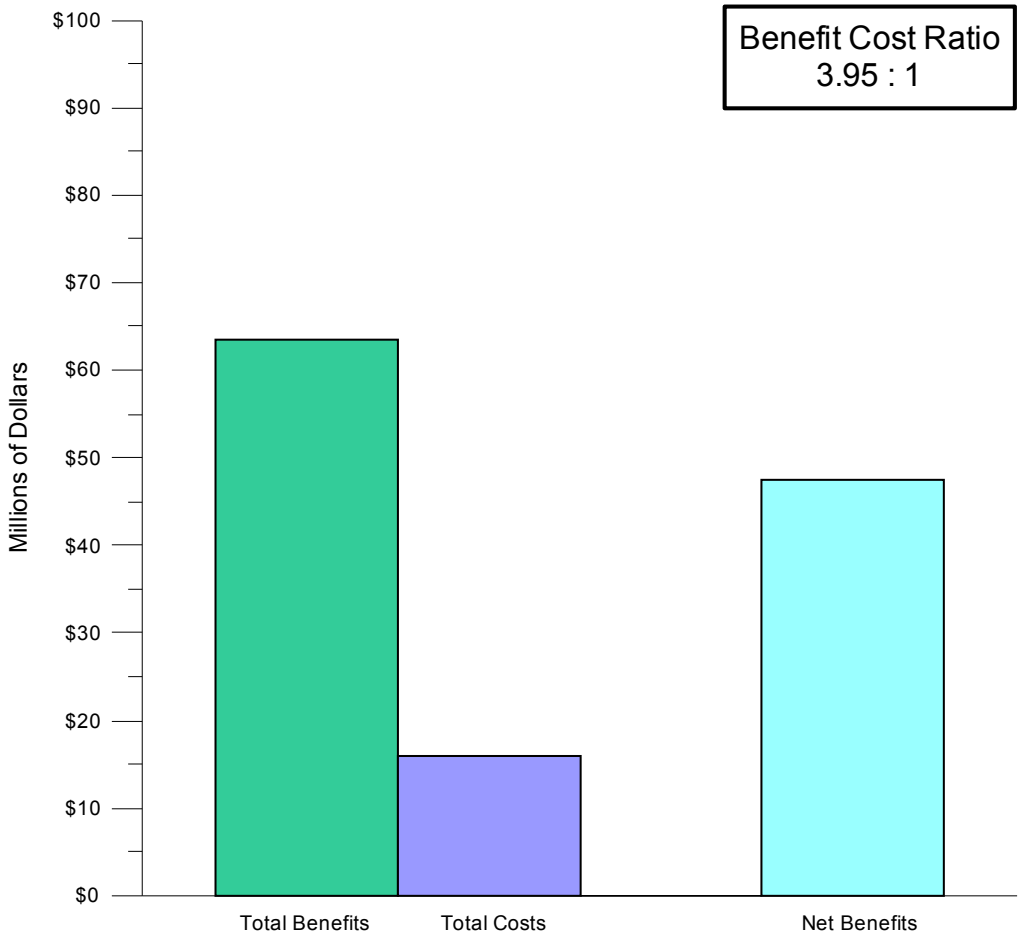
Table 6-10.
Costs of the Grant County Reservoir Proposal

Cost Category	Time Period	Total Cost Amount
Capital Expenditures	2025 - 2034	$14,842,000
O&M Expenditures	2035 - 2050	$1,232,000
Other Expenditures	NA	$0
Total		**$16,074,000**

Note: All costs have been discounted back to 2013 present value dollars.
Source: Harvey Economics.

The Grant County Reservoir proposal has a benefit-cost ratio of 3.95:1, indicating that the benefits outweigh the costs by about a factor of 4. The proposal's net benefits amount to about $47.4 million. Figure 6-5 depicts the proposal's benefits, costs and benefit-cost ratio.

Figure 6-5.
Net Benefits and Benefit-cost Ratio of the Grant County Reservoir Proposal



Note: All benefits and costs have been discounted back to 2013 present value dollars.
Source: Harvey Economics.

Catron County Ditch Improvements (Proposal 11b)

The construction and implementation of the Catron County Ditch Improvements proposal would result in increased irrigation efficiency as well as lower annual O&M costs related to the maintenance of the irrigation system. There will be a an assumed 25 percent increase of on-farm efficiency/crop yield and a reduction of $5,000 in O&M costs per ditch per year or $50,000 per year for all ten ditches. The total estimated benefit of the Catron County Ditch Improvements proposal amounts to about $11.4 million through 2050, as shown in Table 6-11.

Table 6-11.
Estimated Benefits of the Catron County Ditch Improvements Proposal

Benefit Category	Time Period	Total Benefit Amount
Economic Stimulus of Construction	2017-2019	$8,191,000
Agricultural	2020-2050	$3,172,000
Environmental	NA	$0
Municipal	NA	$0
Recreational	NA	$0
Total		**$11,363,000**

Note: All benefit estimates have been discounted back to 2013 present value dollars.
Source: Harvey Economics,

Besides the construction stimulus, all other benefits related to Catron County Ditch Improvements are agricultural in nature.

