8. Analysis of Alternatives for Meeting Future Demand

Once the region has studied their water supply and projected future demand for water, the next key component of the regional water plan is to develop alternatives for meeting the projected water demand. Alternatives are actions that the region can take to increase supply, reduce demand, protect or improve water quality, or better manage water resources so that the water supply of the region continues to be viable. This section provides information on the process used to identify and screen alternatives and analyzes the feasibility of priority alternatives selected by the Steering Committee.

8.1 Identification and Selection of Alternatives

As discussed in Section 2, the region initiated the current phase of regional water planning in the spring of 2002. A complete list of potential alternatives for addressing water supply needs was developed at a Steering Committee meeting and public meetings held in 2002. The alternatives were generated by having the participants split into several small groups to brainstorm as many possible alternatives as they could. As the small groups reported their results, the alternatives were classified into categories. Following this exercise, alternatives from four other regions were made available for the participants to consider including in the Socorro-Sierra list. A subcommittee of volunteers from the Steering Committee was formed to refine and clarify the alternatives proposed.

At a subsequent meeting in June 2002, the Alternatives Subcommittee presented their revised list of alternatives reorganized into seven categories. Some of the alternatives had been chosen by SSPA (consultants to the ISC) as feasible for modeling the potential amount of water saved, and a sub-list of those alternatives was also presented. Meeting participants further refined and prioritized alternatives by discussing and clarifying the alternatives in the lists, adding or revising alternatives, and then voting their priorities.

To help determine which of the alternatives were the most important to identify and analyze in the regional water plan, the Steering Committee identified the following criteria:

- Economic feasibility
  - Local capital costs
  - Local operation and maintenance costs
  - Feasibility of state funding
  - Feasibility of federal funding

- Technical feasibility
  - Physical possibility

- Legal
  - Legal impediments

- Hydrologic impacts (saves or produces more water)
  - Diversions
  - Consumption
  - Timing

- Political feasibility/social-cultural issues
  - Impairment/public welfare
  - Support by political leaders

These criteria were used to score all of the alternatives as an initial evaluation of the technical, legal, financial, and political feasibility of the alternatives. In the interim between the June 2002 meeting and the next Steering Committee meeting in October 2002, either SSPA or the project team scored the alternatives on how well they met criteria relating to impacts on the hydrologic system, and the project team supplemented the hydrologic impact scores with preliminary scores regarding the technical, financial, and legal feasibility of each alternative.

On October 24, 2002 more than 20 persons from both counties participated in ranking more than 40 water use alternatives using a decision matrix. Meeting participants scored the alternatives on the two remaining criteria (impairment/public welfare and support by political leaders), decided what weight each criterion should have, and in some cases made adjustments to project team scores. Scores were then added by computer and the top alternatives were presented to the group. Attendees compared these with those prioritized at the June 2002 meeting to arrive at a final list for evaluation.

In April 2003 meetings, participants discussed the potential water savings and implications of each alternative, including social or public welfare implications, political feasibility, potential environmental impacts, and implementation issues. Participants then had the opportunity to discuss and remove from mention in the plan alternatives that received lower scores.

In accordance with the ISC template, the alternatives defined by the Steering Committee fall into the categories of water resource management, water conservation, water and infrastructure development, and water quality management. The alternatives were also categorized separately by the Steering Committee. Based on the scoring and review processes described above, the Steering Committee identified the following subset of these alternatives for analysis within this Regional Water Plan:

- Improve the efficiency of surface water irrigation conveyance systems.
- Improve on-farm efficiency.
- Control brush and weeds along water distribution systems and drains.
- Control non-reservoir surface water evaporation by reducing surface water in engineered and natural locations.
- Require proof of sustainable water supply for approval of new developments.
- Encourage retention of water within the planning region.
- Remove exotic vegetation (i.e., salt cedar, Russian olive) on a wide scale.
- Manage watersheds to increase yield and improve water quality.

In accordance with the ISC template, these priority alternatives were evaluated with regard to their technical feasibility, political feasibility, social and cultural impacts, financial feasibility, and hydrologic and environmental impacts (Sections 8.2 through 8.9). Physical impacts, if relevant to the alternative, are discussed in the hydrologic impacts subsections of Sections 8.2 through 8.9.

Scores for legal feasibility were provided for all alternatives and reflect varying degrees of legal complexity in implementing the alternatives. Legal issues relevant to the alternative of making water rights a non-condemnable resource are discussed in Section 8.11. For the other alternatives, no legal issues that would prohibit implementation were identified, although in some cases, permits, water rights, or other legal concerns would need to be addressed; these concerns are discussed in the alternative evaluations. Legal issues affecting the water supply in the region are discussed in Section 4.

In addition to the priority alternatives that are analyzed in this document, the Steering Committee identified several other alternatives to be included as part of the long-term water plan, including:

- Develop economic potential for non-native species removal, harvest, and product output by local industries.
- Make water rights a non-condemnable resource.
- Improve reservoir management for better coordination of flows with demand.
- Identify and protect areas vulnerable to contamination.
- Adopt and implement local water conservation plans and programs, including drought contingency plans.
- Facilitate interregional water management decisions, public participation, and funding.

Though a full analysis of these alternatives was not included in the work plan for the region, the region nevertheless wanted to present a description of these alternatives along with the key issues and implementation strategies. Accordingly, these alternatives are discussed in Sections 8.10 through 8.15.

Finally, recommendations and an implementation schedule for all alternatives considered in the regional water plan are included in Section 8.16.

8.2 Improve Efficiency of Surface Water Irrigation Conveyance Systems

More than 90 percent of the water used by humans in the Socorro-Sierra planning region goes into agricultural activities, the majority of which occur along the Rio Grande Valley (Figure B-3 in Appendix B). Both surface water and groundwater are used for irrigated agriculture, which the OSE defines as “all diversions of water for the irrigation of crops grown on farms, ranches, and wildlife refuges” (Wilson et al., 2003). According to the OSE, almost 96 percent of all irrigation water used in Socorro and Sierra counties is applied by flood irrigation, with the balance applied using sprinkler- or drip-type systems. Given that more than 200,000 acre-feet of water are diverted for agriculture each year, even relatively minor improvements in efficiency can result in significant water savings.

Water lost between a point of withdrawal and the point of application can be significant, and in 1999, approximately 40 percent of surface water diverted for irrigation purposes in New Mexico was reportedly lost in off-farm conveyance systems (Wilson et al., 2003). These inefficiencies cause unnecessary water supply shortages that in turn result in idle or fallow acreage, limit the crops grown on farms, ranches, and wildlife refuges, and reduce agricultural income. Identifying and adopting water management measures and improving off- and on-farm infrastructure will increase efficiency, conserve water, and result in higher agricultural incomes.

The main contributor to these losses is reportedly seepage and excessive vegetative growth. This alternative addresses seepage losses through the installation of canal lining systems such as impervious soils, soil-cement, concrete, blocks, and piping systems (reducing excessive vegetative growth is addressed in Section 8.4). Although these improvements can be effective, they can also be costly and time consuming. Additionally, some amount of this seepage water may also be a meaningful component of shallow groundwater recharge, and the relative trade-offs between efficiency and enhanced recharge need to be evaluated in more detail before proceeding with this alternative.

After conveyance efficiency measures are implemented, the establishment of on-farm water-conservation techniques (Section 8.3) would further reduce crop water requirements and allow for additional acreage to be irrigated or for additional water to be applied to existing acreage.

Adjustments in water system management, including distribution and pricing of irrigation water, should also be factored into future improvement projects and programs. Consideration of these measures may be necessary to attract the major investment that is required for physical improvements.

A detailed Water Conservation Plan for the Socorro-Sierra Region that focuses on irrigated agriculture has been prepared and is included in Appendix H. In the plan the applicability and feasibility of specific conservation measures to irrigated agriculture in Socorro and Sierra Counties are evaluated, and the range of water savings that may result from these measures, as well as their associated costs, are estimated. A summary regarding water conservation funding programs in New Mexico is also provided.

In 2002, SSPA prepared a report for the ISC that evaluated the MRGCD irrigation and measurement program in an effort to reduce diversions to allow more water to stay in the Rio Grande (SSPA, 2002b). For the MRGCD Socorro Division the study recommends the following measures relative to seepage losses:

- Gage all diversions from the Low Flow Conveyance Channel (LFCC) to irrigation systems.
- Evaluate canal seepage losses.
- Evaluate abandonment of the Socorro Ditch inside the City of Socorro.
- Evaluate lining or piping reaches of major canals with significant seepage and/or few irrigators.
- Determine the feasibility of implementing rotational scheduling.

It is important to recognize that a reduction in diversions alone does not necessarily guarantee water savings. For example, a reduction in diversions implemented without changes to the off-farm water delivery system would result in reduced pressure at the farm headgate and consequently reduced on-farm irrigation efficiencies, possibly negating any savings associated with the reduced diversions. To fully realize the potential water saving benefits of reduced diversions, the MRGCD would need to implement a rotational water delivery system and/or install numerous automated check gates on the canal laterals to maintain higher heads.

8.2.1 Technical Feasibility

Canals, laterals, and reservoirs experience significant water losses due to seepage, leakage, evaporation, and transpiration by plants growing near the unlined channels and laterals. Many factors affect seepage and evaporative losses, including soil characteristics, silt deposition, water depth and surface area, water velocity, depth of groundwater, and ground slope. Characteristics that indicate significant seepage losses include visible seepage, waterlogging on adjacent properties, presence of riparian phreatophytes, and return flow problems.

There are several ways to improve off-farm conveyance efficiency:

- Most methods involve improvements to irrigation management systems to ensure that water deliveries are scheduled and measured. Such management improvements keep water in the right farming units at the right time and ensure accurate delivery amounts with minimal wastage.

- A second category of enhancements to irrigation conveyance systems is through improvements to the physical infrastructure (i.e., canals). Various canal lining and piping systems have been proposed, tested, and are in use today all over the world. The most common “improved” canal lining system uses simple non-reinforced concrete lining or, on larger canals, reinforced concrete lining. Other materials that can be used include gunite (shotcrete) and geo-membranes. Compacted clay and/or clayey soils are also used, and combinations of each of these are sometimes used together depending on the application, the size of the canal, the local geology, maintenance requirements, and cost.

Site-specific seepage/lining studies need to be carried out to determine where and how much seepage occurs, what type(s) of canal lining systems (concrete, liquid applied, and or geo-membrane) can be used, and what the actual local unit costs will be. The relative benefits of enhanced recharge versus canal efficiency should also be evaluated as part of the site-specific studies.

Lining canals, laterals, and reservoirs, installing piping systems, or increasing storage capacity will increase the efficiency of energy use and water use, production, and distribution, and may reduce water losses to less than 10 percent in some instances. A reevaluation of individual conveyance systems may be of some benefit in identifying opportunities for implementing these improvements to gain efficiencies in distributory canals that may serve more than one water user.

The issue is complicated by the effects of canal lining or piping, such as reduction or elimination of useful and aesthetic vegetation and trees now found growing along canal alignments that use seepage water for nourishment. Lining canals must be done thoughtfully so as to minimize the future destruction or breaking of linings by farmers who might want to install new or change the location of existing farm turn-outs.

Agricultural water conservation is well studied and documented. A large amount of irrigation water management and planning conservation information is downloadable from the Internet along with the names and contact numbers of government and private sector experts who are available to assist. In New Mexico, staff from the USDA, Natural Resources Conservation Service (NRCS), and State of New Mexico are also readily available to give advice and to help any irrigation manager and/or user develop and implement a large or small water management and/or conservation plan.

Non-government agencies are also active in assisting farmers and irrigators with conservation. In particular, the Irrigation Association (www.irrigation.org), founded in 1949, is a non-profit trade organization whose members represent all segments of the irrigation industry. One of the principal goals of the organization is to provide the membership with a full array of programs and services that will help them keep pace with the industry's rapidly changing technology. The association is also dedicated to promoting water and soil conservation through proper water management. In 1990, the association formally adopted a water conservation policy that stresses the importance of improving irrigation efficiency.

8.2.2 Political Feasibility and Social/Cultural Impacts

Public comments received during the planning process for this water plan support this alternative, although funding would be needed to implement it. Political, social, and cultural concerns with regard to off-farm efficiency, as raised at water planning meetings, include:

- It is more efficient to run water through MRGCD canals.
- A tax credit for new metering is recommended.
- Acequias measure the amount of water diverted and return flow.
- Sufficient head is needed at the farm headgate.
- Water scheduling and management reduce the time that the canals are full.

8.2.3 Financial Feasibility

The Water Conservation Plan for the Socorro-Sierra region (Appendix H) evaluates the applicability of conservation measures to water systems in Socorro and Sierra Counties. Tables H3-1 and H3-2 (Appendix H) summarize estimated water savings and costs associated with applicable water conservations measures for irrigated agriculture in Socorro and Sierra Counties, respectively. As detailed in these tables, the cost to improve delivery scheduling was estimated to be $50,000 per county, and canal lining costs were estimated to range from $50 to $200 per linear foot of canal.

In addition to initial installation costs, other factors to consider in decisions regarding lining materials are their effectiveness, durability, and maintenance costs (Table 8-1).

Table 8-1. Performance and Maintenance Characteristics of Selected Lining Materials

Type of Lining	Effectiveness in Reducing Seepage (%)	Durability (years)	Maintenance ($/ft^2/yr)
Concrete	70	40-60	0.005
Exposed geomembrane	90	20-40	0.01
Fluid-applied geomembrane	90	10-20	0.01
Concrete with geomembrane underliner	95	40-60	0.005

Source: USBR, 1999
$/ft^2/yr = Cost per square foot per year

Water conservation projects can be expensive, but social, economic, and environmental benefits are realized when large, steady supplies of water are available. Because of these benefits, state and federal agencies provide funding to assist irrigation associations with water conservation improvements, including infrastructure improvements and technical assistance.

Prior to developing a capital project plan, it is recommended that an irrigation system study its existing and future operations, including its potential to remain viable through the engagement of new farmers and the planting of crops that bring a reasonable rate of economic return. The more prepared an applicant system is in terms of its management and planning, the better it will do when seeking external funding for any improvement.

Some of the major sources of funding are:

- The U.S. Army Corps of Engineers (USACE) offers a funding program for irrigation system infrastructure improvements. This program consists of a 75 percent grant for projects such as canal lining, reservoir dredging, and flow control and measuring appurtenances. The program works in conjunction with a similar program offered by the ISC that assists systems taking advantage of the USACE program. The ISC program provides grant funding for an additional 15 percent of a given project's improvements, leaving just 10 percent of the total cost to be funded by the irrigation organization.

- Low-interest loans are available to systems through the New Mexico Finance Authority (NMFA) and the USDA. These loans could provide funds for the 10 percent not covered by the above funding.

- The USBR offers various project funds in grants and loans for all types of infrastructure projects.

- The State of New Mexico Water Trust Board funds selected water projects in New Mexico.

- The State of New Mexico Capital Outlay Program offers grant funds for approved projects that are championed by local State representatives and senators.

- The NRCS Environmental Quality Incentives Program provides financial and technical assistance to farmers and ranchers to implement structural and management conservation practices on eligible agricultural land.

8.2.4 Hydrological Impacts

This section summarizes the hydrological impacts for this alternative as determined by SSPA. The complete SSPA documents regarding this alternative are contained in Appendix E1. To perform the hydrological analyses, SSPA used their water supply model and considered only savings in the Socorro district of the MRGCD. Although the estimates do not include the entire region, they give an idea of the amount of water that would be saved by implementing this alternative.

Potentially large reductions in agricultural diversion demand are possible through improvements in irrigation efficiency. Minimal irrigation-related consumptive use reductions may also occur due to vegetation removal associated with efficiency improvements. Reductions in diversion demand resulting from these changes would allow water to be retained in upstream storage reservoirs longer and provide timing advantages for irrigation (or ancillary needs/benefits). Reductions in consumptive use will both reduce the diversion demand and “save” water.

“Saved” water will not likely be directly available to the planning region. Because the basis of the MRGCD’s permitted water right is irrigated agriculture, any water not needed for this purpose due to conservation efforts is assumed to belong “to the public and is subject to appropriation for beneficial use” (NMSA 1978, 72-1-1). In the Rio Grande Basin, which is considered by the State Engineer to be fully appropriated, these waters would satisfy other established water rights that might otherwise not be fully supplied, subject to the constraints of the Rio Grande Compact. In other words, these savings, while not likely available for transfer to a specific use within the region, avoid what could be construed as waste and thus benefit the entire region by more efficiently using the available water supply and improving the ability to provide a full supply to all irrigators, including those in this region.

8.2.4.1 Canal Lining or Piping

Canal lining will result in a reduction in seepage losses from the canals, thereby requiring smaller diversions to convey water to farms than under present conditions. Canal lining will also result in a reduction in riparian growth along the canals and a commensurate reduction in evapotranspirative consumptive use.

Lining all of the canals in the region would be expensive and probably unnecessary; it is likely that the majority of canal seepage comes from a minority of the canals (SSPA, 2003; Appendix E1). This analysis was therefore based on lining 20 percent of the canals. Results can be scaled for other percentages.

SSPA estimated the reduction in canal seepage based on the following assumptions:

- A total of 133.9 miles of canals in the Socorro division (obtained from project GIS coverage and reported in the MRGCD efficiency study (SSPA, 2002b, Table I-1), multiplied by 1.5 to take into account small canals and laterals not counted in the original mileage survey

- A division supply of 138,713 acre-feet of water in 2001 (about 65 percent of the total diversions in the Socorro-Sierra planning region)

- Canal seepage of 20 percent of canal flow (USBR estimate) (27,743 acre-feet of water)

- An 80 percent reduction in seepage resulting from lining canals

Based on these assumptions, SSPA estimated the resulting reduction in the diversion requirement at 4,440 ac-ft/yr. If the leakiest canals were located and lined, this value might be increased, and if all of the canals were lined, diversion requirements would be reduced by 22,200 acre-feet.

This reduction in seepage might in effect be “new” water if the seepage is currently returning to the LFCC and is subsequently lost to evaporation in the delta (Section 8.5).

The decrease in riparian consumption, based on the same lining of 20 percent of the canals, was calculated using the following assumptions:

- The same total canal mileage as used for the seepage reduction estimate (133.9 miles of canals multiplied by 1.5)
- A riparian corridor width of 20 feet (10 feet on either side of the canals)
- Annual evapotranspiration from existing riparian growth of 2 feet (based on the average annual evapotranspiration of salt grass [USBR, 1997)
- Eradication of the riparian corridor by lining the canal.

Based on these assumptions, SSPA estimated the water savings (consumptive use) from reduced riparian usage to be approximately 195 ac-ft/yr.

Additionally, some canals/laterals or sections of canals/laterals in the division could possibly be abandoned. Abandoning canals will reduce seepage and evapotranspiration losses to near zero for that stretch.

8.2.4.2 Managing Deliveries and River Diversions and Returns

Effectively managing irrigation deliveries, diversions, and returns has the potential to significantly reduce required irrigation diversions. Consumptive use might also be reduced, but such changes would be primarily incidental.

River diversions and returns are now metered in the Socorro Division of the MRGCD (with the exception of the LFCC and the river as they exit the division). Much of this metering is relatively new, and over the next few years it will allow the region to better understand irrigational water diversions and consumptions, which in turn will aid in planning and provide insight into potential areas where water can be saved or conserved. Estimates of both potential changes in consumptive use and reduced diversion demands as a result of this metering are unavailable at this time.

Gaging the LFCC would further improve knowledge of regional water allocation. Currently, the LFCC is only gaged at San Marcial.

Rotational water delivery would reduce required diversions by reducing the amount of time that canals must be run full. However, no data are currently available to quantify the improvement in off-farm efficiency resulting from rotational delivery. Rotational delivery is already practiced in the Socorro Division of the MRGCD at some times.

Metering farm deliveries would reduce on-farm demand and therefore reduce diversion requirements. In other irrigation districts metering has been found to increase farmers' water efficiency by 10 to 20 percent (Fipps, 2000). If the water required at the farm turnouts is reduced by this percentage, required diversions are reduced by a minimum of 10 to 20 percent (which, based on 2001 division diversions, would be a potential reduction of 13,870 to 27,740 acre-feet). Depending on how the conveyance system is run in response to reduced on-farm demand, conveyance losses could also be reduced, further reducing diversion requirements.