Total costs of the Catron County Ditch Improvements proposal are presented in Table 6-12. Between capital expenditures and annual O&M expenditures, the total cost of the proposal amounts to about $14.5 million through 2050.

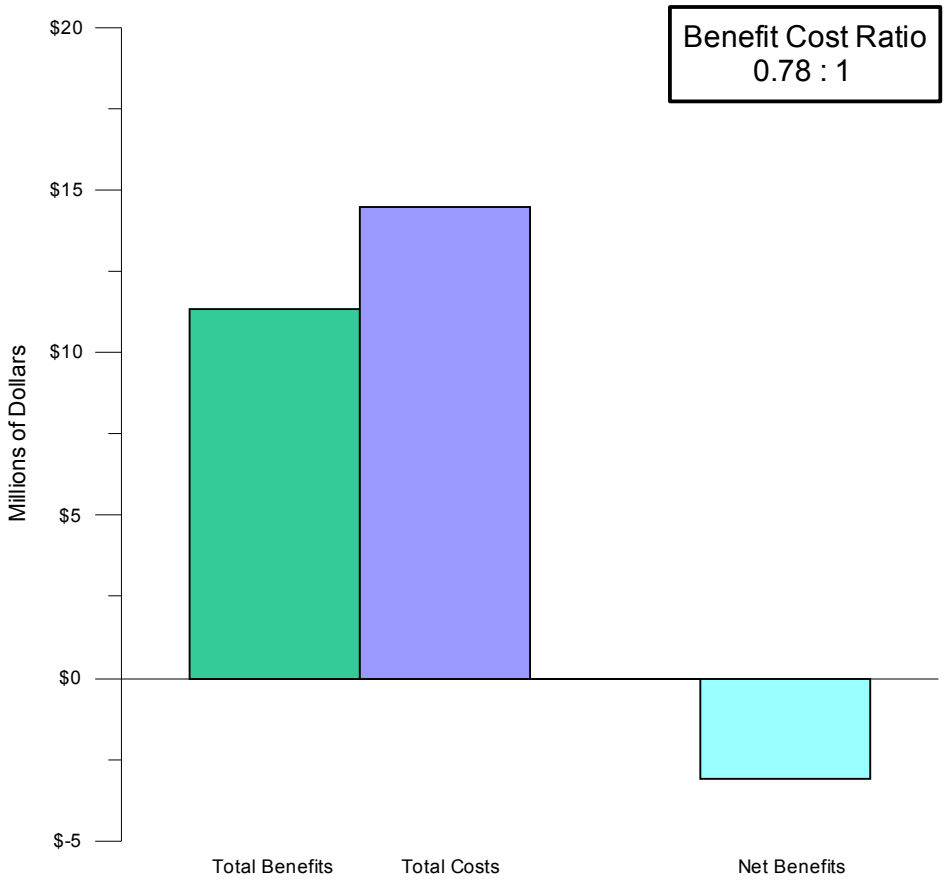
Table 6-12.
Costs of the Catron County Ditch Improvements Proposal

Cost Category	Time Period	Total Cost Amount
Capital Expenditures	2017-2019	$6,284,000
O&M Expenditures	2020-2050	$8,200,000
Other Expenditures	NA	$0
Total		**$14,484,000**

Note: All costs have been discounted back to 2013 present value dollars.
Source: Harvey Economics.

Estimated benefits of the Catron County Ditch Improvements proposal are less than the assumed proposal costs, resulting in a net cost of about $3.1 million. The benefit-cost ratio of this proposal is 0.78. These calculations are illustrated in Figure 6-6.

Figure 6-6.
Net Benefits and Benefit-cost Ratio of the Catron County Ditch Improvements Proposal



Note: All benefits and costs have been discounted back to 2013 present value dollars.
Source: Harvey Economics.

1892 Luna Irrigation Ditch Improvements (Proposal 12)

Completion of the Luna Ditch Improvements proposal would result in reduced O&M costs, avoided loss of supply for approximately 6 weeks annually, and avoided reconstruction costs. The reduced O&M costs of $12,000 per year relate to the servicing of unlined ditches and re-establishing diversion points. The avoided loss of supply will amount to an estimated 20 percent of diversions or about $7,600 per year, and the reconstruction that occurs three times per year would be avoided completely with the improvements leading to a savings of about $5,300 per year. The total estimated benefit of the Luna Ditch Improvements proposal amounts to about $2.4 million through 2050, as shown in Table 6-13.

Table 6-13.
Estimated Benefits of the Luna Ditch Improvements Proposal

Benefit Category	Time Period	Total Benefit Amount
Economic Stimulus of Construction	2016-2018	$1,779,000
Agricultural	2019-2050	$635,000
Environmental	2019-2050	Qualitative
Municipal	NA	$0
Recreational	NA	$0
Total		**$2,414,000**

Note: 1) This proposal will result in qualitative environmental benefits associated with riparian are preservation.
(2) All benefit estimates have been discounted back to 2013 present value dollars.

Source: Harvey Economics,

Besides the construction stimulus, other Luna Ditch Improvements benefits are agricultural and environmental in nature. The Luna Ditch proposal would also reduce the disturbance of riparian areas with the completion of the new, stable structures. Additional proposal benefits include reduced disturbance to riparian areas and local waterways, resulting in the preservation of riparian vegetation, riparian habitat and aquatic habitat. Since the area affected and the frequency of disturbance are unknown, this benefit cannot be quantified, but is no less important than the quantified benefits.

Total costs of the Luna Ditch Improvements proposal are presented in Table 6-14. Between capital expenditures and annual O&M expenditures, the total cost of the proposal amounts to about $3.2 million through 2050.

Table 6-14.
Costs of the Luna Ditch Improvements Proposal

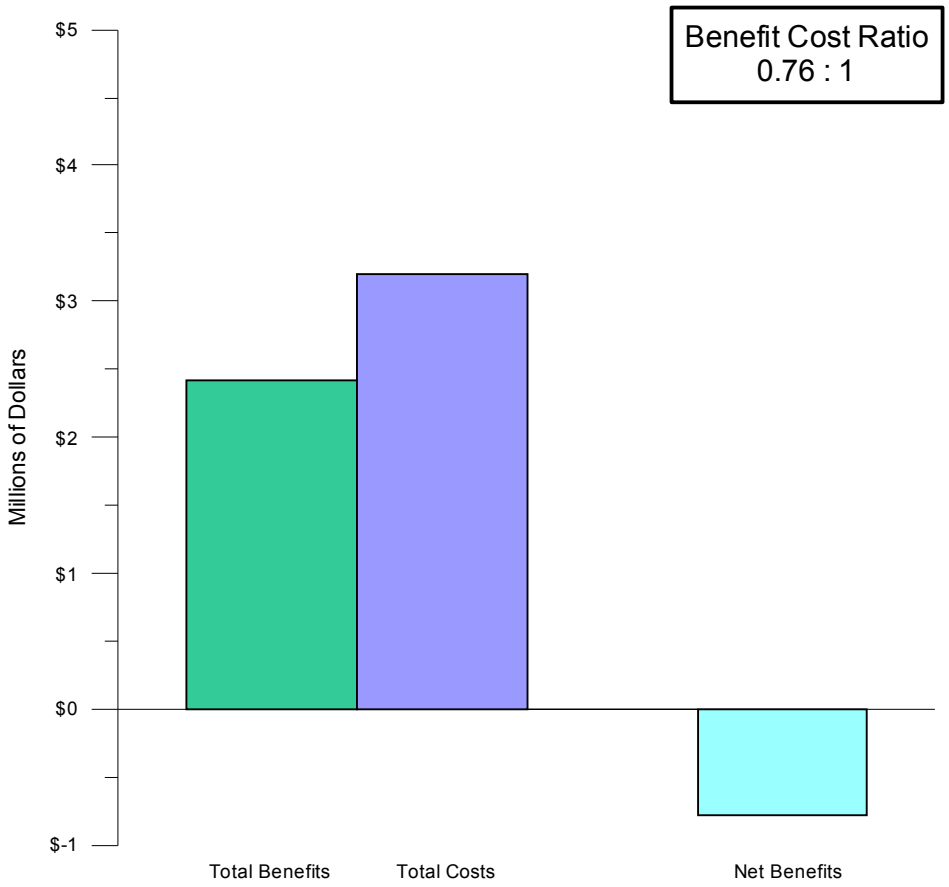
Cost Category	Time Period	Total Cost Amount
Capital Expenditures	2016-2018	$1,365,000
O&M Expenditures	2019-2050	$1,832,000
Other Expenditures	NA	$0
Total		**$3,197,000**

Note: All costs have been discounted back to 2013 present value dollars.

Source: Harvey Economics.

Luna Ditch Improvements proposal benefits are less than the assumed proposal costs, resulting in a net cost of about $0.8 million. The benefit-cost ratio of this proposal is 0.76:1. These calculations are illustrated in Figure 6-7.

Figure 6.7.
Net Benefits and Benefit-cost Ratio of the Luna Ditch Improvements Proposal



Note: All benefits and costs have been discounted back to 2013 present value dollars.
Source: Harvey Economics.

Sunset/ New Model Ditch Improvements (Proposal 13)

Implementation of the Sunset/New Model Ditch Improvements proposal would result in avoided conveyance loss and avoided costs related to maintenance and reconstruction of flood-damaged sections. Conveyance losses make up an estimated 20 percent of the water that is diverted from the river. Ditch reconstruction takes place up to two times per year and costs $1,000 each time. The total estimated benefit of the Sunset/New Model Ditch Improvements proposal amounts to about $18.9 million through 2050, as shown in Table 6-15.