Although the improvements discussed in this analysis have the potential to significantly reduce required river diversions and canal seepage, they do not actually save water. The water "lost" to canal seepage and on-farm seepage is returned to the surface water system; it either flows into the drains and is returned directly, or it flows to the shallow groundwater system, which is in effective hydraulic connection with the river/drain system. Although river flow may be reduced in local areas, the "lost" seepage will return to the stream system at some point, and the Rio Grande system will remain unchanged further downstream. Nevertheless, lowering diversions could help to satisfy local endangered species habitat needs, potentially reducing the demand for additional release of stored water or other adverse remedial measures.

As noted above, however, the improvements discussed in this analysis have a small impact on crop consumptive use, the variable modeled in the basin-wide probabilistic water budget model developed for the middle Rio Grande water supply study (Appendix E1). In addition, the combined proposed changes described in this alternative have the potential to reduce evaporation from the water surfaces in the canals and drains. In the analysis of the regional water budget, however, these are relatively small terms. Using their model, SSPA estimated the amount of water savings (consumptive use) from implementing this alternative, combined with the on-farm (Section 8.3) and weed control (Section 8.4) alternatives, to be 2,768 ac-ft/yr, or 5 percent of the planning region agricultural consumptive use (Appendix E1). Estimates of the water savings for these alternatives individually, or for the canal lining and management options for this alternative, were not calculated.

8.2.5 Environmental Impacts

Any canal lining project must be planned and designed to account for groundwater recharge requirements if it is determined that such recharge does occur and is beneficial. Also, reductions in canal seepage could potentially affect the Rio Grande bosque and vegetation along canals. Impacts would need to be evaluated for specific canals and could be mitigated by selective lining.

Clean Water Act and NEPA regulations need to be considered when designing a lining or piping project, although all of the issues related to the environment can be easily addressed if these projects are properly designed and planned to minimize impacts. In addition, conserved water stored in upstream reservoirs would increase operational flexibility and may therefore increase management alternatives for maintaining endangered species habitat.

8.3 Improve On-Farm Efficiency

Within the planning region, the majority of irrigated agricultural land is located along the Rio Grande Valley (Figure B-2 in Appendix B). Both surface water and groundwater are used for irrigated agriculture, and according to the OSE, almost 96 percent of all irrigation water used in Socorro and Sierra Counties is applied by flood irrigation, with the balance applied using sprinkler- or drip-type systems (Wilson et al., 2003). This alternative examines on-farm water efficiency and conservation measures that can reduce the quantity of water that must be delivered to a farm in order to satisfy crop water requirements. Reduction of farm water deliveries will reduce diverted irrigation water quantities at the system level (intake point of diversion). It will not, however, result in "new" water because the consumptive irrigation requirement (CIR) does not change unless irrigated acreage is reduced or lower water use crops are introduced. However, on-farm efficiencies have the potential to reduce incidental depletions.

A detailed Water Conservation Plan for the Socorro-Sierra Region that focuses on irrigated agriculture is included in Appendix H. In the plan the applicability and feasibility of specific on-farm conservation measures to irrigated agriculture in Socorro and Sierra Counties are evaluated, and the range of water savings that may result from these measures, as well as their associated costs, are estimated. A summary regarding water conservation funding programs in New Mexico is also provided.

Of interest to this alternative is the passage of the Farm Security and Rural Investment Act of 2002 and the creation of the Conservation Security Program. This is a national incentive program in which farmers who are implementing conservation technologies in fiscal years 2003 through 2007 can receive payments (SWCS, 2003). Additional information regarding the 2002 farm bill and incentive program eligibility can be found on the Soil and Water Conservation Society web site at www.swcs.org/t_seeking_sectionsummaryfarmbill.htm.

8.3.1 Technical Feasibility

On-farm water efficiency is a simple ratio of the quantity of water taken up or consumed by crops, including evapotranspiration, divided by the quantity of water delivered to a farm. On-farm efficiency is affected by several factors (Kay, 1986):

- *Methods of irrigation:* Available irrigation methods, including flood (basin), border, furrow, or micro-irrigation, vary in their efficiency of water use.

- *Farm layout:* The shape and slope of the farmed areas used in flood and border irrigation systems affect the farm's ability to promote efficient root zone saturation without deep percolation loss.

- *Soil types:* Differing soil types in a farm or in several basins can cause uneven watering effectiveness and extremely high deep percolation losses.

- *Land preparation practices:* Land leveling needs to be done every 5 to 10 years to ensure that water does not pond and that water flows freely in basins.

- *Farm canal condition:* Large amounts of water can be lost to seepage in on-farm canals.

- *Irrigation scheduling:* Crops can be supplied with the right amount of water at the right time, without wasting water, and as economically possible.

- *Crop management:* The crops grown on a parcel of land can be selected to optimize crop yields and water use.

Further discussion related to these factors is provided in Sections 8.3.1.1 through 8.3.1.3.

8.3.1.1 Irrigation Methods

Several on-farm technologies are available to increase the efficiency of production agriculture irrigation systems. Though widespread application of such on-farm techniques is dependent on substantial funding, individual farmers who find that improvements such as gated piping, laser leveling, or other issues provide significant water savings in their operations may choose to implement on-farm measures. For future planning purposes, these technologies are summarized in Sections 8.3.1.1.1 through 8.3.1.1.4.

8.3.1.1.1 Surge Valves. For some fields currently using furrow irrigation, surge valves can be added to increase application efficiencies and reduce deep percolation losses of irrigation water. The principle behind surge irrigation is to switch the water back and forth between irrigation sets using an automated valve. The valve may be set for different lengths of out-times (i.e., times when water is applied to advance it through the length of run). At the end of this part of the irrigation cycle, the valve changes to shorter time lengths to switch back and forth between the sets, called “cutback” and “soaking” cycles. Correct out-times and cutback times minimize runoff (tailwater) and deep percolation.

This method of irrigation advances the water more quickly and efficiently through the field than continuous irrigation. Surge valves typically improve furrow irrigation efficiency by an average of 10 to 40 percent, depending on soil type, land slope, and the length of the runs, and some growers have cut irrigation amounts by as much as 50 percent.

The use of surge valves requires more farmer time and daily adjustment. Laser-leveled fields are also usually required, as the principle behind surge irrigation is that water applied uniformly on a given area has time to percolate before the following application. Irregularities in farm topography, which can be covered by flood irrigation, are not compatible with surge techniques.

8.3.1.1.2 Gated Piping. Pipeline conveyance systems are often installed to reduce labor and maintenance costs, as well as water losses to seepage, evaporation, spills, and non-crop vegetative consumption. Underground pipeline is generally constructed of steel, plastic, or concrete and is permanently installed, while aboveground pipeline generally consists of lightweight, portable aluminum, plastic, or flexible rubber-based hose that can be moved.

One form of aboveground pipeline, gated pipe, distributes water to gravity-flow systems from individual gates (valves) along the pipe. One method of irrigation (commonly called “cablegation”) using gated piping involves the use of a moveable plug that passes slowly through a long section of gated pipe, with the rate of movement controlled by a cable and brake. Due to the oversizing and required slope of the pipe, water will gradually cease flowing into the first rows irrigated as the plug progresses down the pipe. Improved water management is achieved by varying the speed of the plug, which controls the timing of water flows into each furrow.

8.3.1.1.3 Sprinkler Systems. Most crops can be irrigated with some type of sprinkler system, although crop characteristics such as height must be considered in system selection. Sprinkler systems are well suited for germinating seed and establishing ground cover for crops like lettuce, alfalfa, and sod because they can provide the light, frequent applications that are desirable for this purpose. Most soils can be irrigated with the sprinkler method, although soils with an intake rate below 0.2 inch per hour may require special measures.

Sprinkler systems are useful for irrigating soils that are too shallow to permit surface shaping or too variable for efficient flood irrigation. In general, sprinklers can be used on any topography that can be farmed. Land leveling is not normally required, thus making sprinkler irrigation easier to apply than other methods such as surge valves.

There are some disadvantages to using sprinkler systems for irrigation. Sprinklers may require more pumping energy than other irrigation methods. They also require better quality (or filtered) source water than flood irrigation methods. Sprinkler systems can be labor-intensive, especially systems that must be moved manually. If the source water is salty, sprinkler methods that apply water to leaves may be unsuitable.

Many types of sprinkler devices and sprinkler systems are available today. Sprinkler devices include rotating head sprinklers (apply water in circular pattern), low-pressure spray nozzles (often used on center pivot and linear move systems or in orchards), under-tree rotating heads that keep the spray below tree foliage, and perforated pipe that sprays water from small-diameter holes in pipes. Attainable irrigation efficiencies for different sprinkler systems are listed in Table 8-2. More detailed descriptions of these systems are provided by Burt et al. (2000).

Table 8-2. Attainable Sprinkler Irrigation Efficiencies

System Type	Efficiency (%)
Hand-move or portable	65-85
Side roll	65-85
Traveling gun	60-75
Center pivot	75-90
Linear move	75-90
Solid set or permanent	70-80
Low-energy precision application	80-93

Source: Burt et al., 2000.

Labor requirements vary depending on the degree of automation and mechanization of the equipment used. Hand-move systems require the least degree of operational skill, but the greatest amount of labor. At the other extreme, center pivot, linear move, and low-energy precision application systems require considerable skill in operation and maintenance, but the overall amount of labor needed is low.

With the exception of the low-energy sprinkler systems, incidental depletions are higher with sprinkler systems than with flood irrigation. High-pressure center pivot systems result in incidental depletion losses of 17 percent due to the evaporation of the water before it reaches the ground (Wilson et al., 2003). Compared to flood irrigation with incidental depletions of 2.5 percent, low-energy sprinklers with a partial drop (6 feet above ground surface) have incidental depletions of 5 percent, and low-energy sprinklers with a sock and applicator 18 inches above ground have incidental depletions less than 1 percent (Wilson et al., 2003). Efficiency losses due to incidental depletions are the most important losses to recover in considering any plan to improve efficiency, as these losses do not have the added benefit of groundwater recharge and eventual return to the river system.

8.3.1.1.4 Drip/Micro-Irrigation Systems. Drip/micro-irrigation methods can conserve water because they deliver water directly to the root zone through emitters placed along a water delivery line (typically a polyethylene hose). Also, in contrast to most other types of irrigation systems, a properly designed and well operated drip/micro-irrigation system:

- Can be used on steep slopes
- Requires minimal land grading
- Can be installed on parcels of land of any size or shape
- Has few, if any, runoff problems or chances of excessive over-irrigation
- Has greater distribution uniformity (especially the newer system designs)
- Provides optimal soil moisture through more frequent irrigation
- Allows direct application of fertilizer to the root zone
- Results in no incidental depletions

Systems can be installed permanently (typical for orchards and vineyards) or seasonally (typical for row crops), or they may have permanent main lines with removable or disposable lateral lines. Because drip/micro-irrigation system components typically remain in place for the growing season, the systems can be automated (however, they should be monitored and shut off temporarily as appropriate during rainy periods).

Drip/micro-irrigation systems are of three main types: (1) aboveground drip systems, (2) buried drip systems, and (3) aboveground microspray and microsprinkler systems.

The International Arid Lands Consortium (IALC) has been involved in a demonstration project in Artesia, New Mexico to determine the benefits of drip irrigation technology for alfalfa. In this study they have estimated a 40 percent reduction in water application with the use of drip irrigation compared to traditional sprinkler technology, without a reduction in yield (IALC, 2000). Similarly, the USBR funded a demonstration project for drip irrigation of alfalfa on a farm in Socorro County. Results of this study (Reasner, 2003, personal communication) are promising, with the biggest problem being frequent maintenance to address system degradation by gophers.

8.3.1.2 Soil Treatments

Water available to plants depends not only on the amount of rainfall and/or irrigation, but also on the physical, chemical, and biological properties of the soil. The soil acts as an absorbent for water from precipitation and irrigation and serves as a reservoir of water for plants in the interval between water applications.

Soil structure is an important physical parameter to consider, as soil sealing and soil crusting decrease the infiltration rate of water into the soil. A common constraint to both water filtration and root penetration in the soil is the degree of soil compactness or density. Structureless soil can severely restrict the downward percolation of water. Other soil characteristics that affect water availability to plants include the extent of organic matter in the soil and the types and density of soil organisms present.

In situ moisture conservation is a form of water conservation in which all rainfall is conserved where it falls and no runoff is permitted. Measures that can be adopted by farmers to optimize the physical, chemical, and biological soil parameters with a view to increasing the water efficiency include:

- Covers or mulches laid down on the surface of the soil and along rows. This practice is very important for water and soil conservation as well as for organic matter preservation. These mulches protect soil structure by reducing the mechanical action of raindrops on soil aggregates, thus preventing runoff and erosion. Mulching dramatically decreases evaporation and improves soil moisture retention capacity and, therefore, soil water content. Soil temperature, soil strength, and soil aeration are also improved, thus increasing soil productivity and crop yield.

- Tilling or physically (manually or mechanically) breaking up the plough layer is a common agronomic practice that can improve the infiltration rate, thus conserving soil moisture. Tilling also helps to control soil pests and weeds (the pests are brought up to the surface where they are then killed by radiation and/or predators). This approach therefore reduces the need for pesticides and their attendant use of fairly large quantities of water.

- Planting in small depressions, known as planting pits, is a practice common in arid areas. These pits conserve and concentrate both water and nutrients.

- Contour cultivation slows down the movement of water across the soil surface and also helps to conserve water. This can be achieved by constructing physical barriers such as ridges, with or without ties, across the contours to prevent runoff and soil erosion. In contour cultivation, the runoff from the higher elevations is trapped in furrows in the contours, thereby increasing infiltration into the soil.

- Terracing fields is another measure of collecting and conserving water. Different types of terraces can be constructed (e.g., stone terraces, earth banks, bench terraces, and contour stone) to conserve soil moisture as well as to collect water.

Such in situ moisture conservation measures should be encouraged on lands with marginal rainfall.

8.3.1.3 Crops

Crop management is an extra means of reducing water losses and optimizing water use in any farming system. Crop management considerations include crop water requirements, timing of irrigation, crop selection, crop configuration (plant density, crop mix), and cropping calendar (planting dates, rotation).

Planting density and crop mix have an effect on the hydrologic characteristics of the system. Increasing planting density increases the soil cover by crops and can lead to a decrease in evaporation losses; however, these measures can also increase water uptake from the soil. Annual crops and some perennials (i.e., sugar cane) use moisture mainly from the top layer, whereas deep-rooted plants such as fruit and other trees tap water that is beyond the reach of the annuals. Additionally, some trees shed their leaves in winter, thereby covering the soil and creating mulch. A synergistic planting of this nature may yield more abundant crop production while protecting critical top soils. In addition, mixed cropping systems in particular combinations can help to significantly reduce pest damage. For instance, cabbages grown in alternate rows with either tomatoes or garlic or carrots have been shown to suffer fewer insect attacks.

8.3.2 Political Feasibility and Social/Cultural Impacts

Public comments received during the planning process for this water plan support this alternative, but funding is needed to implement it. The comments also support the identification of commercially feasible low-water-use crops that could be sold for as much money as alfalfa, the crop commonly grown in the region. Additional political, social, and cultural concerns with regard to on-farm efficiency, as raised at water planning meetings, include:

- Meeting attendees showed support for the 2002 farm bill conservation security program.

- Flood irrigation is needed periodically to flush salts out of the soil.

- Irrigation tubing needs to be gopher resistant.

- If farmers cannot sell or lease water saved through conservation, they do not perceive a benefit from conservation.

- Every orchard of at least 10 to 20 acres in size should be on a drip system.

- Use of groundwater for drip irrigation would be possible if the OSE would explicitly recognize conjunctive use of surface water and groundwater.

- Use of furrow and drip system is expensive, requiring pumps and sand filters; these irrigation methods may be cost-effective for 50 or more acres.

- Conservation can benefit farmers in year where a full water allotment is not available.

- Improvement projects need to be identified as part of the regional water plan, to raise their potential of being funded by the state water trust board.

8.3.3 Financial Feasibility

The Water Conservation Plan for the Socorro-Sierra region (Appendix H) evaluates the applicability of conservation measures to water systems in Socorro and Sierra Counties and summarizes estimated water savings and costs associated with applicable on-farm water conservations measures for irrigated agriculture in Socorro and Sierra Counties (Tables H3-1 and H3-2, respectively). As detailed in these tables, the estimated cost for concrete lining (discussed in Section 8.2) or piping of on-farm ditches is $15 per linear foot of ditch, and laser leveling costs are approximately $250 and $200 per acre, respectively, for Socorro and Sierra Counties.

Surge irrigation is an inexpensive method to adopt given its benefits of more uniform water distribution, reduced deep percolation, reduced tailwater, and reduced total irrigation. Although surge valves cost approximately $1,000 to 1,500 per valve, a surge valve may be used on one or more fields.

Both federal and state funding assistance should be available for the measures described in this section. The most applicable federal program for funding on-farm activities is the NRCS Environmental Quality Incentives Program. However, this program is understaffed, which could increase the time needed to process applications and disburse funding. Federal funding sources are not available for operation and maintenance costs.

8.3.4 Hydrological Impacts

This section summarizes the hydrological impacts for this alternative as determined by SSPA. The complete SSPA documents regarding this alternative are contained in Appendix E1. To perform the hydrological analyses, SSPA used their water supply model and considered only savings in the Socorro Division of the MRGCD. Although the estimates do not include the entire region, they give an idea of the amount of water that would be saved by implementing this alternative.

Improvements in on-farm efficiency reduce diversion through the farm turnout primarily by reducing runoff and percolation to the aquifer. Smaller reductions in water use are also effected by reducing ponding. Of all the possible reductions, reducing ponding is the only action that results in changes in consumptive use. Any other changes will impact required diversions only. Thus improvements to irrigation efficiency will improve water supply and potentially increase water available for use in the Rio Grande Valley at large, but may not make new water available for the region.

Most of the Socorro Division of the MRGCD is devoted to production farms, where laser-leveling and concrete lining of the on-farm ditches has already been done. Anecdotal evidence suggests that these improvements can reduce on-farm water use by 30 percent and reduce turnout time to 25 percent of that previously required to irrigate the same acreage. These reductions in turn reduce required diversions, make rotational delivery far more efficient, and allow for increased off-farm efficiency.

Though many of the big production farms in the Socorro Division have already made efficiency improvements, some percentage of the district's irrigated lands remain unimproved. Focusing on improving these lands and those in need of improvement outside of the division will boost on-farm efficiency in the planning region and allow for effective rotational delivery to these lands, further improving off-farm efficiency.

Laser-leveling can increase on-farm efficiency by about 30 percent (Darryl Reasner, NRCS, personal communication). Assuming that 30 percent of the Socorro Division is currently unimproved, then the implementation of efficiency improvements on that 30 percent of the lands could increase efficiency by 30 percent, or improve division on-farm efficiency by 9 percent. This improved efficiency will in turn allow for a minimum of a 9 percent reduction in required diversions. For 2001, this would have allowed for a reduction in diversions of about 12,500 acre-feet of water.

With the exception of laser-leveling fields and improving on-farm ditches, any improvements to on-farm efficiency would likely be costly in relation to their potential to reduce diversions and very costly in relation to their potential to reduce consumptive use.

This alternative includes improvements in agricultural and conveyance efficiency through on-farm laser-leveling of fields and lining of ditches. The changes described in this alternative have the potential to significantly reduce on-farm water requirements, but will have less impact on crop consumptive use, the variable modeled in the basin-wide probabilistic water budget model. The changes to reduce ponding described for this alternative do have the potential to reduce incidental evaporative losses from puddles in non-laser-leveled fields, but in the analysis of the regional water budget, this is a relatively small term. With the model developed for the Middle Rio Grande water supply study, SSPA (Appendix E1) estimated the amount of water savings (consumptive use) from implementing this alternative, combined with the off-farm (Section 8.2) and weed control (Section 8.4) alternatives, to be 2,768 ac-ft/yr, or 5 percent of the planning region agricultural consumptive use. Estimates of the water savings using their water supply model for these alternatives individually were not calculated.

8.3.5 Environmental Impacts

The reduction of deep percolation on farms will reduce seepage and thus affect groundwater levels and recharge. Changes in recharge to the shallow aquifer due to changes in flows through on-farm canals may impact the bosque and the types of ecosystems that may be established in the irrigation canals and drains. However, flows in these systems are already intermittent due to the seasonal nature of irrigation, and ecosystem impacts should be minimal if on-farm projects are planned and designed to avoid impacts to these ecosystems. Additionally, increased water supply management flexibility will provide more options for supporting endangered species habitat.

8.4 Control Brush and Weeds along Water Distribution Systems and Drains

The New Mexico OSE estimated that approximately 40 percent of surface water diverted for irrigation purposes in 1999 was lost in off-farm conveyance systems (Wilson et al., 2003). Excessive growth of vegetation along these conveyance systems and drains is a contributor to this loss. To reduce transpiration losses due to excessive vegetation growth, this section evaluates the feasibility of controlling brush and weeds along water conveyance systems and drains in the Socorro-Sierra planning region.

8.4.1 Summary of the Alternative

A certain amount of the water that seeps into the ground through unlined canals is used for transpiration by peripheral vegetation, and this water is therefore lost from the system. Implementation of this alternative would involve a control program to effectively minimize the amount of brush and weeds (i.e., peripheral vegetation) growing along water distribution systems and drains. Peripheral vegetation can be reduced by mechanical, chemical, and/or biological methods:

- Mechanical removal involves physical methods and requires staff time, equipment (e.g., mowing machine), and equipment maintenance.

- Chemical removal consists of the use of various herbicide sprays and requires staff time, chemical purchases, and equipment (e.g., tank with sprayer or crop duster).

- Biological methods involve using a biological entity to control the invasive species

A combination of any of these three methods can be implemented as well. Lining of the canals and drains would also reduce the amount of peripheral vegetation, but is evaluated separately in Section 8.2.

Benefits of a weed control program include a reduction in water consumption by the vegetation, an increase in water delivery capacity, and possible reductions in operation and maintenance costs (Wilson et al., 2003).

8.4.2 Technical Feasibility

The technology required to control peripheral vegetation has already been implemented in parts of the planning region. Within the planning region, chemical removal (spot spraying with an aquatic herbicide) is currently carried out by the Socorro SWCD, the USBR, and the MRGCD. Mechanical removal is also used by the MRGCD. Biological methods are rarely used because of possible detrimental primary and secondary impacts to the local ecosystem and are not further evaluated in this analysis.

A chemical weed control program is generally the most effective (Wilson et al., 2003). However, several factors that affect the performance of herbicides need to be considered, including rainfall, temperature, relative humidity, soil type, past use, rate of application, and application method (Lantagne, 2001).

8.4.3 Political Feasibility and Social/Cultural Impacts

The natural ecosystems that are supported along ditches contribute to the identity of the bosque environment. The bosque provides a diversity of animal and plant life that is valued by traditional cultures as well as by individuals seeking the open space for leisure activities. Public perception regarding the effects of using chemicals near areas with endangered species (e.g., silvery minnow, southwestern willow flycatcher) can also be a concern in this planning region. Despite these concerns, public comments received during the planning process for this water plan for the most part support continuation of current efforts to remove excessive vegetation along water distribution systems and drains. Public concern was raised, however, about the potential health and environmental effects of herbicide spraying, and additional communication with the public on this issue may be warranted.

8.4.4 Financial Feasibility

A chemical weed control program is generally the most economical (Wilson et al., 2003). The cost of one gallon of the different types of herbicides that are currently being used in the region ranges from less than $30 to more than $300. Based on current costs for conducting weed removal programs, it is estimated that a dedicated program for this alternative would require approximately $30,000 per year for the planning region ($15,000 each for the Sierra and Socorro SWCDs) to cover the cost of chemicals and staff time (Stowe, 2003). Possible sources of funding include grants and/or user fees. The SWCD programs would supplement the activities currently undertaken by MRGCD and USBR.

The cost of mechanical brush control by the MRGCD is estimated to be approximately $700 per day, including the cost of the mower, operator's time, fuel, and maintenance (Mounyo, 2003). Typically, mechanical mowers can cover 1 mile of large canal or 2 to 3 miles of small canal each day.

8.4.5 Hydrological Impacts

This section summarizes the hydrological impacts for this alternative as determined by SSPA. The complete SSPA documents regarding this alternative are contained in Appendix E1. To perform the hydrological analyses, SSPA used their water supply model and considered only savings in the Socorro district of the MRGCD. Although the estimates do not include the entire region, they give an idea of the amount of water that would be saved by implementing this alternative.

SSPA (2003 [Appendix E1]) reports that the MRGCD is currently mowing all of the canals and drains in the Socorro Division; canals are mowed at least two to three times per year and drains at least once per year. Conversely, Steering Committee members indicate that most canals in the planning region are only being mowed once per year or by request. Aside from the conflicting reports, the existing weed control programs in the planning region could likely be improved to gain additional water savings. Some of the smaller irrigation systems may benefit if additional resources were available for weed control programs.

Because plant roots currently provide bank support, complete eradication of vegetation along the canals and ditches would result in bank destabilization. Consequently, a balance needs to be maintained between controlling growth through mowing and maintaining adequate root mass to stabilize the canal and ditch banks. The primary vegetation types along the canals and drains are weeds and grasses with an occasional patch of willow (personal communication with Johnny Mounyo, MRGCD Socorro Division, as cited by SSPA, 2003).

Water usage by weeds and grasses is likely 2 feet per year or less (the highest water user, salt grass, uses about 2 feet per year). Some water savings might be achieved by increasing the number of mowings, but it is likely to be small. SSPA (2003 [Appendix E1]) reports that insufficient data currently exist to allow quantification of the potential savings from increased mowing frequency.

With the model developed for the middle Rio Grande water supply study, SSPA (2003 [Appendix E1]) estimated the amount of water savings (consumptive use) from implementing this alternative, in combination with the on-farm (Section 8.3) and off-farm (Section 8.2) alternatives, to be 2,768 ac-ft/yr. Estimates of the water savings for the off-farm brush control only was not calculated by SSPA.

8.4.6 Environmental Impacts

Any method for weed control will have environmental impacts. As mentioned in Section 8.4.5, complete eradication of vegetation along the canals and ditches would result in bank destabilization. In addition, the effects of certain herbicides may be environmentally unacceptable because of Clean Water Act and NEPA regulations.

The use of herbicides requires knowledge regarding their effects, weed identification, and application equipment (Lantagne, 2001). Their application can lead to environmental damage and health risks if used improperly and it is important to consider the consequences of alternative treatments before selecting a weed control method. Herbicides currently used in the planning region are aquatic types that are safe to use in and near waterways.

Decreasing depletions, which is the focus of this alternative, increases the probability that the river can remain wet. Any means of increasing surface water reliability provides greater assurance that the endangered silvery minnow will survive in the middle Rio Grande area.

8.5 Control Non-Reservoir Surface Water Evaporation by Reducing Surface Water in Engineered and Natural Locations

Because evaporation and evapotranspiration are significant components of the depletions in the region (Section 6), efforts to reduce consumptive losses have the potential to greatly benefit the region. This alternative focuses on controlling the evaporation component of those consumptive losses, specifically non-reservoir evaporation in engineered locations (mainly the LFCC) and in natural locations such as wildlife refuges.

The LFCC provides drainage in the region from San Acacia to the Elephant Butte delta and was designed to improve the delivery of diverted river water and intercepted drainage water to the reservoir. Currently, the lower part of the LFCC through the delta area is not functioning as designed due to siltation and channel breaches, and as a result, the water carried in the LFCC is deposited in marshy areas in the delta. Additionally, water in the river channel, whose bed elevation has significantly aggraded over past decades, spreads into the delta area, with much of it contributing to ponded or marshy areas. The ISC has been conducting extensive efforts to address this situation.

While evaporation for small ponds shaded by trees and other growth, such as backwaters being constructed along the river for silvery minnow habitat, may have evaporation rates equal to or smaller than that of riparian vegetation, evaporation from exposed open water bodies generally exceeds riparian evapotranspiration. Reduction in surface areas of these larger ponds could, therefore, result in reduced depletion for the region.

8.5.1 Technical Feasibility

Field studies to support the characterization of the water budget in the delta area have not been conducted, but the following general statements can be made:

- Water from the LFCC and the river spreads across the delta area. The disposition of these waters includes seepage into the subsurface, open water evaporation, evapotranspiration by riparian vegetation, and surface flow to the reservoir through a network of smaller channels.

- Water in the shallow subsurface of the delta area has the following disposition: evaporation from wetted soils, riparian evapotranspiration, subsurface flow to the reservoir, and interception by portions of the LFCC in places where the LFCC water surface lies below the shallow groundwater elevation. The relative quantities of these dispositions are unknown.

A channel (called the Pilot Channel) is currently under construction to reconnect the river to the reservoir. The downstream reach of this channel also intercepts a main area of spreading LFCC drainage. The intent of these maintenance activities is to provide a channel that can effectively carry spring runoff to the reservoir, thus avoiding the spreading of floodwaters into the delta area. If these activities are successful, the delivery of water will return to what might be considered a “baseline condition,” akin to conditions that existed prior to the flooding and high waters that occurred in the 1980s. At present, the depth of the channel has not been designed to drain subsurface water to an elevation beyond the reach of riparian vegetation.

Both the ISC and USBR are currently involved in efforts related to the Pilot Channel. More than 11 miles of the channel have been completed, with a width of 100 to 150 feet and depth of 3 to 5 feet (Stageman, 2003). The previous channel was poorly defined, and it has therefore been straightened and sediment plugs have been removed so that it is now a viable channel. Due to possible drought conditions, the water level in the reservoir will likely drop and the pilot channel will need to be extended.

8.5.2 Political Feasibility and Social/Cultural Impacts

Public comments received during the planning process for this water plan support reduction in evapotranspiration losses and improvements to the LFCC in an effort to keep Compact deficits from occurring. Additional comments received suggest that implementation of this alternative in national wildlife refuges may not be acceptable because the open water areas are a key part of the wildlife habitat and adverse impacts to the refuges could negatively affect tourism.

8.5.3 Financial Feasibility

As discussed in the water conservation plan (Appendix H), the cost to implement this alternative is likely beyond the ability of local governments. State and federal water management agencies are better prepared to deal with implementing this alternative in order to meet Compact obligations. As discussed in Section 8.8, the ISC and USBR are currently involved in efforts related to this alternative.

8.5.4 Hydrological Impacts

This section summarizes the hydrological impacts for this alternative as determined by SSPA. The complete SSPA documents regarding this alternative are contained in Appendix E1. To perform the hydrological analyses, SSPA used their water supply model and considered only savings in the Socorro district of the MRGCD. Although the estimates do not include the entire region, they give an idea of the amount of water that would be saved by implementing this alternative.

Reduction of water surface areas, such as a reduction in the wetted area of the Elephant Butte delta and reduction of ponded areas between San Marcial and the reservoir, is important for efficient delivery of water to Elephant Butte Reservoir for meeting obligations under the Rio Grande Compact. Under current conditions, the open water and swamp portions in the delta are significant and result in high evaporative losses. There are also some smaller open water areas in wildlife and game refuges within the Socorro-Sierra region. Reduction in these open water areas could reduce the amount of water lost to evaporation. Those reductions in evaporative losses will not directly provide water to the region, in terms of making new water available for appropriation and use within the region, but efforts to ensure that Compact deliveries are maintained will make conflicts over existing supplies less likely, particularly during drought periods. SSPA analyzed the reduction in water depletion that might be realized through implementation of this alternative for two conditions:

A. Evaporation control in exposed areas of Elephant Butte Reservoir

B. Evaporation control through reduced water surface areas elsewhere in the planning region

Condition A addresses evaporation control through reduction in open water evaporation and riparian colonization in exposed portions of the north basin of Elephant Butte Reservoir when reservoir levels are low. Drainage of a portion of the Elephant Butte delta and the exposed north basin is currently being undertaken by the State of New Mexico through construction of the Pilot Channel. As of July 2003, this effort appears to have successfully drained several ponded areas in the portion of the north basin south of Nogal Canyon, and in general, flow and drainage have improved in the areas where the channel has been completed. However, it appears that once areas are drained or exposed by receding reservoir waters, salt cedar, and occasionally willow, colonize the area within about 3 months.

In implementing Condition A, the following assumptions were made:

- The state will complete the Pilot Channel through the north basin of Elephant Butte Reservoir and will maintain the channel as long as the reservoir levels remain low.

- With the Pilot Channel in place, there will be little ponded water in the northern basin of the reservoir.

- In the absence of further intervention in the north basin, 90 percent of the exposed portion of the northern basin of Elephant Butte Reservoir is subject to colonization by growth of non-native species, with an evapotranspiration rate of 4 acre-feet per acre.

- With intervention, only 50 percent of the exposed portion of the northern basin of Elephant Butte Reservoir is subject to colonization by non-native species, resulting in a savings of 1 acre-foot per acre of water (by replacing salt cedar, at a consumptive use of 4 acre-feet per acre, with native vegetation at a consumptive use of 3 acre-feet per acre) over 40 percent of the total north basin acreage of 14,196 acres (Appendix E1, Section 4.4.5).

"Intervention" could be in the form of salt cedar removal and replacement with native riparian vegetation or in the form of active drainage projects (i.e., lowering the Pilot Channel at the northern end of the reservoir in order to lower the water table in the area, potentially reducing riparian habitat). In the SSPA base case model analysis (Appendix E1), riparian evapotranspiration from the north basin area of Elephant Butte is included in the Elephant Butte losses term. For the base case it is assumed that evapotranspiration losses occur on 90 percent of the exposed portion of the north basin.

An alternate distribution was calculated for Condition A under the assumption that intervention reduces evapotranspiration losses by 1 acre-foot per acre over 40 percent of the exposed north basin area, while 50 percent of the exposed north basin area continues to experience 4 acre-feet per acre of evapotranspiration. Using the model developed for the middle Rio Grande water supply study, SSPA estimated the amount of water savings from implementing Condition A of this alternative to be 11,855 ac-ft/yr. If the area could be kept clear of recolonized vegetation, which would require extensive maintenance, considerable additional savings could be realized (SSPA, 2003 [Appendix E1]).

In implementing Condition B, evaporation control through reduced water surface areas elsewhere in the planning region, the following assumptions are made:

- Open water acreage between the Socorro County line and the north end of Elephant Butte Reservoir is 6,344 acres.
- Ten percent of the open water acreage, or 634 acres, could be converted to native bosque.
- Open water evaporation for this area is 5.6 acre-feet per acre (average annual rate for open water for the Bernardo to San Acacia and San Acacia to San Marcial reaches).
- Native bosque evapotranspiration for this area is 3 acre-feet per acre (King and Bawazir, 2000).

Using their Middle Rio Grande water supply model along with the above assumptions, SSPA estimated the amount of water savings from implementing Condition B of this alternative to be 1,649 ac-ft/yr.

8.5.5 Environmental Impacts

As stated in the 2003 Programmatic Biologic Assessment (USBR and USACE, 2003), during pilot channel construction, measures are being implemented to minimize the impact on the silvery minnow and southwestern willow flycatcher and their associated habitats. In addition, efforts are made to enhance the local riparian conditions, including adding sinuosity to the Pilot Channel, constructing the channel with a variable width, constructing low water crossings along the temporary channel to allow for overbank flows to inundate the existing native riparian vegetation and encourage native revegetation, and widening the channel in the southern reach of the Bosque del Apache refuge to improve aquatic and riparian habitat (USBR and USACE, 2003). The USFWS has concurred with the USBR's determination that the project "may affect, but is not likely [to] adversely affect, either the silvery minnow or the southwestern willow flycatcher provided that additional monitoring and annual reporting be included for the silvery minnow" (USBR and USACE, 2003).

The current acreage for ponded areas between San Acacia and the Elephant Butte delta is not available. If this alternative is pursued in this portion of the region, the value of these areas to habitat and the ecosystem would need to be considered carefully, along with the value that many in this region place on the benefits provided by these open water areas. Furthermore, many of these stand-alone ponds lie within state and federal wildlife and game refuges, and these areas are beyond the region's direct control.

Decreasing depletions, which is the focus of this alternative, increases the probability that the river can remain wet, and any means of increasing surface water reliability provides better assurance that the endangered silvery minnow will survive in the Rio Grande.

8.6 Require Proof of Sustainable Water Supply for Approval of New Developments

While the State of New Mexico recognizes the need to provide adequate water supplies for new development, the responsibility of passing ordinances that require proof of available water supply lie with counties. However, lack of a technical definition of a long-term water supply, inconsistent standards among counties, and insufficient requirements for municipalities allow for development to proceed under varying degrees of protection of water supplies. The purpose of this alternative is to evaluate the potential for protecting Socorro-Sierra water supplies by ensuring that development proceed only when long-term viable water supplies, that don't impact existing users, are in place.

8.6.1 Technical Feasibility

The New Mexico Subdivision Act mandates that counties pass subdivision ordinances requiring developers to demonstrate that a proposed subdivision will have water supplies of sufficient quantity and quality to meet demand (NMSA 47-6-11 (F)). As part of the approval process, both the OSE and the NMED must review the subdivider's water availability documentation. In

Socorro and Sierra Counties, subdivision regulations require proof of a 40-year water supply, and the counties rely on the OSE to determine whether that condition has been met.

The subdivision act does not apply to municipalities, although they do have the power to adopt city ordinances governing land platting, planning, and zoning (NMSA 3-19-1 through 12; 3-20-1 through 3-20-16). Specifically, municipal subdivision regulations may govern the extent and manner in which water will be provided to the subdivision as a condition of plat approval (NMSA 3-19-6 (B)(5)(b)).

Limitations to the subdivision act requirements stem from the lack of consistency in how counties apply the statute in their ordinances. For example, ordinances can require proof of water typically for 40 years, though some counties have chosen to require proof of water for up to 70 years. Depending on existing and projected cumulative use and local hydrology, these time frames may not be sufficient. The definition of “adequate” can vary, and counties have not necessarily technically defined what water availability means. Consistent technical definitions of water availability and adequacy for the counties in the region, as well as a consistent means of evaluating the cumulative effect of multiple subdivisions over time, are technical issues that need to be resolved to ensure that development proceeds based on long-term, reliable water supplies.

New subdivisions within municipalities are typically served by a municipal system, and a municipality could include consideration of system capacity in its land use regulations. For example, the City of Albuquerque requires a written statement of water and sewer availability for any proposed development project for building permits, site plan, or subdivision approval. Again, a jurisdiction that ties approvals to system capacity should have a sound technical basis for evaluating development and implementing such regulations.

The existence of county regulations doesn't necessarily mean that subdivisions will be required to comply with the water availability requirements. Cases have occurred in which the OSE has issued a negative opinion about the water supply availability for a proposed subdivision, yet the county commission has nevertheless approved the subdivision (Drennan, 1997). Additionally, developers can take advantage of lax municipal water supply requirements. In cases where the county commission has denied a permit, developers have convinced nearby municipalities to annex the subdivision in order to allow the subdivision to move forward. Efforts to protect water supplies for future use will require the cooperation of informed county commissions, municipalities, and other planning agencies

In 2001 the State of California passed legislation (SB 221) linking water supply to subdivision approval. The text of the bill defines "sufficient water supply" as "the total water supplies available during normal, single-dry, and multiple-dry years within a 20-year projection that will meet the projected demand associated with the proposed subdivision in addition to existing and planned future uses, including but not limited to, agricultural and industrial uses."

What is significant about this legislation is that it addresses the cumulative effects of existing water supplies coupled with the proposed subdivision. In New Mexico, cumulative effects are often not considered:

- In some cases where models exist, the OSE may evaluate cumulative impacts of development. However, in more rural areas, the OSE typically reviews pump tests for the proposed well to determine whether that well has sufficient water to continue pumping during the length of time specified in the county subdivision act. This process does not take into consideration the cumulative impacts on the entire groundwater basin of the proposed additional pumping, and the OSE often does not have the data to make that determination, because they receive individual permit requests rather than a comprehensive development plan.