Table 6-15.
Estimated Benefits of the Sunset/ New Model Ditch Improvements Proposal

Benefit Category	Time Period	Total Benefit Amount
Economic Stimulus of Construction	2017-2018	$15,939,000
Agricultural	2019-2050	$2,983,000
Municipal	NA	$0
Recreational	NA	$0
Total		**$18,922,000**

Note: (2) All benefit estimates have been discounted back to 2013 present value dollars.
Source: Harvey Economics,

Besides the construction stimulus, other Sunset/New Model Ditch Improvements benefits fall under the agricultural category. Total costs of the Sunset/New Model Ditch Improvements proposal are presented in Table 6-16. Between capital expenditures and annual O&M expenditures, the total cost of the proposal amounts to about $28.6 million through 2050.

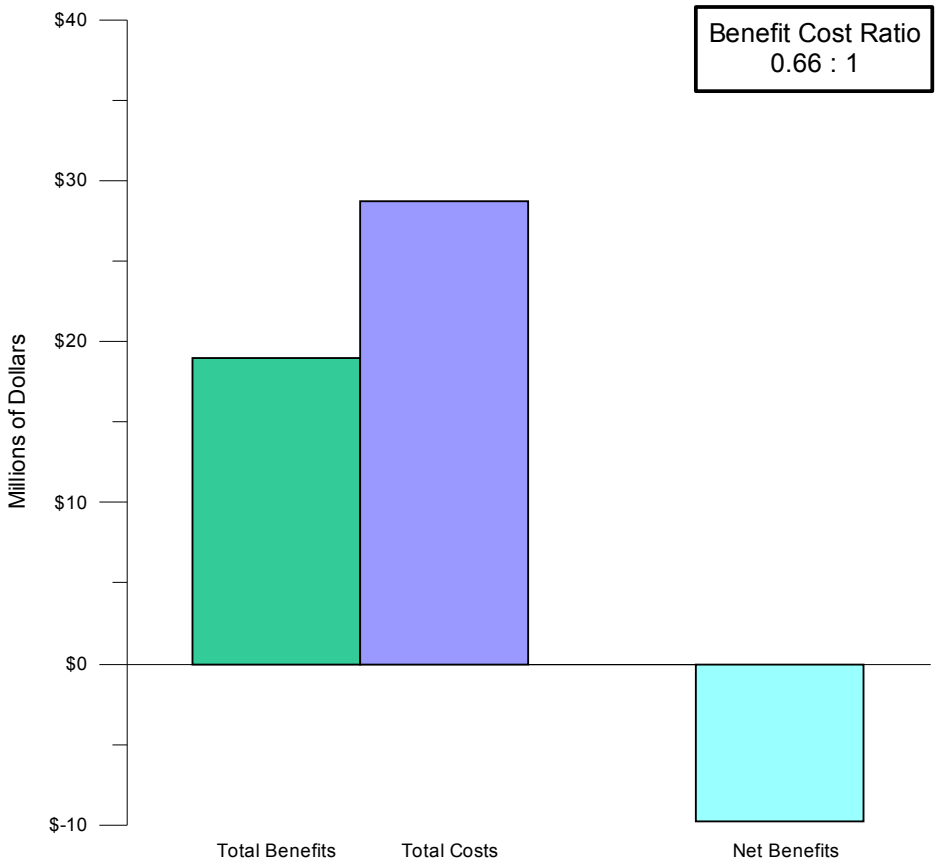
Table 6-16.
Costs of the Sunset/ New Model Ditch Improvements Proposal

Cost Category	Time Period	Total Cost Amount
Capital Expenditures	2017-2018	$12,229,000
O&M Expenditures	2019-2050	$16,433,000
Other Expenditures	NA	$0
Total		**$28,662,000**

Note: All costs have been discounted back to 2013 present value dollars.
Source: Harvey Economics.

Sunset/New Model Ditch Improvements proposal benefits are less than the assumed proposal costs, resulting in a net cost of about $9.7 million. The benefit-cost ratio of this proposal is 0.66:1. These calculations are illustrated in Figure 6-8.

Figure 6-8.
Net Benefits and Benefit-cost Ratio of the Sunset/ New Model Ditch Improvements Proposal



Note: All benefits and costs have been discounted back to 2013 present value dollars.
Source: Harvey Economics.

Pleasanton East-Side Ditch Improvements (Proposal 14)

If the Pleasanton East-Side Ditch Improvements proposal came to fruition, the benefit would be an assumed 9 percent increase in irrigation and on-farm efficiency. The total estimated benefit of the Pleasanton East-Side Ditch Improvements proposal amounts to about $4.2 million through 2050, as shown in Table 6-17.

Table 6-17.
Estimated Benefits of the Pleasanton East-Side Ditch Improvements Proposal

Benefit Category	Time Period	Total Benefit Amount
Economic Stimulus of Construction	2017-2020	$3,108,000
Agricultural	2021-2050	$1,087,000
Environmental	NA	$0
Municipal	NA	$0
Recreational	NA	$0
Total		**$4,195,000**

Note: All benefit estimates have been discounted back to 2013 present value dollars.
Source: Harvey Economics,

Besides the construction stimulus, Pleasanton East-Side Ditch Improvements benefits are agricultural in nature.

Total costs of the Pleasanton East-Side Ditch Improvements proposal are presented in Table 6-18. Between capital expenditures and annual O&M expenditures, the total cost of the proposal amounts to about $5.4 million through 2050.

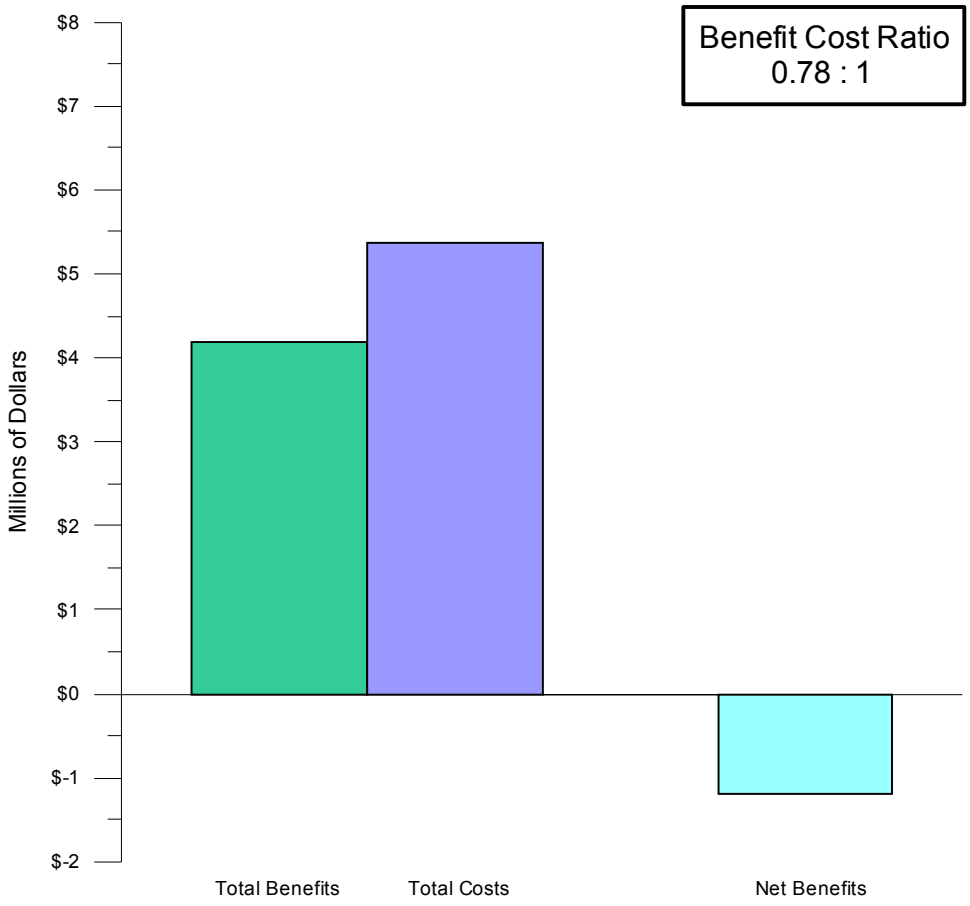
Table 6-18.
Costs of the Pleasanton East-Side Ditch Improvements Proposal

Cost Category	Time Period	Total Cost Amount
Capital Expenditures	2017-2020	$2,385,000
O&M Expenditures	2021-2050	$2,994,000
Other Expenditures	NA	$0
Total		**$5,379,000**

Note: All costs have been discounted back to 2013 present value dollars.
Source: Harvey Economics.

Pleasanton East-Side Ditch Improvements proposal benefits are less than the assumed proposal costs, resulting in a net cost of about $1.2 million. The benefit-cost ratio of this proposal is 0.78:1. These calculations are illustrated in Figure 6-9.

Table 6-9.
Net Benefits and Benefit-cost Ratio of the Pleasanton East-Side Ditch Improvements Proposal



Note: All benefits and costs have been discounted back to 2013 present value dollars.
Source: Harvey Economics.

Municipal Conservation for Southwest New Mexico (Proposal 15)

Implementation of the Municipal Conservation for Southwest New Mexico proposal would lead to a municipal benefit of water saved each year the programs were in place. Water savings varies from year to year increasing over the program's life as additional participants are added over time. The total estimated benefit of the Municipal Conservation for Southwest New Mexico proposal amounts to about $75.7 million through 2050, as shown in Table 6-19.