- Presumably, when a subdivider applies for a water right, impacts to neighboring wells are addressed through the protest process. However, if the proposed water right has only minor impacts, then the OSE may find that no impairment exists, even though the cumulative, long term impact of numerous developments may be significant.

- Domestic wells are exempt from the Subdivision act, and neither the immediate or cumulative impacts of these wells are considered in determining available water supply. Steering Committee members have indicated that cases have occurred within the region where water rights for a particular parcel of land have been transferred from agricultural land to other users, but then the agricultural land is converted to subdivisions with domestic wells, which continue to withdraw from the aquifer. This practice allows for increased withdrawals that could impair other water users, yet there is no opportunity for protest or evaluation of impairment. There have been attempts to address this issue with legislation, but none of them have yet succeeded.

In areas where an existing water system will supply new subdivisions, infrastructure development requirements that would tie development approvals to existing or planned system capacity could address water supply availability. Local governments could better link capital improvements to the timing of new development by identifying growth areas in advance and providing new publicly funded infrastructure to serve these areas in a timely manner. Conversely, local governments have established concurrency ordinances which require that new development is restricted to areas where infrastructure capacity exists or will be available within a specified period of time. This approach may not alter the type or cost of improvements, but would affect the timing of construction.

If water suppliers do not have the capacity to serve new development, they may either increase capacity through system expansion or refuse to provide services. If a water supplier does not provide service and local governments have no provision for private utilities, then development will go elsewhere. Planning in a rational way for system expansion and for an equitable sharing of cost between developers and existing ratepayers may be the preferable method of directing growth in the region.

Typically, a public water supplier provides a master plan for its system without any change to existing laws. However, cost sharing would be defined through the supplier's rate structure and modifications to local subdivision and/or other ordinances. To meet future capacity needs, the water supplier must also determine that funding will be available as needed through revenues, developer fees, and other sources. Outside funding sources might include state and federal loans and grants.

8.6.2 Political Feasibility and Social/Cultural Impacts

Ensuring sufficient water supplies for new development while taking into account existing demand would benefit all residents in the region by protecting their water supplies. However, initiatives that are perceived to slow growth and development, or to provide added regulation, tend to generate significant political opposition. Additionally, developers will likely oppose any attempts to limit their ability to construct new developments at will, and their financial resources to fight proposed legislation are usually greater than those of the local governments, nonprofit groups, and other interested parties who would support such legislation. Opinions expressed at Steering Committee and public meetings indicated mixed support for this alternative, indicating that while protecting the public and subdivisions homeowners is important, added regulation is generally not welcome.

8.6.3 Financial Feasibility

The impact of not implementing this alternative could be negative, if growth occurs without adequate water supplies. The long-term effect is depletion of groundwater, falling water levels, and wells going dry. If this happens on a wide scale, costly projects will be required to either import water or deepen wells.

The cost of developing new legislation to further refine the technical aspects of proof of water availability will be limited to the time and materials expended in this effort. The greatest expense for requiring proof of adequate water supplies may be the technical evaluations required for a rigorous analysis. Neither county has adequate resources at the present time to evaluate the adequacies of water supplies, and they must thus continue to rely on the OSE's process.

8.6.4 Hydrological Impacts

No new water will be made available to the region as a result of this alternative, but senior water rights will be better protected. Instituting more protections regarding water supply will protect the region from development that is faced with future water shortages.

8.6.5 Environmental Impacts

This alternative is not expected to create any environmental impacts. Ensuring that development proceeds only when adequate water supplies have been secured should protect against potential undesirable impacts to other users or the environment that may result from groundwater overdraft.

8.7 Encourage Retention of Water Within the Planning Region

This section discusses several different approaches for encouraging water rights holders in Socorro and Sierra Counties to continue to use their water in the region and avoid selling to out-of-region buyers. These approaches can be characterized as either land use approaches or water rights transaction approaches. A land use approach is any effort to keep land in agriculture as a means of keeping water in the region. Water rights transactions are mechanisms to influence whether a transfer occurs or, in cases where a water transfer is inevitable, actions to offset the negative impacts from water being transferred out of the region.

In the western United States, agriculture has traditionally been where most water rights are used, and the agricultural sector has thus typically been the source of new water for municipalities (Tarlock, 1999). Farming can be a low–profit, marginal occupation, and farmers experiencing financial difficulties often have few assets other than their land and the associated water rights. In a market where water rights can go for more than $5,000 an acre-foot, it may be very difficult for land and water rights holders in this situation to turn down a purchase offer. This alternative therefore focuses on ways to counter-balance such pressures.

8.7.1 Technical Feasibility

Potential avenues to encourage retention of water rights within the region include:

- Conservation easements
- Transfer of development rights
- Efforts to influence water rights transactions
- Area of origin protections

These approaches are discussed in Sections 8.7.1.1 through 8.7.1.4.

8.7.1.1 Conservation Easements

In the West, many non-profit organizations dedicated to farmland protection (e.g., American Farmland Trust, Rio Grande Agricultural Land Trust) advocate the use of conservation easements to keep land in agriculture. Land use easements are permanent restrictions on the use or development of the land so that its conservation values remain intact. Under the New Mexico Land Use Easement Act, a conservation easement is defined as “a holder’s non-possessory interest in real property imposing any limitation or affirmative obligation the purpose of which includes retaining or protecting the natural or open space values of real property assuring the availability of real property for agricultural, forest, recreational or open space use or protecting natural resources” (NMSA 47-12-2(B)). New Mexico law allows the granting of land use easements to “preserve the availability of real property for agriculture” as well as “the protection of natural resources” (NMSA 47-12-2(A)).

Conservation easements can only be valid if an owner willingly grants the easement (NMSA 47-12-3(E)). In many parts of the country, farmers are compensated for granting these easements through local, state, and federal programs. However, in New Mexico, the only program currently available to compensate farmers for conservation easements is the federal Farmland Protection Program, which was created as part of the 1996 Farm Bill. New Mexico’s first participation in the Farmland Protection Program occurred in 2003 with the Village of Corrales and the Rio Grande Agricultural Land Trust receiving a $1.1 million grant for acquisition of conservation easements. An alternative to selling conservation easements is to donate them to a qualifying land trust, which provides the donor with significant tax benefits.

Whether an easement can be granted to restrict the use of a water right to one particular sector is unclear. The New Mexico Constitution requires that water be used beneficially, and agriculture is considered a beneficial use. However the Land Use Easement Act contains the following provision: “. . . no application or permit for a change in point of diversion place or purpose of use of a water right at any time shall be impaired, invalidated or in any way adversely affected by reason of any provision of that act” (NMSA 47-12-6(C)).

In the case where an owner of property with a valid land use easement wishes to convey the water rights, this provision appears to allow that to occur. The land could remain in dry land farming (thus still in agriculture), with the water right transaction still occurring. To attempt to block a water right transfer by claiming that it violates an existing conservation easement would appear to be contrary to this provision. No New Mexico case law addresses this provision of the act.

Conservation easements are useful for farmers who wish to protect the future use of their agricultural lands. If a willing buyer of the easement can be found, the farmer will obtain compensation without having to sell his or her land or water rights. Regional (e.g., Rio Grande Agricultural Land Trust), statewide (e.g., New Mexico Land Conservation Collaborative), and national (e.g., American Farmland Trust) land trusts have many resources to assist farmers in protecting and retaining their land in agriculture. If the water is not being put to beneficial use through active farming, it would be beneficial to have a local water bank in place that only leases water rights within the region so that the water right can be protected. Links to many of these resources can be found at http://www.rgalt.org, http://www.lta.org/findlandtrust/NM2.htm or http://www.farmland.org/rocky_mountain/newmexico.htm.

8.7.1.2 Transfer of Development Rights

This mechanism allows for the transfer of development rights for one parcel of land to another parcel of land. Generally, this is implemented through local zoning ordinances. In order to protect agricultural lands, implementation of this concept involves moving development rights of agricultural land to other lands located closer to the areas of growth, thereby preventing the conversion of agricultural land to residential or commercial developments. The owner of the parcel of land receiving the development rights can generally build at a higher density than is allowed under existing zoning, while the owner of the agricultural land derives some financial gain from the development potential of his/her land without taking it out of agriculture.

New Mexico has no legislation in place that specifically permits this type of transaction to protect agricultural lands. A bill proposing this concept (HB 363) was introduced in the 2001 New Mexico legislature, but was not passed. In other areas where this type of transaction is allowed, its implementation has met with limited success (Hanly-Forde et al., Undated).

Some of the challenges faced when implementing such a program are insufficient local support, difficulties in administering the program, changing land use needs, and the need for cooperation across jurisdictional boundaries.

8.7.1.3 Efforts to Influence Water Rights Transactions

Water is a property right that individuals own and can sell if they find a willing buyer. Efforts to impede a water right holder from selling his or her right directly cannot violate basic property rights. New Mexico water law does allow individuals to protest a transaction. However, the State Engineer will generally not deny an application or condition a permit unless the protestant can make a compelling case that his or her existing water right will be impaired by the transaction. Even lowering of the groundwater levels of existing wells does not necessarily support a claim of impairment (*City of Roswell v. Berry,* 80 NM 110 (1969)).

Another way to influence water rights transactions could take place through water banking. Water banking allows an individual to "deposit" the water right in a "bank" for use by a third party. Through this mechanism, the water right holder can benefit financially by leasing the water right without having to sell it or see it move outside the region. The MRGCD has established such a local water bank with detailed rules for evaluating loan applications and determining loan rates (NMAC 21.7.5). Nevertheless, since the MRGCD extends into Valencia, Bernalillo, and Sandoval Counties, water placed in the MRGCD water bank could be transferred outside the region unless the owner places some type of condition regarding the place of use for that water right. The MRGCD water bank rules state that water right loans for agricultural uses are preferred, which encourages keeping land in agriculture rather than seeing the water move to a different type of use (NMAC 21.7.5.8).

For water rights holders in the Socorro-Sierra Region but outside the MRGCD, a statewide water bank would be necessary to allow those users to protect water rights by depositing them in a water bank for lease within the region. With the passage of recent water banking legislation, the State of New Mexico may consider establishing a statewide water bank that could serve this purpose.

8.7.1.4 Area of Origin Protections

The transfer of water out of the region can have negative impacts to the local economy and way of life (Howe, 2000). Legislating area of origin protections to offset those impacts may at least provide benefits to the region even if the water is being transferred elsewhere.

A recent study addressing interbasin transfers proposed a set of 22 criteria that the state agency granting water rights should consider prior to granting a permit for an interbasin transfer (Interbasin Transfer Working Group, 2002). Many of these provisions are applicable to interregional transfers and could be useful for furthering the intent of this alternative. Based on this list (with slight modifications to tailor it to the Socorro Sierra region), the following criteria to be considered in reviewing water rights applications might be proposed for area of origin legislation:

- Protection of the present uses and consideration of projected uses of the region-of-origin, including but not limited to present agricultural, municipal, industrial, and instream uses, and assimilative needs, with special concern for low-flow conditions

- Protection of the water quality in the region of origin at low-flow conditions

- Impacts of the proposed permit on the region-of-origin economy, cost effectiveness, and the environment in relation to alternative sources of water supply

- Imposition of a mitigation fee to offset adverse impacts of an out-or-region transfer

- The overall current water demand and the reasonably foreseeable future water needs of the region of origin

- The supply of water presently available to the receiving region, as well as the overall current water demand and the reasonably foreseeable future water needs of the receiving region, including methods of water use, conservation, and efficiency of use

- The beneficial impact of any proposed transfer and the capability of the applicant to effectively implement its responsibilities under the requested permit

- The nature of the applicant's use of the water, to determine whether the use is reasonable and beneficial

- Verification that the receiving region has implemented all reasonable efforts to promote conservation

- Verification that the proposed project uses all available methods, programs and incentives to promote conservation of water

- Requirements of other state or federal agencies with authority relating to water resources

- The availability of water to respond to emergencies, including drought, in the region of origin and in the receiving region

- The quantity, quality, location, and timing of water returned to the region of origin, receiving region, or a downstream region

- Climatic conditions

- The number of downstream river miles from which water will be diverted as a result of the transfer

- Concerns of local governments affected by the proposed transport and use

- The cumulative effect on the donor region and the receiving region of any water transfer or consumptive water use that is authorized or projected

In order to implement this alternative, the region would need to convince legislators to draft legislation adopting these or similar permit review criteria.

8.7.2 Political Feasibility and Social/Cultural Impacts

Efforts to retain water in the region are designed to benefit the local economy, water suppliers, and other water rights holders in the region. Retaining water in agriculture means that local businesses supplying that sector will continue to thrive. Other agricultural water rights holders benefit from a system-wide continued use of water, especially in small systems where ditch maintenance is often the collective responsibility of the farmers who use it. Finally, the local economy and municipalities will benefit if they can find sources of water to meet future demand within the region without facing competition from the larger upstream municipalities.

In addition to the economic implications, agriculture is a vital component of the Socorro Sierra region, and implementation of this alternative contributes to the preservation of agricultural lands and the local character and culture of the region. From an aesthetic perspective, maintenance of agricultural lands enhances the quality of life for the surrounding area, as it creates a greenbelt in an otherwise desert landscape.

8.7.3 Financial Feasibility

Several federal programs, many of which are managed by the USDA-NRCS, indirectly support the preservation of agricultural land and retention of water rights, by providing funding to farmers to perform a variety of tasks, from granting conservation easements to improving and protecting wetlands and wildlife habitat on their lands.

In many cases, demand outweighs the supply of funds available. Links to information about these programs can be found at the NRCS web site (http://www.nm.nrcs.usda.gov/ farmers.html). Because these programs generally involve a cost-sharing component, farmers must have private financing to take advantage of these funds.

In the private sector the number of sellers of conservation easements is greater than the number of buyers with sufficient funding. While many landowners would likely welcome an offer from an individual or organization to sell a conservation easement in their property, buyers for conservation easements usually include private land trusts or organizations like the Nature Conservancy that use donations to purchase land and easements. Because these nonprofit organizations have limited resources, the financial feasibility of this alternative is limited, and in all likelihood, the number of willing buyers for water rights dwarfs the number of buyers for conservation easements. For example, organizations in the State of Colorado, which has a state lottery-funded grant program that provides matching funds for conservation easements to nonprofit organizations such as land trusts, can only purchase a limited number of those conservation easements that sellers have offered.

When a conservation easement has been donated or sold, landowners can take advantage of fiscal benefits offered through state and federal tax law.

- Donated conservation easements may be treated as a charitable gift under the federal tax code (IRS 170(h)). Donors can deduct an amount equal to 30 percent of their taxable income the year of the gift. Donations valued in excess of that amount can be carried forward and applied against their taxable income for up to 6 years in the future.

- The New Mexico tax code provides for special tax treatment for land used primarily for agriculture (NMSA 7-36-20). Under this provision the property value of the land is assessed for its agricultural use rather than a higher use that might significantly increase the property value and associated taxes, thus forcing landowners to sell the land because they cannot afford to keep their land in agriculture.

- For estate tax purposes, the conservation easement will keep the land in a lower property tax value, possibly preventing heirs from being forced to sell the land or water rights in order to afford the estate tax.

- Federal legislation passed in 1997 created an estate tax incentive for landowners to grant conservation easements. Executors can exclude 40 percent of the value of land subject to a donated qualified conservation easement from the taxable estate (I.R.C. § 2031(c))

8.7.4 Hydrological Impacts

Retaining water within the region can have several hydrologic benefits. Continuing the use of water within an irrigation system, be it an acequia or a conservancy district, will help retain flows and seepage that contribute to local hydrology. Once water is no longer used in the region it is diverted upstream or is considered an offset for upstream use through groundwater pumping at the move-to location. This pumping has an effect on the river, causing additional water to seep from the river bed to the groundwater, rather than flowing to downstream regions.

In complex hydrologic systems, the movement of one water right generally has a more significant impact in the move- to location, where a new well is proposed whose pumping is likely to affect existing well owners in that area. However, some impacts can occur at the move-from location:

- If a surface water right, particularly on the Rio Grande, is transferred from the downstream end to a reach further upstream, the downstream reach will have less water.

- In a ditch system, where participation in ditch maintenance is essential for all users, fallow land can present a problem, because those landowners no longer participate in ditch maintenance.

- When landowners fallow their land, less water must be diverted through the ditch system. Without sufficient head in the ditch, however, there may not be enough water to reach the intended destinations.

- Seepage from ditch systems contributes to maintaining shallow groundwater levels, and the domestic wells drawing from this part of the aquifer may be impacted if seepage is reduced because not enough water is diverted into the system.

8.7.5 Environmental Impacts

In the Socorro-Sierra region, keeping land and appurtenant water rights in agriculture will have a variety of environmental benefits.

- Agricultural lands in the region provide habitat for much local and migrating wildlife.
- Groundwater seepage from the irrigation canals recharges the shallow aquifer and helps sustain the bosque.
- Utilization of water in the Socorro-Sierra water planning region keeps the Rio Grande wetter than it would be if the water rights were diverted upstream of this region, thereby helping the silver minnow and overall health of the Rio Grande.

8.8 Remove Exotic Vegetation on a Wide Scale

This section discusses the removal of exotic vegetation in riparian systems. Riparian zones occur along all streams and rivers, but this discussion focuses primarily on the Rio Grande bosque area, as exotic species such as salt cedar (tamarisk) and Russian olive are a problem primarily in that part of the planning region. Exotic species are also prevalent along the intermittent tributaries to the Rio Grande, such as the Rio Salado and Rio Puerco. The purpose of this alternative is to evaluate the potential to increase water yields through wide-scale removal of this exotic vegetation and long-term vegetation management.

8.8.1 Technical Feasibility

Restoration efforts using herbicides and/or mechanical removal have been carried out at numerous locations along the Rio Grande within the planning region. Efforts to restore the native vegetation in the Rio Grande bosque are constrained by the existing channel morphology and alteration of the flow regime to manage the river. If a vegetation management plan is not implemented, however, exotic species will continue to increase in dominance while native species decline.

Significant effort and research on the removal of exotic vegetation, establishment of native vegetation, and bosque management have been ongoing at the Bosque del Apache National Wildlife Refuge. Techniques for exotic vegetation removal used by the refuge include a combination of mechanical, burning, and herbicide methods. One combination method that is often referred to as "cut-stump" involves mechanical removal of the vegetation followed by application of herbicide on the cut stump. In general, herbicide methods have not been as successful as mechanical methods. The effect of general-use herbicides can be toxic to cottonwood trees, and therefore mechanical means may need to be used in areas with mixed native and exotic vegetation (Cleverly, 2003).

Within the planning region, the Save Our Bosque Task Force has created 18 "pocket parks" along the Rio Grande bosque by clearing forests of salt cedar and creating a picnic area for public use (Stowe, 2003). Development of a five-phase plan as a part of the Middle Rio Grande ESA Collaborative Program to restore the active floodplain of the Rio Grande from San Acacia to San Marcial is in progress. Phases include (1) data collection and analysis, (2) determination of specific river issues, (3) development of restoration concepts and strategies, (4) development of a riparian corridor restoration plan, and (5) preparation of a monitoring program (Dello Russo, 2002).

The Socorro SWCD is currently in the process of treating more than 7,600 acres with a helicopter herbicide spraying program. Treated exotic vegetation areas include locations along the Rio Salado, in the Sevilleta National Wildlife Refuge, and along the Rio Grande from Bernardo to Rincon, New Mexico (Stowe, 2003). Global positioning software (GPS) allows the helicopter to spray only in designated areas, leaving a quarter mile radius of non-treated vegetation around southwestern willow flycatcher nest sites that have been identified by the USFWS.

8.8.2 Political Feasibility and Social/Cultural Impacts

The amount of water that can be gained from bosque restoration is affected by current laws and regulations, which indicate that any "additional" runoff created by riparian restoration becomes part of the public water supply and is subject to the prior appropriation system. This policy effectively means that water rights holders downstream of the treated area may be more likely to receive their full supply, regardless of their role (or lack thereof) in the land management activities leading to the increased supply. Though there will not be a direct benefit through new water rights, reducing riparian depletions in the Socorro-Sierra region will help the State to meet Rio Grande Compact deliveries.

Public comments received during the planning process for this water plan suggest strong support for salt cedar removal efforts. Requests were made to monitor the effects of the use of chemicals on public health and on endangered species habitat (e.g., silvery minnow, southwestern willow flycatcher).