Table 6-19.
Estimated Benefits of the Municipal Conservation Proposal

Benefit Category	Time Period	Total Benefit Amount
Economic Stimulus of Construction	2015-2020	$0
Agricultural	NA	$0
Environmental	NA	$0
Municipal	2016-2050	$75,749,000
Recreational	NA	$0
Total		**$75,749,000**

Note: All benefit estimates have been discounted back to 2013 present value dollars.
Source: Harvey Economics,

Total costs of the Municipal Conservation for Southwest New Mexico proposal are presented in Table 6-20. Combining capital expenditures and annual O&M expenditures leads to a total proposal cost of about $10.4 million through 2050.

Table 6-20.
Costs of the Municipal Conservation Proposal

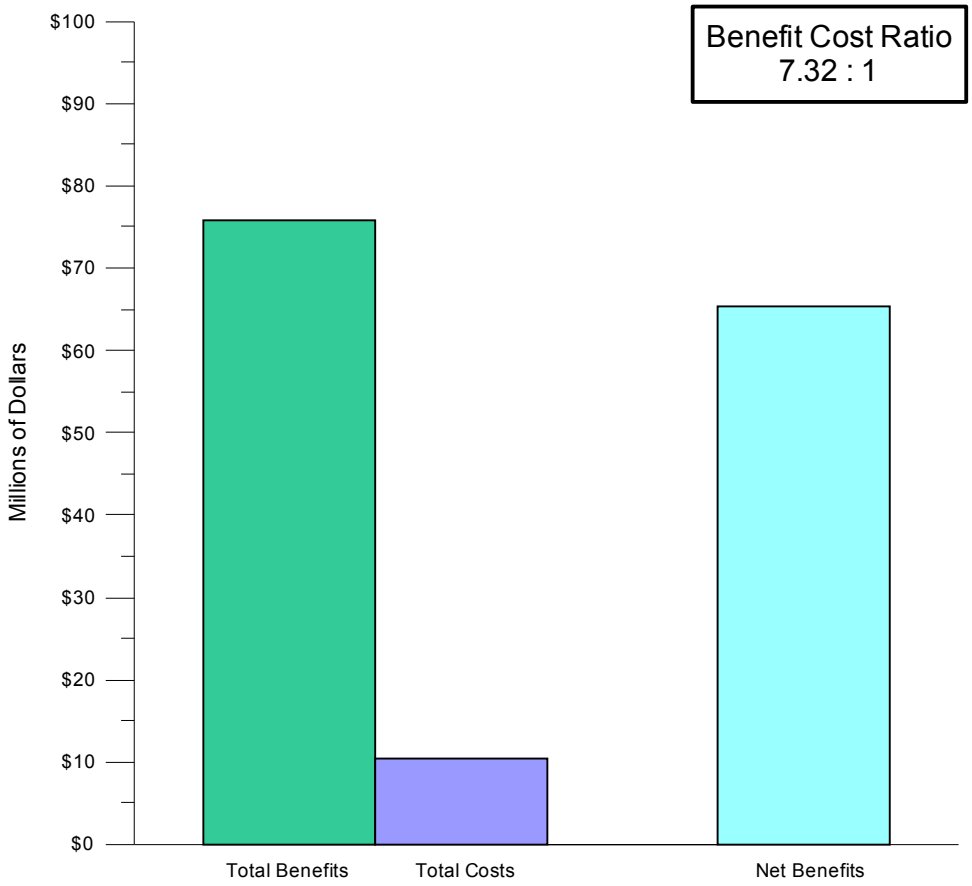
Cost Category	Time Period	Total Cost Amount
Capital Expenditures	2015-2020	$8,742,000
O&M Expenditures	2015-2020	$1,613,000
Other Expenditures	NA	$0
Total		**$10,355,000**

Note: All costs have been discounted back to 2013 present value dollars.
Source: Harvey Economics.

The Municipal Conservation proposal benefits are larger than the assumed proposal costs, resulting in a net benefit of about $65.4 million. The benefit-cost ratio of this proposal is 7.32:1.

It should be re-iterated that this proposal carries a higher, multifaceted degree of uncertainty than the other proposals, owing in part to conservation program uncertainty, customer response, and costs, as discussed in previous sections. These calculations are illustrated in Figure 6-10.

Figure 6-10.
Net Benefits and Benefit-cost Ratio of the Municipal Conservation Proposal



Note: All benefits and costs have been discounted back to 2013 present value dollars.
Source: Harvey Economics.

Summary of Results

Table 6-21 offers the total benefits, total costs and benefit-cost ratios of the AWSA proposals analyzed as part of this study. These proposals vary in both size and scope; several proposals involve multiple components and beneficiaries, while others include more focused benefits on a much smaller scale. Individual proposal benefits range from $2.4 million (Luna Ditch Improvements) up to $733.4 million (SWRWS) through 2050.