8.8.3 Financial Feasibility

Reestablishing a functioning riparian zone with native riparian vegetation can be very costly. These areas often have to be planted and seeded, and relatively intensive efforts to control regrowth of exotic species may also be required, particularly in the first few years after planting. Large areas of riparian vegetation are privately owned, and the implementation of an aggressive program to restore riparian areas will require substantial expenditures with relatively small financial returns, at least in the short or medium term. Hence, some kind of financial assistance program generally will be needed if large areas are to be treated or restored. As discussed in the water conservation plan (Appendix H), in 2002 the New Mexico legislature allocated $2.5 million for the management of exotic vegetation. As a result, 7,600 acres within the planning region are currently being treated using the Socorro SWCD helicopter program. The helicopter program costs about $190 per acre treated plus salaries for four full-time staff members (at an estimated total salary cost of $130,000).

On the Bosque del Apache National Wildlife Refuge, exotic vegetation removal costs vary from $180 to $1,000 per acre depending on the methods implemented (Cleverly, 2003). Herbicide use is less expensive than mechanical removal. The cost for the “pocket parks” discussed above varied from less than $1,000 to $2,000 per pocket park (Stowe, 2003).

8.8.4 Hydrological Impacts

As discussed in Section 6, with the exception of Elephant Butte Reservoir, riparian evapotranspiration, at 157,600 ac-ft/yr, is the largest consumptive use in the region. Therefore, reductions in riparian evapotranspiration have the potential to significantly impact the regional water budget. This section summarizes the hydrological impacts for this alternative as determined by SSPA. The complete SSPA documents regarding this alternative are contained in Appendix E1.

To perform the hydrological analyses, SSPA used their water supply model and considered only savings in the Socorro district of the MRGCD. Although the estimates do not include the entire region, they give an idea of the amount of water that would be saved by implementing this alternative.

Depending on how it is implemented, removal of exotic vegetation has the potential to result in either significant reduction of consumptive use, little change in consumptive use, or possibly even an increase in consumptive use.

- In some areas the water table can be lowered, with the addition of drainage, such that the area ceases to be riparian habitat. Once vegetation is removed and drainage installed, the area will become scrub or grassland with little or no direct evaporative loss. In such cases, the evaporative savings will be on the order of 4 acre-feet per acre, the average evapotranspiration loss from salt-cedar (King and Bawazir, 2000). This approach may be possible in areas such as the east side of the Rio Grande north of San Antonio where arroyos no longer connect to the river, instead serving only to water large areas of salt cedar. Reconnection of the arroyos to the river, as some property owners appear to be working on, might also reduce salt cedar habitat along the eastern margin of the currently vegetated area. If this re-engineering is combined with salt cedar removal, the area could prove a valuable opportunity to test the effectiveness of this course of action in reducing salt cedar acreage.

- If non-native vegetation is removed but the water table remains high enough to support riparian growth, revegetation with native riparian plants is required to avoid recolonization by non-native species. Removing non-natives and revegetating with native plants may result in evaporative savings on the order of 1 acre-foot per acre, reflecting a change from salt-cedar (at a consumptive use of 4 acre-feet per acre) to native bosque (at 3 acre-feet per acre) (King and Bawazir, 2000).

- If the area is not revegetated with native riparian species, either non-natives will recolonize the area, resulting in no water savings, or the water table may rise, resulting in saturated soils and standing water, which evaporates at 5.6 ac-ft/yr, thereby increasing consumptive use.

In analyzing the hydrologic impact of this alternative, SSPA assumed that exotic vegetation removal in non-drainable areas would be accompanied by revegetation by native species. To adequately capture both the potential variability in savings based on location of removal and the possible range in acreage on which non-natives are eradicated, different scenarios were evaluated. Using their Middle Rio Grande water supply model (Appendix E1), SSPA estimated the following water savings for three options:

- Removal of non-native vegetation from and draining of 4,060 acres (10 percent of the 40,598 riparian acres between the Socorro County line and the north end of Elephant Butte Reservoir at full capacity), resulting in a decrease in consumptive use of 16,240 ac-ft/yr (4 acre-feet per acre over 4,060 acres). It is assumed that the area can be sufficiently drained so that it will recolonize only in native grasses and scrub, rather than riparian growth.

- Removal of non-native vegetation from 4,060 acres (10 percent of the riparian acreage between the Socorro County line and the north end of Elephant Butte Reservoir at full capacity), replaced with native vegetation, resulting in a decrease in consumptive use of 4,060 ac-ft/yr (1 acre-foot per acre reduction in consumptive use).

- Removal of non-native vegetation from 20,300 acres (50 percent of the riparian acreage between the Socorro County line and the north end of Elephant Butte Reservoir at full capacity), replaced with native vegetation, resulting in a decrease in consumptive use of 20,300 ac-ft/yr (1 acre-foot per acre reduction in consumptive use).

An area of riparian vegetation is also developing in the now-exposed Elephant Butte northern basin. The benefits of treatment in that area are considered in Section 8.5.

There are several potential complications to controlling non-native vegetation:

- The removal of exotic vegetation may potentially conflict with the Endangered Species Act over southwestern willow flycatcher habitat. Global positioning software (GPS) allows the helicopter to spray only in designated areas, leaving a quarter mile radius of non-treated vegetation around southwestern willow flycatcher nest sites that have been identified by the USFWS.

- Once non-native vegetation is removed, it will need to be maintained on a regular basis, or the area will need to be returned to more "natural" conditions such that non-natives have less advantage over native vegetation. Cost of ongoing maintenance, in the former scenario, or the potential for increased water use resulting from re-engineering the area to recreate "natural" conditions, should be figured into the planning.

- Because non-native riparian plant species such as salt cedar consume large quantities of shallow groundwater, to some extent they control shallow groundwater levels. Reconstruction and maintenance of the LFCC to ensure adequate drainage will be important to ensure that waterlogging and evaporative losses are not exacerbated upon removal of salt cedar. Water table response and alternatives for water table elevation management should be built into any vegetation removal plan.

8.8.5 Environmental Impacts

The restoration of riparian zones is generally regarded as being environmentally beneficial. A healthy riparian ecosystem is critical to the health of the adjacent stream in terms of temperature regulation, bank stability, sediment inputs, input of organic matter and large wood, and filtering of sediment and nutrients from overland flow.

Conversely, the effects of certain herbicides may be environmentally unacceptable, and requirements of the Clean Water Act and the National Environmental Policy Act (NEPA) must be addressed if federal funds are used. Any such program may impact flora, fauna, water, and soil, and therefore may require an environmental assessment. Additionally, the use of herbicides requires knowledge regarding their effects, and their application can lead to environmental damage and health risks if used improperly.

The SWCD did not have to perform an environmental assessment prior to implementing their program because they are treating state lands with state funds. The Socorro SWCD is currently monitoring the areas being treated in their helicopter program for any adverse effects from the herbicides being used. To do this they are gathering soil salinity information, wildlife data, shallow ISC well data, USGS well and flow data, and results of USBR herbicide tests on the Rio Grande (Stowe, 2003).

Decreasing depletions (which is the ultimate goal of this alternative) increases the probability that the river can remain wet. Any means of increasing surface water reliability provides better assurance that the endangered silvery minnow will survive in the Rio Grande.

8.9 Watershed Management

Watershed management consists of a variety of activities that can contribute to the health of a watershed, including those that protect or improve water quality, enhance water supply, and/or enhance the ecosystems of the area. Another important benefit of watershed management can be reduction of fuel loads, which in turn minimizes the potential for catastrophic forest fires.

Ideally, watershed management proceeds in a manner that will optimize the benefits in all of these areas.

The first step in developing watershed management plans is to bring together entities and individuals with interests in the watershed, including local, state, tribal, and federal agencies that have some jurisdiction in the watershed, along with private landowners. The key to maintaining this type of group is to make sure it is well coordinated and facilitated, which can be accomplished by hiring professionals who specialize in facilitation or involving employees of land management agencies, if they are available. Numerous resources for watershed groups are available from the U.S. Environmental Protection Agency (EPA) and through the Internet

Once a watershed group has been formed and plans have been developed, strategies that benefit the watershed can be implemented. Examples of such strategies include:

- Management practices for roads, culverts, or other construction projects that minimize erosion and protect water quality from increased sedimentation

- Projects that address water quality issues such as elevated stream temperatures, suspended sediment loads, and impacts from septic systems, mining, or potential contaminant sources

- Grazing practices that minimize water quality degradation, riparian impacts, and impacts to upland watersheds

- Thinning and/or prescribed burns to reduce the risk of catastrophic forest fire and to potentially increase water supplies at higher elevations

Ideally, watershed management activities that address both water quantity and water quality will proceed as an integrated approach. For purposes of determining how watershed management activities can potentially affect the water balance of the region, the remainder of this analysis focuses primarily on watershed thinning activities and their potential for increasing water yield.

8.9.1 Technical Feasibility

The management activity with the greatest potential to increase water yields is to reduce forest density. Thinning techniques to reduce forest density are technically feasible and are conducted on a regular basis throughout the western United States. Feasibility issues for this alternative are more related to adequate funding and environmental concerns, and depending on the location, the potential for gaining additional water. These issues are discussed in Sections 8.9.3 through 8.9.5. The remainder of this section provides technical background on the alternative.

Forested areas are generally categorized into two zones: forests and piñon-juniper woodlands. For the purpose of this plan, these zones are defined as follows:

- Forests are the areas dominated by conifers and aspens; this zone typically occurs at elevations above approximately 7,000 feet.

- Piñon-juniper woodlands are those areas where the overstory is dominated by piñon pine, juniper, or both; this zone typically occurs at elevations below approximately 7,000 feet.

8.9.1.1 Forest Zone

In the past couple of decades vegetation density in the forest zone has generally increased due to the suppression of fire and the limited amount of timber harvest. This increased density has almost certainly resulted in a decrease in water yields. Management activities such as forest harvest or thinning could potentially increase water yields. In addition, reducing vegetation density can help lower the risk of severe wildfires. As seen in the case of the Cerro Grande and numerous other fires (Robichaud et al., 2000; Moody and Martin, 2001), high-severity fires can greatly increase the size of peak flows and surface erosion rates, thus increasing channel erosion, causing downstream sedimentation, and adversely affecting water quality.

In the absence of any efforts to reduce forest density, a continuing high risk, or a gradual increase in risk, of high-severity wildfires can be expected. High-severity fires are of considerable concern because of the potential to destroy property and greatly increase runoff and erosion rates (Robichaud et al., 2000; Moody and Martin, 2001, as cited by MacDonald et al., 2002; McCord and Winchester, 2001). These increases can then have severe effects on downstream channels, aquatic habitat, and reservoir sedimentation rates.

8.9.1.2 Piñon-Juniper

In the piñon-juniper zone there also has been a general increase in tree density, as well as a corresponding reduction in the abundance of forbs and grasses. Past management practices have focused on reducing woody vegetation and increasing the amount of forbs and grasses. Management practices that are used to treat piñon-juniper woodlands, including chaining and prescribed burns, are technically feasible, though the impacts of the treatments on yields may be marginal (Section 8.9.4). Natural widespread loss of piñon trees is currently occurring across New Mexico, due to extended drought and impacts of the bark beetle.

Piñon-pine and juniper woodlands are prevalent in the Socorro-Sierra planning region in areas between about 5,000 and 7,000 feet in elevation. Annual precipitation is typically from 10 to about 15 inches in the piñon-juniper woodlands, and tree species in these communities have evolved both drought and cold resistance. Though the research discussed in Section 8.9.1.1 indicates the potential for water yield increases only at higher elevations, potential water supply impacts due to thinning in piñon-juniper woodlands are discussed here because this zone constitutes a significant portion of the Socorro-Sierra planning region.

Though some improvements in the ecological health of the area and the timing of runoff events can be expected, the opportunities for management actions to affect water yields in the piñon-juniper zone are generally much more limited than in the forested areas. Increased fuelwood harvests would probably have minimal effects on runoff, but the corresponding increase in herbaceous vegetation could improve water quality.

8.9.2 Political Feasibility and Social/Cultural Impacts

Efforts to harvest or thin public forest lands often elicit opposition initially, although efforts to inform and educate the public can create support for these actions that might substantially reduce the risk of high-severity wildfires while having minimal effect on water quality. For example, the City of Santa Fe and the Santa Fe National Forest were able to garner support from local environmental groups by including them in the planning process and developing a monitoring plan that would provide some measure of trust. Efforts to alter the management of piñon-juniper woodlands or other privately controlled areas may be viewed as a threat to local or private controls on land and resource use. However, private landowners participating in watershed groups in some parts of New Mexico have indicated strong local support for this option.

Given the general enhancement of environmental conditions and watershed productivity possible with active watershed management, local rural residents are likely to be allies in these efforts. Nevertheless, some of the management actions discussed herein may encounter local opposition. Piñon and juniper have long been the preferred fuelwood in New Mexico, and any program or action that would reduce or strictly limit access or supply might encounter local opposition. Grazing of sheep and cattle is also a tradition and a source of livelihood for local people in the planning region, and efforts to restrict or control the number of animals and the intensity of use could meet with local opposition. Involvement of the local community in project design and implementation should help alleviate potential conflicts and possible opposition.

Prescribed burning programs often encounter considerable public resistance due to the adverse effect of smoke from the fire on visibility and visual esthetics, as well as concerns about the USFS's ability to control prescribed fires. An extended period of prescribed fire could also raise issues such as the potential effect on tourism.

Designing restoration and management plans in collaborative consultation with affected local communities would help enlist local support and involvement and would integrate valuable knowledge about local resources. Direct socioeconomic and cultural benefits would flow from contracting with local communities and small-scale local enterprises for forest thinning and fire management, riparian system enhancement, erosion control, and/or other stewardship work.

8.9.3 Financial Feasibility

Costs for conducting thinning projects are variable depending on the ease of access, thickness of vegetation, amount of thinning to be done, treatment of slash (i.e., it can be, in order of increasing cost, scattered, piled, burned, or removed), and techniques used (in order of increasing cost, hand pruning, chainsawing, bulldozing). Example cost ranges are:

- In areas with road access, costs for non-commercial thinning are approximately $100 to $200 per acre for ponderosa forest vegetation.
- The piñon-juniper forest is more expensive because there are more small branches and more slash; costs vary from $160 to $280 per acre (Alter, 2003).
- Costs for steeper or more inaccessible terrain could be considerable higher. For example, recent costs for thinning relatively steep terrain within the Santa Fe watershed were approximately $1,000 per acre (MacDonald et al., 2002).
- Reseeding is generally not performed as part of forest thinning programs (Alter, 2003), but should it be conducted, costs for areal reseeding can be in the range of $600 to $2,000 per acre (Lewis, 2000).

These costs do not include expenses for necessary planning or environmental studies, which may be significant.

The primary ongoing cost of forest thinning projects is the need to address regrowth through periodic thinning or prescribed burns. In general, a ponderosa forest must be thinned at least every 30 to 40 years to prevent fires and to maintain increased water yield. Costs for repeat thinning would be similar to the initial costs (excluding inflation).

Costs for conducting watershed projects that affect water quality are highly variable. A general approach is to identify needed projects in the planning stage and implement those projects as funding becomes available.

Funding for watershed activities can be derived from a variety of sources:

- U.S. EPA Section 319 nonpoint source grants can potentially be used to form watershed groups, to identify nonpoint source issues, and to implement projects that use best management practices. The focus of these grants is to improve water quality conditions.

- In 2002, the New Mexico Water Trust Fund issued a request for funding applications in four categories, one of which was watershed management. Depending on legislative appropriations, this may be a continuing source of funding.

- Other potential funding sources include Natural Resources Conservation Service (NRCS) grants (e.g., Conservation Technical Assistance, Small Watershed Program, Environmental Quality Incentives Program, Conservation Reserve Program, Emergency Watershed Protection).

8.9.4 Hydrological Impacts

In general, water yield increases are proportional to annual precipitation and the proportion of the forest canopy that is removed (Bosch and Hewlett, 1982; Troendle and Kaufmann, 1987, as cited by MacDonald et al., 2002; McCord and Winchester, 2001). Little or no water yield increases can be expected in areas where annual precipitation is less than about 18 to 20 inches (Ffolliott and Thorud, 1975; Bosch and Hewlett, 1982; Stednick, 1996, as cited by MacDonald et al., 2002) or in areas at or near timberline, where there is insufficient vegetation to make transpiration a dominant source of water "loss." In the case of the study area, only limited areas along the western boundary of Sierra County and in the southwest quadrant of Socorro County, generally above 8,000 feet in elevation, average more than 20 inches of annual precipitation (Figure B-6).

Research in Colorado has shown that water yield increases in the higher-elevation lodgepole and spruce-fir forests are directly proportional to the amount of basal area that is removed (Troendle and King, 1987, as cited by MacDonald et al., 2002). However, limitations in the accuracy of streamflow measurements and the regressions between paired basins means that at least 20 to 25 percent of the basal area within a watershed must be removed in order to detect a statistically significant change in runoff (Troendle and King, 1987; Troendle et al., 2001, as cited by MacDonald et al., 2002). Smaller reductions in basal area should proportionally increase streamflow, but the magnitude of increases from small changes in forest density cannot be predicted with any confidence.

The large variability in annual precipitation is another important limitation to managing forests for water yield. Data from the Fool Creek study in central Colorado showed that water yield increases in dry years were only about one-quarter of the increases in wet years (Troendle and King, 1985, as cited by MacDonald et al., 2002). This means that water yield increases from forest harvest would be least in the dry years, when they are most needed, and greatest in the wet years, when they are least needed. Since the relative variability of annual precipitation increases as annual precipitation decreases, the increase in water yield with forest management becomes increasingly variable, and therefore increasingly uncertain, as annual precipitation drops near the threshold of 18 to 20 inches. Additional storage capacity will be needed to carry over excess water from wet years if forest management is to be a viable option for increasing water yields.

Areas with precipitation of 20 inches per year or greater (Figure B-6), which cover approximately 172,000 acres of the region, were used to estimate the potential yield increases in the Socorro-Sierra planning region. The estimated potential yield increases are based on two primary assumptions:

- Based on previous studies in the Rocky Mountains (MacDonald, 2002), it was assumed that yield increases from thinning would be on the order of 0.7 to 0.9 inch over the land treated.

- Because it is probably not realistic to assume that the entire area could be thinned, it was assumed that 30 to 70 percent of the area with precipitation above 20 inches would be thinned.

Table 8-3 illustrates the potential water supply increases in the region. As shown in this table, for the assumed 30 to 70 percent of the high-precipitation area that would be thinned, yield would increase by approximately 3,000 to 9,000 ac-ft/yr. However, as discussed above, this amount would vary from year to year, with lesser yield increases occurring in the dry years.

Table 8-3. Potential Water Supply Increases in Socorro-Sierra Planning Region

Percentage of Total Area Thinned [a]	Area Thinned [b] (acres)	Water Yield Increase (acre-feet)	
		Low-End [c]	High-End [d]
0	0	0	0
10	17,190	1,003	1,289
20	34,380	2,006	2,579
30	51,570	3,008	3,868
40	68,760	4,011	5,157
50	85,950	5,014	6,446
60	103,140	6,017	7,736
70	120,330	7,019	9,025
80	137,520	8,022	10,314
90	154,710	9,025	11,603
100	171,900	10,028	12,893

[a] Within each incremental fraction, at least 25 percent of the basal area (i.e., 25 percent of the vegetation) must be removed to achieve indicated yield.
[b] Total area where precipitation is above 20 inches per year = 171,937 acres.
[c] Calculations assume that thinning results in 0.7 inch of additional water yield over area thinned.
[d] Calculations assume that thinning results in 0.9 inch of additional water yield over area thinned.

Although much of the research on this topic has been conducted outside of New Mexico, the Mescalero Apache Tribe has been conducting extensive forest management, including thinning projects. Anecdotal evidence indicates increases in streamflows due to these forestry projects; however, data reflecting these changes have not yet been collected in the streamflow monitoring program currently being implemented (Hornsby, 2002; Walsh-Padilla, 2003). Additional research on the effects of thinning programs within New Mexico could help to improve confidence in the estimates of potential yield increases.

In summary, the average long-term increase in water yield depends on the annual precipitation, the species being treated, the proportion of the canopy that is removed, the regrowth rate, and the length of time between treatments. Based on these factors, the relative potential for increasing water yields is as follows:

- The greatest potential for increasing water yields is in the higher-elevation fir and spruce forests.

- The aspen and mixed conifer forests have a more limited potential for increasing water yields because of the lower annual precipitation and the more rapid hydrologic recovery of aspen sites.

- The smallest potential for increasing water yields is in the ponderosa pine forests. In these drier sites the remaining vegetation and soil evaporation will take up more of the water that is “saved” by the reductions in interception and transpiration, and less regrowth will be needed before the site has hydrologically recovered. Observed increases in flow from the harvest of ponderosa pine stands in other areas have ranged from zero to a maximum of 2 inches per unit area (Rich, 1972; Brown et al., 1974; Ffolliott and Thorud, 1975; Gary, 1975; Troendle, 1983, as cited by MacDonald et al., 2002). A recent study of the potential for increasing water yields in north-central Colorado assumed that harvesting ponderosa pine would result in no net increase in water yield (Troendle and Nankervis, 2000, as cited by MacDonald et al., 2002).

In any case, the timing of the increase in runoff may not match up well with the timing of peak demand, so storage capacity will be required to obtain the full benefits of any projected increase in streamflow.

Research regarding piñon-juniper management has produced variable results, as indicated by the following examples:

- In 1956, research conducted in Arizona on the removal of piñon and juniper estimated a per-acre yield between 0.5 and 1.0 acre-inch, and in the next decade, a considerable number of acres were cleared using mechanical methods. Almost 20 years later, continued research and field results found that chaparral-infested lands that were treated, which had been dismissed by the first study, exhibited significantly more potential for water yield, while the piñon-juniper acres that were treated provided disappointing results (Hays, 1998).

- A summary of research into the effects of piñon-juniper management on hydrology was provided by Roundy and Vernon (1999). The results of the studies they surveyed were variable depending on watershed conditions, soil types, removal practices (i.e., whether vegetation is left on-site after cutting), and the scale of the projects, and they cannot necessarily be generalized to cover broader conditions. However, several of the investigations indicated that little usable water would result from piñon-juniper management. Conversely, studies in Oregon and Utah reported some benefits to springflow and/or increased infiltration.

- In reviewing piñon-juniper management, Gottfried and Severson (1994) indicated that many control programs failed to produce more water and better wildlife habitat, as had originally been expected.

- Research conducted by Wood and Javed (2001) compared runoff from untreated piñon-juniper stands to runoff from stands where the piñon-juniper were clear-cut and the land was either cleared, burned, or covered with slash. The test plots were monitored from the time of treatment in 1989 until 1999. The findings of this study suggest that treatment of slash following thinning can be used to effect short-term changes in runoff, but that long-term changes are more difficult to achieve. The reestablishment of understory growth may be beneficial for certain land use practices (cattle grazing, fire suppression), but does not appear to achieve greater water yields.

In some cases, the timing and quality of streamflow can change substantially after removing piñon-juniper, even though annual water yields remain unchanged. If the removal of the woody vegetation results in a much denser vegetation cover, there can be a shift during high-intensity rainstorms from overland flow and high surface erosion rates to more subsurface flow and lower surface erosion rates. The greater infiltration may reduce peak flows and cause some streams to flow on a more regular basis. Thus while total annual runoff may be less, the nature of the runoff could be drastically changed. Such changes will be highly site-specific and will depend on a variety of factors, such as soil depth, soil texture, slope, bedrock type, changes in percentage of ground cover, and precipitation amounts and intensities. Sid Goodlow, a rancher in the Capitan area, demonstrated this change by rehabilitating his land, which had become overgrown with piñon and juniper. After removing the piñon and juniper and establishing grass, the once dry arroyos became perennial streams.

The amount of water that can be gained from watershed restoration is affected by current laws and regulations, which specify that any “additional” runoff created by watershed management becomes part of the public water supply and is subject to the prior appropriation system. This effectively means that any appropriator could obtain the increased water generated, regardless of their role (or lack thereof) in the land management activities leading to the increased supply. No mechanism exists whereby the person or entity that increases the amount of runoff can lay a priority claim to the water produced. Furthermore, any permit obtained to use that water would be a new, very junior water right. The more likely scenario in the Rio Grande Basin is that no new appropriations would be allowed, but that existing water rights would receive their full supply in more years.

8.9.5 Environmental Impacts

An extensive program of forest harvest or thinning could increase erosion rates and adversely affect water quality as a result of increased turbidity and sediment loads. The increase in erosion from harvested areas and the accompanying adverse impacts on water quality can usually be minimized by applying best management practices, and studies have shown that the careful design of treatments and the use of best management practices can reduce the watershed-scale impacts of thinning or prescribed fire to very low levels (MacDonald et al., 2002). The careful design and construction of the road and skid trail system is critical to minimizing overland flow and reducing erosion, while the use of buffer strips along ephemeral and perennial streams is needed to minimize sediment delivery into the stream network. Maintaining riparian vegetation is the best means to minimize increases in water temperatures.

The primary environmental advantage of reducing forest density is the reduced risk of high-severity fires. High-severity fires in coniferous forests can increase runoff and erosion rates by one or more orders of magnitude relative to unburned conditions, and these increases can have severe downstream effects such as flooding, reservoir sedimentation, and adverse effects on aquatic habitat. The effects of prescribed fires on runoff and erosion are generally minimal, as the fire severity is mostly low to moderate, resulting in much less soil water repellency or highly discontinuous patches that are water repellent (MacDonald et al., 2002). Areas burned at moderate or low severity also have much lower percentages of bare ground, which according to recent research, correlate very strongly with lower erosion rates. As long as the percentage of bare ground is less than about 20 to 30 percent, post-fire erosion rates should be very low and therefore pose little or no threat to water quality and downstream water resources (Benavides-Solorio and MacDonald et al., 2002).

An important concern in the case of prescribed fire and broadcast burning is the effect on air quality. Fires in forested areas produce a large number of particulates that are a hazard to human health. Smoke also has an adverse effect on visibility and visual aesthetics. For this reason, prescribed burning programs often encounter considerable public resistance, and the agencies that regulate air quality may also have some reservations about issuing permits that may result in a substantial, albeit temporary, reduction in air quality.

Management goals for piñon-juniper woodlands are typically to increase the amount of forage and vegetative ground cover, reduce erosion, and re-establish native riparian species. More aggressive treatments such as chaining are generally not acceptable because of the excessive ground disturbance and potential increases in erosion. In general, efforts to improve range conditions and reduce grazing impacts should help reduce erosion, enhance habitat quality in the riparian zone, and improve water quality.

As in the case of the forest zone, any vegetative treatment in piñon-juniper woodlands will favor some species at the expense of others. Whether the net effect is acceptable will depend on the relative values of the species affected and the intended use of the area after treatment. In most cases, a reduction in tree density will increase the ground cover, thereby increasing the productivity of the land for grazing by large ungulates. The use of fencing and best management practices related to movement and location of livestock will help eliminate the tendency to overuse some areas and underuse others, with a net benefit on erosion rates and downstream water quality.

8.10 Develop Economic Potential for Non-Native Species Removal, Harvest, and Product Output by Local Industries

The purpose of this alternative is to develop the economic potential for use of small-diameter timber or non-native species that may be removed as part of efforts to implement exotic species removal or watershed restoration, as discussed in Sections 8.8 and 8.9. Small-diameter trees are typically smaller than trees that are considered for commercial logging purposes, usually about 6 to 8 inches in diameter or less.

8.10.1 Background

Forests that are overgrown with small-diameter trees are not resistant to fires are vulnerable to insects and disease and have low commercial value. These conditions occurred partly due to overgrazing, which reduced the fuel loading for frequent, low-intensity fires and partly due to fire suppression over the last century.

Devastating forest fires during 2000 enhanced public awareness of the need to reduce forest densities, and there has been considerable interest in forest and/or riparian area thinning or removal of exotic vegetation as a means of not only improving forest health and reducing fire risks, but potentially increasing water yield as well (Sections 8.8 and 8.9).

Most forest restoration projects are funded with grants and/or tax dollars, both of which are in high demand. If a market for small-diameter trees were developed, watershed restoration could occur as part of the economic system, provided that environmental concerns are addressed. Costs for conducting forest thinning programs and for removal of exotic riparian vegetation could potentially be offset if there is a market for small-diameter timber, which can include salt cedar as well as other trees.

8.10.2 Key Issues

The key issue for this alternative is identifying markets for small-diameter timber. Several national programs can provide information or assistance on fire protection issues and/or are developing opportunities and exploring new uses for small-diameter forest products:

- The U.S. Department of Agriculture (USDA) Forest Service established the Forest Products Laboratory (FPL) in 1910. This laboratory serves the public as a premier research institute in wood science. They are nationally and internationally recognized as a technical authority and work cooperatively with many universities and state and national government agencies (http://www/fpl.fs.fed.us).

- The National Fire Plan was started after the wildfires of 2000 as an initiative from the White House. The USDA Forest Service, in cooperation with the U.S. Department of the Interior and National Association of State Foresters, has developed plans to address the unhealthy state of our forests. Also, assistance to communities to reduce fire hazards is offered (http://www.fireplan.gov).

- Toby Martinez, New Mexico State Forester under Governor Johnson, along with other Western State Foresters, began the Four Corners Sustainable Forests Partnership in 1997 to increase awareness and resources for forest reforestation and community help. The Partnership provides an excellent resource for communities that are attempting to harvest small-diameter forest products (http://www.fourcornersforests.org) and has provided funding for several community projects that address development of specific markets for small-diameter timber.

Current and expanding uses for small-diameter timber are of several types:

- Value-added uses include flooring, paneling, latillas, vigas, cabinets, and millwork. In addition, a few people are producing furniture made from small-diameter timber material. The key component for marketing this type of use is to find a niche. The Sustainable Harvest Initiative Forum involves many different cultures and has brought tribes, research institutes, and profit and non-profit organizations together to promote native products and, in the process, support healthy communities and healthy forests. Some of the features of the action plan developed by the Forum are to provide furniture making training with master craftsmen, develop timber mills and facilities, and link tamarisk (salt cedars) removal programs with basketry and furniture craftsmen to provide them with materials (Nabhan et al., 2002).

- Traditional uses consist of sawlogs, structural and non-structural lumber, poles/posts, and pulp chips. These timbers can be used for deck railings and decorative trusses. Another use for poles could be highway guardrails and signposts, but would need acceptance by highway engineers. Projects for several of these uses are being demonstrated through the Four Corners Sustainable Forests Partnership.

- Residue uses include biomass energy, ethanol, firewood, pulp, and composting:

  - The use of a gasifier that converts wood waste (biomass) into a clean, combustible gas is currently being considered for use in Mountainair, New Mexico (Archuleta, 2003). If it comes on-line, the technology would be expected to be up and running within 18 months and would use large quantities of tamarisk and other waste products. The tamarisk would be ground up and used in the manufacturing process.

  - Several species of small-diameter timber material is used in a process that mixes it with plastic to make commercial highway signs.

  - The FPL is currently testing the use of small-diameter timber in a filter made from wood fibers (http://www/fpl.fs.fed.us). These filters can remove phosphates, heavy metals, oils, and pesticides from waters such as lakes and streams.

  - Fiber mats made up of wood fibers can be used for erosion control. Compost material is also useful in controlling erosion.

8.10.3 Implementation

Interest is growing in using small-diameter trees, and technologies are being developed to assist in this process. However, there are also many problems currently associated with the use of small-diameter timber material:

- It is very expensive to acquire and set up the machinery necessary to process this size of material.
- A stable supply of lumber must be maintained.
- The cost of transportation to the processing site may be high.

All of these factors affect the economic feasibility of processing this type of material. However, the organizations noted above have developed a sizable knowledge base and can help with grants and funding, marketing prospects, and infrastructure. In the near future, it could be economically feasible to process small-diameter timber.

8.11 Make Water Rights a Non-Condemnable Resource

This section evaluates the feasibility of making water rights a non-condemnable resource in New Mexico. This alternative is desirable to the region to prevent governmental agencies in other parts of the state from condemning water rights in the Socorro-Sierra region for the purpose of transferring them from non-willing sellers. Although a broad exemption of water rights from the governmental power of eminent domain is unlikely to be successful, targeted protection of water rights in a specific basin or region through legislation or settlement agreements might effectively protect water rights from condemnation.

As condemnation is a complex legal issue, a comprehensive legal opinion should be obtained prior to proceeding with this alternative. Some of the key legal issues relevant to this alternative are summarized below.

8.11.1 Background

The Fifth Amendment of the U.S. Constitution provides that the government may not take or condemn private property unless it provides just compensation to the property owner. Article II of the New Mexico Constitution incorporates this concept and states that “Private property shall not be taken or damaged for public use without just compensation” (N.M. Constitution Art. II, Section 20).

The governmental power to take or condemn private property is known as “eminent domain.” Regardless of the wishes of the property owner, the government can proceed with forced sale of property for a legitimate public purpose as long as it provides just compensation. The Eminent Domain Code (NMSA Chapter 42A) defines condemnation as “taking or damaging property under the power of eminent domain” and outlines the condemnation process (NMSA 42A-1-2 (A)).

The definitions of legitimate public purpose and just compensation are codified and have been examined by New Mexico courts. Generally, any purpose that serves the greater good is considered a public purpose. Fair market value for the property determines the “just compensation” to the property owner.

8.11.1.1 State Entities Having the Power of Eminent Domain

The power of eminent domain is generally held by governmental entities, although in some cases individual or corporate persons may have a specialized eminent domain power. The specific agencies or subdivisions of the state that have this power and the purposes for which it may be invoked are codified throughout the New Mexico statutes. Typically, state governmental agencies, counties, and municipalities have this power.

The Eminent Domain Code generally covers the condemnation process and describes the entities having this power. This chapter also defines legitimate public uses for some of these entities. Elsewhere in the New Mexico statutes, the sections pertaining to particular agencies describe in more detail the power of eminent domain for that agency or entity. Examples of eminent domain provisions related to water are outlined in Table 8-4.

Table 8-4. Eminent Domain Authority of New Mexico Governmental Entities

Type of Entity	Type of Property	Allowable Purposes [a]	Authorizing NMSA Section
State agencies	Land and interests therein including water	Present or future public road, street, or highway	42-2-3
Counties	Water rights within county limits	Development of county water supply system	72-4-2
Municipalities	Springs, wells, water rights, other water supplies	Supplying water	3-27-2
	Acequia, ditch, canal [b]	Widening or constructing streets [b]	42A-3-3
State universities	Property	Specific purposes including water supply	42A-3-1
Water or natural gas association	General power of eminent domain	Prohibits acquisition of any entity, plan, or system regulated by the Public Regulations Commission	3-28-19
Water users associations	Property	Rights of way, canals or ditches	73-5-9
Interstate Stream Commission	Water rights	Miscellaneous purposes; specifically identifies water rights as a condemnable resource	72-14-10
Flood control districts (various districts in New Mexico)	General power of eminent domain	Miscellaneous purposes	72-16-4 72-17-22(L) 72-16-22 (K)
Conservancy districts	General power of eminent domain, including water rights	Miscellaneous purposes	73-14-41 73-14-47(F)

[a] Circumstances under which entity may invoke the power of eminent domain   NMSA = New Mexico Statutes Annotated
[b] Unless 50% of water users petition

8.11.1.2 Condemnation Process

The Eminent Domain Code governs the condemnation process, as described below. Special alternative condemnation procedures exist as well and are available to some state agencies (NMSA 42-2-1-24).

Prior to initiating condemnation proceedings, the agency or person must first attempt to negotiate a sale with the property owner (NMSA 42A-1-4). If the negotiation attempt fails, then the agency requests an appraisal of the property and submits three appraisals to the property owner (the government will pay the appraised value of the property to the owner [Section 8.8.1.5]). The government files a petition to initiate the condemnation procedure in court (NMSA 42A-1-17) and provides notice to the property owner (NMSA 42A-1-18).

Either party may request a trial of any issues remaining after the court determines compensation in the case (NMSA 42A-1-21(A)). If no issues other than compensation are raised, the court renders a final judgment awarding the property to the condemnor contingent upon payment of the awarded compensation to the property owner (NMSA 42A-1-21(B)). Generally, a landowner has limited options for preventing a forced sale of his or her property to the entity exercising the power of eminent domain.

8.11.1.3 Water Rights as Condemnable Property

As eminent domain usually involves the condemnation of real property (land), a first area of investigation into possible protections of water rights from condemnation would be to confirm that eminent domain does indeed apply to water rights. While it is possible to argue that water rights are not “property” as defined by the U.S. and New Mexico Constitutions (because they are not tangible real estate), these rights are nonetheless subject to condemnation. As shown in Table 8-4, many sections of the New Mexico statutes include water rights as a type of property subject to eminent domain. In the absence of statutory provisions regarding water rights, it is likely that these rights would still be subject to condemnation. The Eminent Domain Code defines property as “real or personal property under the law of New Mexico.” It further defines real property as “land or any improvement on or connected with land, and includes an easement or other interest therein.” Water rights could be considered an interest as well as an improvement of the land, since water allows the land to be used more economically, and in this sense, water rights would fall under the definition of property subject to condemnation. Finally, water rights are generally considered property rights; they can be bought, sold, or leased and therefore would be subject to condemnation (*United States v. Gerlach Live Stock Co.,* 339 U.S. 725 (1975); *Ball v. United States,* 1 Cl. Ct. 180 (1982)).

8.11.1.4 Public Use

Only legitimate public uses, a term broadly interpreted by New Mexico courts, can justify a condemnation proceeding. Many of these uses have been codified. In cases where the use was not codified, New Mexico courts have deferred to legislatively defined goals and objectives to determine public uses. In other words, if the legislature has created a program or policy and an agency pursues condemnation proceedings to further that purpose, the court will uphold that action because the legislature already determined the “public use” in creating the policy or program. The court has upheld public uses even if the legislature did not specifically identify the public use in dispute. For example, the court found that condemnation of land to build water conveyance structures was a legitimate public purpose because the legislature had already determined that “application of water to beneficial use is a public use” (*Kaiser Steel v. W.S. Ranch* 81 N.M. 414 (1970)).

Other examples of legitimate public uses include rights of way for water conveyance structures, water supply development, schools, parks, roads, highways, fire and police stations, public buildings, and the elimination of blight through redevelopment. The purposes justifying condemnation are listed as a general grant of power or as a list of specific purposes in the statutory provisions governing eminent domain for various agencies or subdivisions of the state (Table 8-4).

8.11.1.5 Just Compensation

The state is required to pay just compensation to the owner of condemned property. The New Mexico courts have determined that property value is based on fair market value. In determining fair market value, the government must consider not only the use of the property at the time of condemnation, but also the highest and best use to which it could be put (*City of Lab. v. PCA-Alb. #19,* 115 N.M. 739 (1993)). In determining highest and best use, the government should “consider the existing business or wants of the community, or such as maybe reasonably expected in the immediate future” (*State ex rel. State Highway Comm’n v. Pelletier* 76 NM 555). The value of the property is generally determined through the appraisal process, which should take into consideration the factors identified by New Mexico courts.

8.11.2 Key Issues

Because this alternative involves efforts to change public policy through legislation, it raises primarily political and social issues. Other key issues include:

- *Hydrologic:* Because condemnation would result in a transfer of water rights from one entity and location to another, hydrologic impacts to streamflow or groundwater levels could occur. The OSE would review hydrologic impacts of such a transfer during a protest and subsequent administrative proceeding to determine whether water rights holders would be impaired.

- *Financial:* The cost to implement this alternative would include the time invested by water rights holders to lobby for a change in state law. This effort would also include time from state legislators and legislative council staff in drafting and reviewing proposed legislation. The financial aspects of condemnation are discussed in Section 8.8.4.

Efforts to limit governmental power to condemn water rights raise no environmental issues.