The larger proposals (with more components and beneficiaries) also tend to be the more expensive ones. Individual proposal costs range from $2.5 million (GBIC Irrigation Diversion Structure) up to $423.2 million (SWRWS) through 2050.

The benefit-cost ratios of the AWSA proposals range from a low of 0.66:1 (Sunset/ New Model Ditch Improvements) up to a high of 7.32:1 (Municipal Conservation).

Table 6-21.
Total Benefits, Total Costs and Benefit-cost Ratios of AWSA Proposals

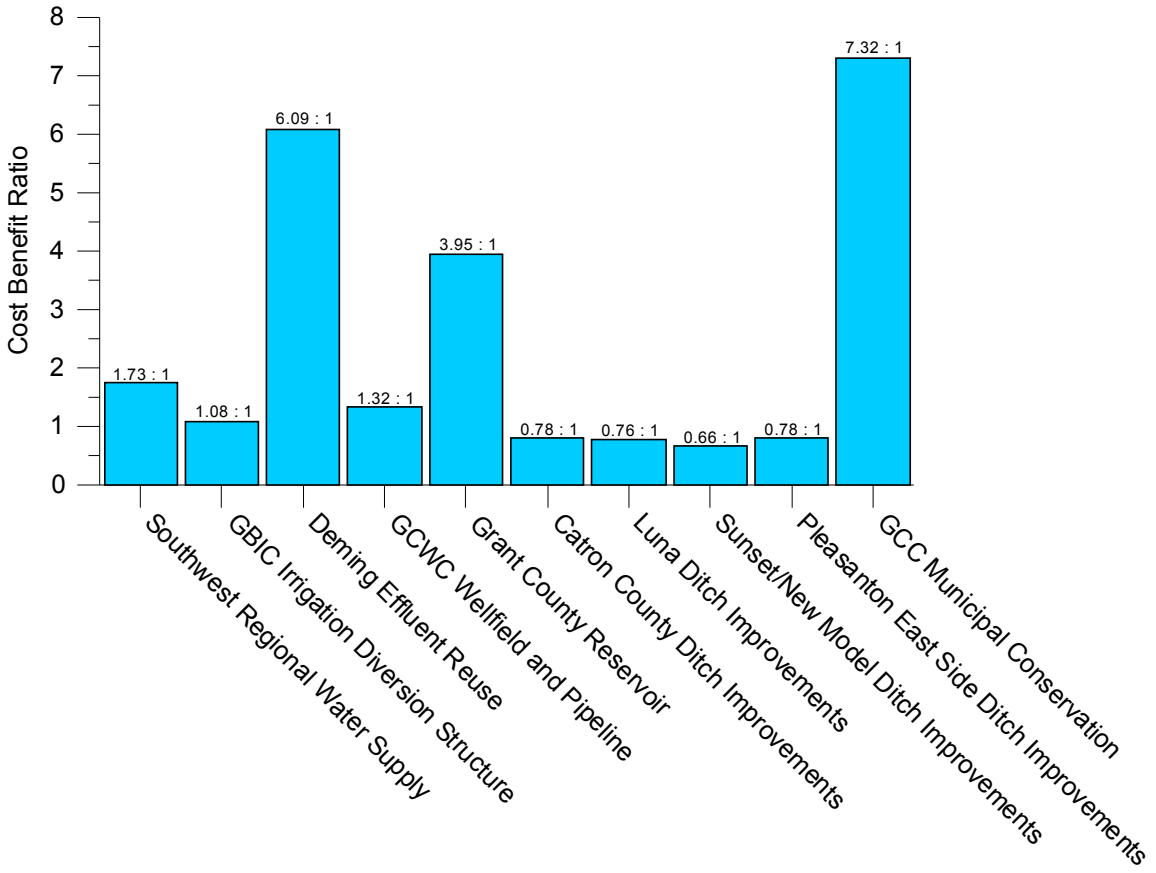
Proposal	Total Benefits (2014 - 2050)	Total Costs (2014 - 2050)	Benefit Cost Ratio
Southwest Regional Water Supply	$733.4	$423.3	1.73
GBIC Irrigation Diversion Structure	$2.7	$2.5	1.08
Deming Effluent Reuse	$36.1	$5.9	6.09
Grant County Wellfield and Pipelines	$38.6	$29.3	1.32
Grant County Reservoir	$63.5	$16.1	3.95
Catron County Ditch Improvements	$11.4	$14.5	0.78
Luna Ditch Improvements	$2.4	$3.2	0.76
Sunset/New Model Ditch Improvements	$18.9	$28.7	0.66
Pleasanton East Side Ditch Improvements	$4.2	$5.4	0.78
Municipal Conservation Programs	$75.7	$10.4	7.32

Note: All benefits and costs have been discounted back to 2013 present value dollars.
Source: Harvey Economics.