8.11.3 Summary of the Alternative

All owners of private property are vulnerable when an overriding public interest prompts the government to exercise its power of eminent domain. In the arid west with its scarce water resources, apprehension about government power to “take” water rights for “public use” is legitimate. Condemnation of water rights is a constitutionally derived power and statutorily codified. Therefore, it would be difficult to obtain a general exemption from these powers for water rights. However, the New Mexico Legislature has passed a law that essentially curtails the ISC’s power of eminent domain in the Pecos Valley. This provision requires that expenditures of funds for water rights purchases or leases to comply with the Pecos Compact may take place only if the sale is from a willing seller (NMSA 72.1.4.2). The settlement agreement of water rights claims in the Pecos Valley area incorporated this provision by reference.

Before the region expends time and resources to implement this alternative, it should conduct further research into whether privately owned water rights are really vulnerable to condemnation by the government. Historically, the State of New Mexico has pursued a policy of purchasing water in the open water markets from willing sellers in order to meet interstate compact delivery requirements. New Mexico case law and a comprehensive history of water management in

New Mexico (Clark et al., 1977) show no case where a governmental entity condemned water rights to develop a water supply or to meet interstate compact obligations. Nevertheless, in areas with limited water rights available on the market, governmental entities may find that condemnation becomes necessary to meet demand or to fulfill other legal obligations.

The Socorro-Sierra region should closely monitor state and local government policy on water rights condemnation and should confer with legislators and local government officials from the region to identify legislation or ordinances that could be introduced to protect water rights holders from condemnation.

Water rights availability depends on location. Some areas of the state have active water markets, while other areas have limited water rights available for transfer or lease. The middle Rio Grande is an area with limited water availability on the open market and significant competition for those few rights that are available. For instance, the City of Rio Rancho is required to purchase large quantities water rights to offset groundwater pumping as a condition of approval of its application for additional groundwater. As demand in this area continues to grow, the municipalities and other water providers may consider condemnation to acquire sufficient water rights to meet demand.

Whether a large municipality would have the authority to condemn water rights outside its jurisdictional boundaries is another issue raised by this alternative. Most condemnation cases involve land within the municipal boundaries. However, in *City of Raton v. Raton Ice Co.* (26 NM 2300 (1920)), the City condemned land outside the municipal boundaries for purposes of developing the water supply pipeline. Plaintiffs argued that the city did not have jurisdiction over the land outside the 2-mile boundary referenced in the municipal condemnation statute in effect at that time. The court concluded that it was "improbable that the Legislature intended to restrict a city to a two-mile limitation for condemnation proceedings in constructing waterworks and in acquiring the source of its water supply."

County authority to condemn water rights may be applicable to water rights located some distance from the source of demand as long as they are within county lines.

8.11.4 Implementation

One approach for implementing this alternative would be to support legislation to limit or set conditions under which governmental entities could obtain water rights through condemnation. Some existing condemnation provisions limit the scope and applicability of this power under certain circumstances. For example, water utilities may not condemn existing functioning utilities.

Constituents could petition legislators to introduce limiting language with regard to water rights similar to the language in the Pecos Valley legislation (NMSA 72.1.4.2) (Section 8.8.3). Additional limiting language that could be helpful to the region would be to require governmental entities to have in place a well established and well funded conservation program, including leak detection and repair, before proceeding with condemnation. Another condition could be that the government first use its existing water rights, even if significant expenditures must be made to perfect and develop those water rights. Third party compensation could also be required, to offset the public welfare impacts to the move-from area of origin. Finally, the governmental entity could be required to demonstrate that the water rights are required immediately and that all other options to maximize existing water rights have been exhausted.

Another approach would be to encourage legislation to allow only leases of water rights. Instead of a forced sale of the water right, owners could only be compelled to lease the water right at a fair market value without losing the right entirely. The difficulty is that if the water right is needed to fulfill an OSE offset requirement directly related to ongoing groundwater pumping, the OSE may not consider a lease with an expiration date sufficient protection to allow a groundwater application to go forward.

Should a governmental entity attempt to condemn water rights in the Socorro-Sierra area, affected parties could initiate legal action to challenge the legitimacy of the public purpose driving the condemnation. Since water rights are being beneficially used for agriculture or other purposes, water rights holders could assert that these rights already serve an overriding public interest (the beneficial use of water) and are therefore not subject to condemnation. A similar case regarding acequias was successfully litigated in the early 20th century. In that case the

City of Albuquerque attempted to condemn an existing acequia for the purposes of widening a street (*City of Albuquerque v. Garcia* 17 NM 445 (1913)), but the court found that the property was serving a legitimate public use and was not subject to condemnation.

8.12 Improve Reservoir Management for Better Coordination of Flows with Demand

To meet water demands for agriculture or for other purposes, it is critical that the water is available at the time needed to optimize crop growth. This alternative considers the potential for better coordination of flows, making water available when needed to meet demands. Coordination of flows with demands is dependent on the ability to store water until it is needed; hence this alternative considers storage in Rio Grande reservoirs.

8.12.1 Background

Rio Grande surface water flows are managed through a series of dams and reservoirs located along the Rio Grande and tributaries upstream of the Socorro and Sierra region. The majority of these structures are part of the Rio Grande Project; the facilities that are located upstream or within the planning region are listed in Table 8-5:

As indicated in Table 8-5, the USBR, U.S. Army Corps of Engineers, and/or MRGCD manage the majority of reservoirs and diversion structures that are part of the Middle Rio Grande project.

Numerous factors influence how reservoir releases are managed with respect to demand. These include legal obligations under the Rio Grande Compact, the 1944 Treaty with Mexico, the Endangered Species Act, federal reclamation law, and federal contracts. Existing water rights are protected as long as sufficient water is retained in storage to meet those needs when they arise. For example MRGCD stores water used for the irrigation season in El Vado reservoir in northern New Mexico. The USBR releases water to the district when MRGCD makes a request for the water and if the water is available. Drought conditions and the recent silvery minnow decision (unless federal legislation is approved to counter the court's ruling) will affect the amount of water in storage and available for use by MRGCD.

Table 8-5. Rio Grande Project Reservoirs in the Socorro-Sierra Water Planning Region

Reservoir	Owner/Operator
Platoro Dam and Reservoir	USBR / Conejos Conservancy District
Heron Dam and Reservoir	USBR
El Vado Dam and Reservoir	MRGCD / USBR
Abiquiu Dam and Reservoir	U.S. Army Corps of Engineers
Cochiti Dam and Lake	U.S. Army Corps of Engineers
Galisteo Dam and Reservoir	U.S. Army Corps of Engineers
Jemez Canyon Dam and Reservoir	U.S. Army Corps of Engineers
Angostora Dam and Reservoir	MRGCD
Isleta Diversion Dam	MRGCD
San Acacia Diversion Dam	MRGCD
Elephant Butte Dam and Reservoir	USBR
Caballo Dam and Reservoir	USBR (in consultation with International Boundary & Water Commission)

USBR = U.S. Bureau of Reclamation MRGCD = Middle Rio Grande Conservancy District

Evaluation of river management activities is currently occurring through a coordinated process involving a number of agencies. In 1996, six federal agencies—the USBR, U.S. Fish and Wildlife Service, U.S. Geological Survey, Bureau of Indian Affairs, International Boundary and Water Commission (U.S. Section), and U.S. Army Corps of Engineers—recognized the need for a unified water operations model for the Upper Rio Grande Basin and entered into a Memorandum of Understanding (MOU) to develop such a tool to assist water managers. Additional entities signing the MOU in 1997 were the cities of Albuquerque and Santa Fe, Rio Grande Restoration, and Sandia and Los Alamos National Laboratories. Many other entities are involved in the effort through technical review and outreach support.

The focus of the effort is to develop a numerical computer model capable of simulating water storage and delivery operations in the Rio Grande from its headwaters in Colorado to below Caballo Dam in New Mexico and for flood control modeling from Caballo Dam. Eleven reservoir and river simulation models were evaluated based on general criteria for their use as the Upper Rio Grande Water Operations Model (URGWOM). The model will be used in flood control operations, water accounting, and evaluation of water operations alternatives.

8.12.2 Key Issues

Key issues regarding implementation of this alternative revolve around the availability and location of upstream storage, as well as issues related to timing the releases to meet multiple, sometimes conflicting needs. Some of the key issues are:

- There are numerous stakeholders with an interest in timing of releases, including municipalities, agricultural users, recreational users, and advocates for endangered or other native species. As the region does not have independent authority to manage reservoir releases that supply the region, this alternative is best pursued by working through the URGWOM process or other cooperative efforts to manage the Rio Grande.

- Though El Vado Reservoir, on the Chama River upstream of the confluence with the Rio Grande, provides storage for the MRGCD, the MRGCD currently does not have the ability to store and manage demand for flows on the mainstem of the Rio Grande (there is no authorized storage space in Cochiti for this purpose, and the other diversion dams are not designed as storage facilities). Therefore, the ability to manage mainstem Rio Grande flows is limited without new facilities.

- To optimize reservoir management, complete data regarding the location, timing, and quantity of existing diversions and systems losses are critical. Therefore, efforts to provide improved metering and incorporation of that information into a comprehensive model will support this alternative. The ongoing MRGCD effort to improve metering will be helpful in implementing this alternative.

- In addition to the timing of water deliveries, optimizing reservoir management ideally considers the effect of storing water at higher elevations to minimize evaporative losses. SSPA (Appendix E1) considered this potential and estimated that approximately 2,000 to 5,000 ac-ft/yr could be saved by moving 50,000 acre-feet from Elephant Butte to Cochiti or Abiquiu Reservoirs. These savings, however, need to be balanced against recreation interests at Elephant Butte. Reservoir management could best benefit the region if additional upstream storage to save evaporative losses is considered in wet years while preserving a minimum pool for recreational needs in dry years.

8.12.3 Implementation

As discussed previously, this alternative can best be implemented by ensuring that there is regional participation in the state-wide efforts to evaluate river management. The URGWOM steering committee currently includes representatives from the region, and that participation should continue. Additionally, it may be valuable to have increased participation of Elephant Butte water users so that concerns regarding the Elephant Butte recreation pool can be brought into discussions of system management.

Implementation of this alternative is impacted by the 1938 Rio Grande Compact among Colorado, Texas, and New Mexico. The Compact places limitations on storage of water (NMSA 1978 §72-15-23):

- Under Article VI of the Compact, New Mexico's accrued debit shall not exceed 200,000 acre-feet at any time, except in cases where the debit is caused by holdover storage of water in reservoirs constructed after 1929; however, New Mexico shall retain water in storage at all times to the extent of its accrued debit. This means that the water could not be released for any local use, but must be held for release to Texas if called upon.

- Under Article VII, New Mexico in general shall not increase the amount of water in storage in reservoirs constructed after 1929 whenever there is less than 400,000 acre-feet of usable water in project storage in Elephant Butte and Caballo Reservoirs.

- Under Article VIII, Texas may demand release of water from storage reservoirs constructed after 1929 to the amount of the accrued debits of New Mexico and Colorado, sufficient to bring the quantity of usable water in project storage to its regular annualized amount of 790,000 acre-feet. This provision affects El Vado, Abiquiu, and some tributary reservoirs.

Fundamentally changing the river's storage regime, as outlined above, would require approval by the three-state Compact commission.

Federal law also restricts modifications of the storage regime. Federal reservoirs on the mainstem of the Rio Grande have no authorized storage space available. In particular, Cochiti and Heron Reservoirs are not authorized for storage of Rio Grande water. Additionally, storage in and changes in releases from other reservoirs, such as El Vado and Abiquiu, could be limited by federal environmental laws, primarily the National Environmental Policy Act (NEPA) (42 U.S.C. §4321 *et seq.*) and the Endangered Species Act (ESA) (16 U.S.C. §1531 *et seq.*), to avoid detrimental environmental changes in the river hydrograph and ecosystem around the reservoir.

Although Abiquiu Reservoir has a capacity of 1.5 million acre-feet, federal legislation would be required to store water above the total authorized storage amount of 200,000 acre-feet. Likewise, Cochiti Reservoir would require federal legislation allowing the storage, in addition to needing approval by the U.S. Army Corps of Engineer, Bandelier National Park, and the U.S. Forest Service. Environmental changes to the river hydrograph and reservoir ecosystem would have to comply with the ESA and NEPA. In addition, increased storage would be subject to the post-1929 restrictions of the Rio Grande Compact discussed above.

8.13 Identify and Protect Areas Vulnerable to Contamination

The purpose of this alternative is to identify areas that are vulnerable to contamination within the water planning region and to identify programs that can assist in protecting groundwater within those areas. Although this alternative does not create any new water supply, it can preserve the practical usability of the existing water supply.

8.13.1 Background

In the Socorro-Sierra region, groundwater is used for municipal supplies in Socorro and Truth or Consequences and in some of the smaller communities. In order to maintain a viable supply of groundwater to meet long-term demands, it is important to ensure that both the quantity and quality of these supplies are protected. Contamination of water supplies is an issue particularly in areas with a high density of shallow wells, septic systems, leaking storage tanks, or other contaminant sources, and monitoring and protection programs are often focused on addressing these areas.

Potential sources of contamination in the Socorro-Sierra region are discussed in Section 5.3, and a map of potential sources is provided as Figure B-14. As shown on this figure, many of the potential sources—such as underground storage tanks, landfills, and facilities with groundwater discharge permits—are clustered around municipalities that rely on groundwater for their domestic supplies.

8.13.2 Key Issues

Many sources of contamination are addressed by the NMED and EPA; however, nonpoint source contamination, or contamination from many small sources such as septic tanks, is not adequately controlled by either of these agencies. Potential groundwater contamination issues that are addressed by several existing monitoring programs conducted under the regulatory jurisdiction of the New Mexico Environment Department (NMED) include:

- Monitoring of underground storage tank (UST) sites is overseen by the NMED Petroleum Storage Tank Bureau.
- Monitoring of active and closed landfills is overseen by the NMED Solid Waste Bureau.
- Monitoring of hazardous waste generators and hazardous waste treatment, storage, and disposal facilities is overseen by the NMED Hazardous Waste Bureau.
- Monitoring of mining sites and groundwater discharge plans is overseen by the NMED Groundwater Quality Bureau.
- Monitoring of Superfund sites is overseen by the U.S. Environmental Protection Agency (U.S. EPA) in conjunction with the NMED Groundwater Quality Bureau.

- Monitoring of NPDES permits is overseen by the U.S. EPA in conjunction with the NMED Surface Water Quality Bureau.

Nearly all readily identifiable potential sources of contamination located within identified vulnerable areas fall under the regulatory jurisdiction of one of these programs. Therefore, additional efforts to identify and monitor contaminant sources within vulnerable areas are largely redundant. There may be value, however, in tracking the progress of the existing programs within the region and participating in discussions with regulators regarding program priorities and regional water supply concerns. In particular, additional monitoring wells may be needed in some locations, and vulnerable areas should be monitored more carefully. A region-wide vulnerability analysis could be coupled with existing programs to identify areas where more monitoring and/or protection are needed.

The main contaminant sources relevant to vulnerable areas of the planning region that are not completely included under existing regulatory jurisdiction are on-site domestic wastewater treatment systems (i.e., septic tanks). Bernalillo County has recently enacted a strengthened wastewater ordinance (Bernalillo County Municipal Code, 2001) to address this issue, and this ordinance could be used as an initial model for Socorro and Sierra Counties to address the issue of groundwater contamination from septic tank discharges in vulnerable areas. The Bernalillo County ordinance is performance-based in that treatment requirements are determined by on-site physical conditions and an assessment of the potential risk that effluent from the site's system will contaminate groundwater. The risk depends on factors such as the thickness and quality of the soil, depth to water, and the size of the lot. Additional requirements include a maintenance contract and operator's permit for each system.

A key issue regarding adoption of an enhanced septic tank ordinance is the cost to homeowners. Costs for upgrading existing septic systems can be on the order of $5,000 to $20,000, depending on site conditions and system configuration, and costs to maintain improved on-site wastewater systems range from $10 to $25 per month (UNM Water Resources Program, 2001). To effectively reduce potential septic contamination, therefore, additional financial support for homeowners may be necessary. In Bernalillo County individual homeowners are responsible for paying for system upgrades; however, financial assistance may be available for low-income families (UNM Water Resources Program, 2001). In addition to homeowner financial assistance, enforcement will be needed to ensure that septic upgrades are completed and that required maintenance occurs.

8.13.3 Implementation

The New Mexico Source Water Assessment and Protection Program (SWAPP) can be used to address monitoring and control of potential sources of contamination near public water supplies. This is a federally funded program overseen by the U.S. EPA that assists communities in protecting their drinking water supplies. Specifically, the New Mexico SWAPP will assist local communities in:

- Determining the source water protection area for the water system
- Taking inventory of actual and potential contaminant sources within the source water protection area
- Determining the susceptibility of the source area and water system to contamination
- Reporting the SWAPP findings to the water utility, its customers, and the community
- Working with the community and other stakeholders to implement source water protection measures that safeguard and sustain the water supply into the future

This existing program can thus be used to address this issue with minimal additional cost to the local community. To participate in this program, communities can contact the New Mexico SWAPP (http://www.nmenv.state.nm.us/dwb/swapp.html). The development of source water or wellhead protection plans for Socorro and Sierra Counties may require hiring or contracting technical personnel to work with the New Mexico SWAPP.

Administrative and public participation efforts may be required to develop and implement enhanced on-site wastewater treatment ordinances in Socorro and Sierra Counties. Using the Bernalillo County ordinance as a model will minimize these efforts.

In order to identify the areas of groundwater vulnerability, a number of methods can be used. A common method of assessing groundwater vulnerability is through use of the DRASTIC method (Aller et al., 1987), in which a numerical ranking system is applied to several parameters, including depth, recharge, aquifer and soil media, topography, vadose zone impact, and hydraulic conductivity. WRRI performed this analysis for the Socorro Sierra region, and their results are shown in Figure B-13. As shown in this figure, the most highly vulnerable areas identified by this analysis are those overlying the shallow valley-fill aquifers within the unconsolidated sediments along the Rio Grande.

A simpler analysis approach based on water depths and vadose zone protection was used to develop a map of relative groundwater vulnerability for the entire state (Lee Wilson and Associates, Inc., 1979, Plate 2). The results for the Socorro and Sierra County areas shown in this map were very similar to those determined with the DRASTIC method, with the most highly vulnerable areas overlying the shallow valley-fill aquifer along the Rio Grande.

8.14 Adopt and Implement Local Water Conservation Plans and Programs Including Drought Contingency Plans

An important aspect of regional water planning is water conservation, which allows the region to make efficient use of existing resources. A detailed water conservation plan has been prepared and is included in Appendix H, and alternatives addressing agricultural water conservation activities are included in Sections 8.2 through 8.4. The remainder of this section focuses on key issues and methods of addressing municipal water conservation and municipal and agricultural drought contingency plans. Though municipal conservation will not greatly affect the overall water budget in the Socorro-Sierra planning region, it can provide benefits to individual systems. In addition, the region as a whole would benefit from developing a drought plan that identifies ahead of time drought mitigation measures and the parties responsible for implementing those measures.

8.14.1 Background

Background information about water conservation is provided in Appendix H and Section 8.14.1.1. Background information on drought planning is provided in Section 8.14.1.2.

8.14.1.1 Water Conservation

Water conservation can be pursued either through voluntary programs such as public education, or through ordinances that restrict water use. Water conservation ordinances are a clear way to engage the public in water conservation activities. The primary topics covered by conservation ordinances, in separate or combined legislation, typically include:

- Prohibiting outdoor water waste (fugitive water), requiring low-water landscapes, and/or limited watering schedules

- Changing water rate structures to encourage conservation, thereby reducing water use by residential, industrial, commercial, and institutional customers

- Limiting the amount of water use through low-flow plumbing devices, either through retrofits on existing homes or through new construction standards

8.14.1.1.1 Water Waste. The OSE suggests that water waste can be defined in an ordinance as water that flows or is discharged from a residence or place of business onto an adjacent property. Such discharges occur most often from landscape irrigation or leaking water pipes. In addition to the loss of potable water, these events have safety and maintenance impacts. Water running onto streets, especially when it freezes, can cause vehicle accidents and, if it pools, damage road surfaces.