The Municipal Conservation proposal has the highest benefit-cost ratio of all the proposals at 7.32:1, indicating that benefits are more than 7 times greater than the costs. The Deming Effluent Reuse and Grant County Reservoir proposals also have relatively high benefit-cost ratios, at 6.09:1 and 3.95:1, respectively, although the latter proposal is contingent upon the construction of SWRWS proposal. All four of the ditch improvements proposals have ratios that are less than one, indicating that the costs of these proposals are greater than the estimated benefits, but two of them have qualitative environmental benefits. The SWRWS and the Grant County Wellfield and Pipeline proposals exhibit solidly positive benefit-cost ratios.

Figure 6-11 provides a visual representation of the benefit-cost ratios of each of the AWSA proposals.

Figure 6-11.
Benefit-cost Ratios of AWSA Proposals



Source: Harvey Economics.

Results Summary with Revised SWRWS Information

As this report was going to publication, the ISC completed a value engineering study for the SWRWS proposal to further examine costs and yields. This effort resulted in a number of revisions to the proposal characteristics, according to ISC staff:

1. *Capital costs were estimated to be $560 million.*
2. *O&M costs were reduced by 10 percent.*
3. *Proposal yields were estimated to be a maximum of 8,000 AF.*
4. *A different reservoir configuration was devised, including a large and a small Spar Canyon impoundment.*

HE revised the benefit-cost analyses for the SWRWS proposal; the summary table below reflects the revised results.

Table 6-22.
Total Benefits, Total Costs and Benefit-cost Ratios of AWSA Proposals, including the Revised SWRWS Proposal Data

Proposal	Total Benefits (2014 - 2050)	Total Costs (2014 - 2050)	Benefit Cost Ratio
Southwest Regional Water Supply	*$760.9*	*$528.9*	*1.44*
GBIC Irrigation Diversion Structure	*$2.7*	*$2.5*	*1.08*
Deming Effluent Reuse	*$36.1*	*$5.9*	*6.09*
GCWC Wellfield and Pipeline	*$38.6*	*$29.3*	*1.32*
Grant County Reservoir	*$63.5*	*$16.1*	*3.95*
Catron County Ditch Improvements	*$11.4*	*$14.5*	*0.78*
Luna Ditch Improvements	*$2.4*	*$3.2*	*0.76*
Sunset/New Model Ditch Improvements	*$18.9*	*$28.7*	*0.66*
Pleasanton East Side Ditch Improvements	*$4.2*	*$5.4*	*0.78*
GCC Municipal Conservation	*$75.7*	*$10.4*	*7.32*

Note: All benefits and costs have been discounted back to 2013 present value dollars.
Source: Harvey Economics.

Other Considerations

Beyond quantified benefits and costs, there are a host of other important aspects about the 15 AWSA proposals to consider:

- *Uncertainty.* The proponents of each proposal have expended efforts to reach this stage of the grant selection process, but detailed proposal planning has not been completed in most instances. Costs, construction plans, operational plans, yields, other results and effects are only generally known at this point. Each proposal is at a different stage in the development process, and some carry more uncertainty than others. Hence, the outcomes should be viewed generally.

- *Qualitative benefits and costs.* There are qualitative benefits and costs potentially associated with each of these proposals. For example, some of the proposals help preserve groundwater; this can be prudent water resource policy in areas with finite groundwater supplies. Water quality benefits may be evident with the watershed and other proposals. Certain proposals will reduce environmental impacts from periodic re-construction of water features. Many of the proposals have ancillary benefits.

- *Capital requirements.* Some of the proposals can be completely funded by the requested AWSA grant while others will require a large amount of additional financial support. At least one proposal (SWRWS) would require substantial

funding to proceed. Access to funding will help determine whether the benefits can be realized.

- *Proposal feasibility*. Technical and financial feasibility for the proposals has not been established for many of the proposals. Financing and payment for annual costs must be resolved before any of the proposals can move forward.

- *Type of benefit(s) resulting from each proposal.* The ISC may or may not view all benefit types (agriculture, environmental, municipal, recreation) as being equal. For example, recreational benefits in an area lacking recreation might be a priority.

- *Timing of proposal and readiness to go.* Several proposals include components which would not come on line or provide water for many years or the completion schedule is uncertain due to permitting. Others would only need a short time to get built and start operating, and would provide water to beneficiaries relatively quickly.

- *Geographic area of benefit.* Certain proposals are site specific, with beneficiaries in a confined geographic area, while others benefit larger areas including the SW New Mexico region.

- *Permitting.* For certain proposals, permitting requirements might be a challenge from a cost, timing and even a success standpoint.

- *Watershed proposals.* These might have a host of merits, but due to uncertainties in water yield, as well as no description of beneficiaries of potential water yield,, they are distinct from the other AWSA proposals.

Quantified benefits and costs should be considered in the context of other proposal characteristics.