8.14.1.1.2 Price structures. Nationally, many utilities are using price as a demand management tool. According to a 1992 American Water Works Association (AWWA) survey, approximately 60 percent of the utilities in the United States use a conservation rate structure. Rate structures that can generally be classified as conservation oriented are of four different types:

- *Uniform commodity rates:* All usage is charged at the same unit rate. Although not often viewed as being a water efficiency-oriented rate, uniform rates are an improvement over declining-block rate structures in which the price of water decreases as the volume of water used increases.

- *Flat seasonal rates:* This rate structure incorporates two or more different uniform volume charges for different seasons during the year. Generally, a higher rate is charged during the peak water usage season than is charged during the off-peak season.

- *Inverted block rates:* An inverted-block rate structure involves the use of increasing rates for units of water consumption at higher levels of usage. (In addition to encouraging water conservation, this rate structure could help balance the impact of conservation on loss of revenue to the utility.)

- *Excess use rates:* An excess use rate structure involves establishing an average base water usage volume during the non-peak period and a corresponding base water usage rate. During the peak period or season, water usage above this base level is charged at the base rate plus an excess use rate. Several variations of the excess use rate structure exist. Some utilities provide an allowance above the base usage during the peak season to recognize an increase in non-discretionary use during peak periods.

The OSE recommends that the inverted block rate be favored. However, utilities should analyze whether this structure can achieve conservation effects in the local community. If such a structure is implemented, the amount of water required for “basic human needs” should be determined and kept at an affordable rate for low-income households; rates can increase for water usage above that threshold. Some municipalities, such as Albuquerque, provide for an administrative waiver for low-income households that have more members than the number allowed for in the “basic human needs” assumptions.

Conservation rate structures may result in uncertainty in forecasting revenue, as these pricing policies usually do not exhibit the high minimum charge that standard rate structures incorporate. A utility must assess the interrelationships between rates, consumption, and costs, and the effect that these factors will have on the revenue requirements of the utility.

8.14.1.1.3 Other water conservation measures. Programs can address conservation through improved indoor plumbing devices either through ordinances, education, or rebate programs. Ordinances may provide specific construction guidelines. Education programs are often targeted toward voluntary reductions in water use, for example by turning off facets, repairing leaking plumbing, or doing less laundry. Rebate programs may encourage home owners to retrofit homes with low-flow toilets, showers, or other fixtures. Additionally, metering is an essential element of water conservation. A regulation, resolution, or ordinance can be adopted that requires the installation and regular reading of meters at all water sources, including import or export points, customer service connections, and public landscape sites. All water provided free of charge for public use should also be metered and monitored at regular intervals to allow the utility to more accurately account for water use.

Additional information regarding case histories and descriptions of water conservation measures that have a proven track record for saving water in municipalities, rural public systems, and irrigation districts, as well as examples of water conservation measures that have been implemented in New Mexico, are contained in the Socorro-Sierra Regional Water Conservation Plan (Appendix H). The plan discusses conservation measures applicable to all water use categories defined by the New Mexico OSE, with extra attention given to irrigated agriculture and public water supply since these are the major water use categories within the planning region.

8.14.1.2 Drought Management

Because the Socorro-Sierra region relies heavily on surface water resources, it is vulnerable to drought conditions. Historically, the irrigation districts within the region have generally been able to supply water, even during drought years, by making use of upstream storage. However, during multi-year droughts when upstream storage is depleted and Rio Grande Compact conditions prohibit additional storage, it is likely that supplies will not be adequate to meet demand. Development of drought management plans can help to prepare the region for this contingency.

Drought management plans typically include the following elements:

- A drought task force or other set of responsible parties is designated to oversee declarations of drought conditions and implementation of drought mitigation measures.

- “Triggers” are selected to identify various stages of drought (i.e., mild, moderate, severe). Triggers include indices that categorize levels of drought based on climatic and streamflow conditions.

- Specific mitigation measures that are to be undertaken during each drought stage are identified. Mitigation measures can include standard drought ordinances that define water restrictions, or they may include broader measures such as leasing of supplies during droughts.

Drought management can be undertaken at a regional level through cooperative agreements, or it may be undertaken by individual counties, municipalities, acequias, or irrigation districts within the region. Drought planning that addresses both local and regional mitigation efforts will be the most effective.

8.14.2 Key Issues

8.14.2.1 Water Conservation

The communities of Socorro and Truth or Consequences both rely on groundwater to meet their water supply needs. Because the groundwater is limited in both the volume in storage and the amount of recharge, it is important to use the water wisely for future generations to come. Conservation can help reduce the current stress on the aquifer and help sustain the resource and well yields, as well as reduce the risk of land subsidence or the migration of poor-quality water as has occurred in other communities. The Socorro-Sierra Regional Water Conservation Plan (Appendix H) evaluates the applicability of conservation measures to water systems in the planning region and provides estimates of the range of water savings that may result from these measures, as well as the range of associated costs. The conservation plan also contains further analyses of water conservation measures identified as applicable to the planning region.

Tables H3-1 and H3-2 in the water conservation plan (Appendix H) summarize estimated water savings and costs associated with applicable water conservations measures in Socorro and Sierra Counties, respectively. In addition, Table H3-3 presents an evaluation of key water conservation practices for the City of Socorro.

Unless a mandatory system with fines is implemented, conservation of groundwater requires voluntary compliance from domestic water users, who are generally not accustomed to conserving water. Therefore, the introduction of conservation programs will require educational efforts. For example, the City of Santa Fe requires all businesses to post signs about water conservation in bathrooms. Lifestyle and water-use habits are slow to change, and educational programs on water conservation should begin with small children and continue at least throughout primary schooling.

8.14.2.2 Drought Management

The impact of drought can be substantial for rural communities. The agricultural industry, which relies on surface water for most of its water supply, is most vulnerable to drought. If a plan can be put in place to both forecast for droughts and plan for their impact when they occur, the farming industry will be better prepared to manage their investments and share in the water supply that is available.

A serious environmental impact due to drought is loss of streamflow and subsequent impacts on the riparian habitat. If there is no drought plan, generally all of the flow from the rivers will be diverted by the most senior users on the Rio Grande; however, the situation is complicated by the need to provide water the endangered silvery minnow.

8.14.3 Implementation

8.14.3.1 Conservation

Implementation of water conservation programs is both technically and legally feasible and has been done throughout the southwest. According to the OSE Conservation Program Director, a water conservation ordinance has legal stature and is enforceable, and the OSE has not heard of any legal challenges to conservation ordinances (i.e., landscaping requirements or water waste prohibition) (Darilek, 2001).

To implement water conservation in the planning region, water managers may rely solely on existing legal and institution constraints that encourage conservation in New Mexico or may consider changes to current statutes in order to promote further conservation. Section 5 of the Socorro-Sierra Regional Water Conservation Plan (Appendix H) summarizes information about existing statutes and their incentives and/or limitations to water conservation. The conservation plan also presents some recommendations for actions that do not require statutory changes and briefly discusses the overall conservation potential in the planning region.

To save time for police officers and the local court system, an administrative procedure should be set up to enforce (write citations and assess fines) the water waste ordinance. As an example, for the City of Albuquerque conservation program, the fines associated with water waste violations are listed in the ordinance. Key to the success of the enforcement program is the requirement that the water waste officer videotape the water flowing off the property. The property owner is notified of the violation and fine, and the fine is collected through the water bill (which requires some modifications to the billing system). If the fines are appealed, they go to an Administrative Hearing Officer. Through this process, municipal, court, and police officer time is conserved.

Low-water landscape requirements may also be authorized through an ordinance and can be enforced through the zoning and plumbing codes.

Other challenges associated with water conservation include:

- Mandatory compliance for water waste ordinances can cause resentment if customers perceive them to be excessively restrictive. This can be addressed by a good public relations campaign emphasizing that the guidelines are based on common sense and will benefit the whole community.

- Staff training and time is required.

Water conservation plans also require coordination across county lines. County jurisdictions have assumed the oversight of rural communities, and municipal and county jurisdictions may not represent the vested interest of all rural users. Public comments received during the planning process for this water plan recommended that each municipality or irrigation system develop and implement their own conservation plan. The Socorro-Sierra Regional Water Conservation Plan (Appendix H) can serve as a model for such plans.

8.14.3.2 Drought Management

The following actions would be required to develop and implement a drought plan for the region:

- Convene a meeting of water users/stakeholders to determine who would be interested in participating in developing a regional plan or in developing their own drought plan. Some drought planning activities are ongoing and may best be implemented through irrigation districts.

- Conduct technical analyses to evaluate the correlation between historical data and drought triggers and to define appropriate triggers.

- Analyze drought vulnerability in relation to priority dates of water rights.

- Evaluate drought vulnerabilities during a potential priority administration of the Rio Grande.

- Evaluate and adopt mitigation measures. A series of meetings would be required to develop consensus on appropriate mitigation measures.

8.15 Interregional Water Management Decisions, Public Participation, and Funding

The Socorro- Sierra planning group identified three related alternatives that will affect when and how the regional water plan and water resource management actions will be implemented, including:

- Establishing dedicated and continuous funding for regional water planning
- Ensuring that the planning region is represented in water management decisions being made for the middle Rio Grande
- Ensuring public involvement in ongoing water planning activities

Funding is essential to allow the region to begin implementing its alternatives and to continue a regional water planning process and update the plan as needed. As part of an ongoing regional water planning process, interregional coordination and communication will be necessary to identify conflicts between regional goals and implementation plans. Additionally, public participation will allow affected stakeholders in the regions to update the plan as their goals and objectives evolve.

8.15.1 Background

Since the passage of the regional water planning statute (NMSA SS 72-14-44) in 1987, the 16 planning regions in New Mexico have worked toward developing regional water plans to address local water resource management. The next step in the regional water planning process for those regions that have completed their plans is to implement the alternative actions that will allow them to better manage their water supply to meet demand. However, the future of regional water planning is uncertain, and at the present time the ISC has not allocated funds to the regions that still need to complete their plans.

Initially, regional water planning was limited by only sporadic and piecemeal funding. However, in 1998 the legislature approved $1.5 million of funding, thus allowing the regions to actively begin planning. In 2002, $500,000 was approved for regional water planning and the state framework plan. In 2003, $150,000 was appropriated for regional water planning and the state water plan, and an additional $250,000 was allocated for the state water plan public participation process (HB 260 final version).

The recently passed state water planning statute (NMSA 72-14-3.1) now requires the State of New Mexico, through the ISC, to develop a comprehensive state water plan that addresses all water management issues in the state. Regional water planning is only mentioned briefly in the statute. As one of its many goals, the statute requires the integration of “regional water plans into the state water plan as appropriate and consistent with state water plan policies and strategies.”

The legislature and the Governor have made it clear that a comprehensive state water plan must be completed to address all aspects of water management in the state. Given that New Mexico may soon be in litigation with neighboring states, this strategy is necessary to bolster the position of the state with respect to control and management of water resources. As a perhaps unintentional result, this latest statute makes it clear that the regional water planning process has become secondary to the comprehensive state water plan. It appears from the statute’s language that when regional and state goals conflict, the state water plan objectives will clearly take precedence over regional preferences. However, the state water plan statute has some protections that should reassure the Socorro and Sierra region, including a plan for input from regional water planning groups and a requirement that the state can only purchase water from willing sellers as part of the state water plan implementation.

While the state has actively sought public input through public meetings in all parts of the state and through a water planning town hall held at the end of September 2003, the state plan is being developed entirely within the ISC. The regions will nevertheless have input to the process through an ad hoc committee formed in August 2003 that is made up of representatives from the 16 different planning regions.

Interregional communication and cooperation will be necessary to avoid conflicts between the goals of neighboring regions. For example, if a neighboring region has identified importation of water rights as a means to supplement existing supplies, this would clearly conflict with and negatively affect the Socorro/Sierra region. Because it will integrate all the regional water plans, the state water planning process may be a forum for regions to address interregional decision-making. Additionally, the Water Trust Board, the entity likely to fund most of the alternatives identified by the various regions, could take into consideration whether implementation of a specific alternative would have negative consequences for a neighboring region, and this consideration could be a criteria for scoring proposed projects. However, in the case of a contentious conflict, a special meeting with the ISC and the OSE may be necessary. Additionally, participation in ongoing processes that affect management of the Rio Grande, such as the URGWOM process or the Endangered Species Work Group, should help to make river managers aware of Socorro-Sierra regional concerns.

Public involvement in implementation of the regional water plan will help the region identify changes in priorities and could avoid obstacles to key management decisions as the state begins to implement the state water plan.

8.15.2 Key Issues

Water management decisions that affect the region are often made outside of the region (ISC, upstream users), and without participation, the views of the region are not incorporated in these decisions. There may not be an opportunity for participation in all cases, but whenever possible it is beneficial to participate. Dissemination of information and involvement of the public can help to support initiatives both within and outside of the region.

The primary concern for the Socorro-Sierra water planning region is that the recommendations in this plan be implemented and addressed. Of particular interest is preventing the region's water supply from being transferred to other portions of the state to meet their growing water supply shortages and incorporating this region's concerns into the state water plan. In particular, the state water planning statute (NMSA 72-14-3.1) reemphasizes the policy of "no condemnation." In NMSA 72-14-3.1(J), it states "nothing in the state water plan shall be construed to permit the granting or the condemnation of water rights." Because the statute requires integration of public input, the regions will have the opportunity to at least comment upon all aspects of the plan.

Continued support for the planning process is vital for implementation of the many recommendations, including education to encourage water conservation and tracking legislation that may impact the region and forecast future problems.

Continued involvement through public participation will be essential for all future water management decisions. Lack of public consultation and outreach prior to announcing a major change in management of Elephant Butte Reservoir led to public outcry, much media coverage, and demonstrations against an initiative to ease water shortages through the summer. The State of New Mexico had negotiated a deal with the State of Texas to release a significant amount of water stored in Elephant Butte Lake in exchange for allowing the state to store that water in upstream reservoirs. This agreement would allow the state to continue releasing water through the summer for irrigators and to help protect the silvery minnow. Although the state went through with the agreement, Governor Richardson met with affected residents near Elephant Butte to identify ways the state could help protect the recreation season (New Mexico Office of the Governor, 2003). Early participation from local communities could have provided the region an opportunity to identify mitigating measures and develop a plan that the region could endorse without the negative public reaction.

A significant public participation campaign in the early phases of the state water planning process could be a model for yearly outreach from the State and the regions to make the public aware of the water planning and management activities at the state and regional levels. It is unclear how the State will involve the regions or whether it will have an ongoing public participation process. However, the region should continue to communicate the importance of public participation in all water planning.

8.15.3 Implementation

Implementation of regional water planning alternatives will involve numerous stakeholders and state and local governmental authorities. Ordinances and other local measures will be implemented by county and municipal entities, while funding for most alternatives will come from state, and in some cases, federal sources (Table 8-6).

The water trust board was created through the New Mexico Project Finance Act and is now responsible for allocating the majority of state water project funding (NMSA 72-4A-1 to 10). The state water plan, being developed with the participation of the Water Trust Board, will "provide a basis for prioritizing infrastructure investment" (NMSA 72-14-3.1(B)(7). The Water Trust Board regulations set out guidelines for board operations as well as application process and eligibility requirements for proposed projects (NMAC 19-25-10).

Table 8-6. State and Federal Funding Sources
Page 1 of 7

Program Title / *Agency* / Web Site or Contact [a]	Funding Areas				Description
	Water Supply Conservation	Development and Infrastructure	Water Supply Protection	Water Resources Management	
General Information					
Catalog of Federal Domestic Assistance http://www.cfda.gov/	■	■	■	■	Good information about funding sources, grant writing, etc.
Federal Drought Programs http://www.iwr.usace.army.mil/iwr/drought/feddrghtprogs.htm#_Toc491241963	■	■	■	■	Summary of federal funding sources available for drought programs.
Catalog of Federal Funding Sources for Watershed Protection http://www.epa.gov/owow/watershed/wacademy/fund/sources.html			■		Topical listing of funding sources related to watershed protection.
Links to private funding sources http://www.epa.gov/owow/nps/capacity/funding.htm#private	■	■	■	■	List of links for private funding sources for various areas.
Funding Programs					
New Mexico Clean Water State Revolving Fund *New Mexico Environment Department*, *Construction Programs Bureau* Santa Fe: 505-827-2806 http://www.nmenv.state.nm.us/cpb/cpbtop.html http://www.nmenv.state.nm.us *New Mexico Water Trust Board* Contact New Mexico Finance Authority (NMFA) U.S. *Environmental Protection Agency (EPA)* http://www.epa.gov/owm/cwfinance/cwsrf/index.htm	■	■	■	■	Eligibile projects include water supply development, conservation, watershed management, and infrastrucrture. Water quality protection projects for wastewater treatment, nonpoint source pollution control, and watershed and estuary management.

[a] Web site address as of November 2002; address and information found there is subject to change.

Table 8-6. State and Federal Funding Sources
Page 2 of 7

Program Title / *Agency* / Web Site or Contact [a]	Funding Areas: Water Supply Conservation	Funding Areas: Development and Infrastructure	Funding Areas: Water Supply Protection	Funding Areas: Water Resources Management	Description
Community Block Development Grants *Department of Housing and Urban Development* (local office)				■	Funding source for 40-year plans.
Community Facilities (CF) Direct Loans and Grants *U.S. Department of Agriculture (USDA)* http://www.rurdev.usda.gov/rhs/cf/cp_dir_grant.htm		■			Provides loans for the development of essential community facilities for public use in rural areas and towns with a population of 20,000 or less.
Emergency Community Water Assistance Grants *USDA Rural Utility Services (RUS)* Albuquerque: 505-761-4955 Socorro: 505-835-1710, ext. 4 http://www.rurdev.usda.gov/nm/index.html http://www.usda.gov/rus/water/programs.htm#EMERGENCY http://www.usda.gov/rus/water/programs		■	■		Assists rural communities that have had a significant decline in quantity or quality of drinking water.
Irrigation Works Construction Loan Fund *New Mexico Interstate Stream Commission* Santa Fe: 505-827-6160 Fax 505-827-6188 Socorro SWCD: 505-835-1710, ext. 5 http://nmlocalgov.net/plan/pdf/seall.pdf		■			Makes loans to entities such as irrigation districts, community ditch associations, and municipalities for engineering and design, construction, or rehabilitation of irrigation works.
Acequia Restoration and Rehabilitation Program *U.S. Army Corps of Engineers, Albuquerque office* *New Mexico Interstate Stream Commission* Santa Fe: 505-827-6160 Fax 505-827-6188 http://nmlocalgov.net/plan/pdf/seall.pdf		■			Joint program with U.S. Army Corps of Engineers (COE); provides eligible acequias with COE grants that fund up to 75% of a project's cost with 25% acequia funding. Matching requirements may be met through state grants (17.5%) and loans (7.5%).

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Table 8-6. State and Federal Funding Sources
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Program Title / *Agency* / Web Site or Contact [a]	Funding Areas				Description
	Water Supply Conservation	Development and Infrastructure	Water Supply Protection	Water Resources Management	
Ditch Rehabilitation Grant Program *Office of the State Engineer* Santa Fe: 505-827-6191 Fax 505-827-6188 http://nmlocalgov.net/plan/pdf/seall.pdf		■			Joint program with U.S. Soil Conservation Service; provides grants to community ditches for construction, repair, and improvement of ditches, dams, reservoirs, flumes, and appurtenances.
Planning Assistance to States *U.S. Army Corps of Engineers* Albuquerque*: (505) 342-3109* http://www.spa.usace.army.mil http://www.lrd.usace.army.mil/gl/22.htm	■	■	■	■	Assists in planning for the development, utilization, and conservation of water and related land resources and ecosystems.
Reclamation States Emergency Drought Relief Act of 1991 - Title II *U.S. Bureau of Reclamation* Albuquerque Area Office: 505-248-5323 http://www.uc.usbr.gov/progact/waterconsv/wtr_wmp.html http://nris.state.mt.us/drought2001/reports/DRTBuRecDrRelief.html	■	■	■	■	Assistance in the construction and planning of projects that mitigate effects of drought.
Conservation Technical Assistance *USDA Natural Resource Conservation Service* Socorro: 505-835-1710, ext. 3 Albuquerque Office: 761-4407; 1-800-410-2067 http://www.nrcs.usda.gov/programs/cta/			■	■	Planning and implementation of solutions to natural resource concerns, including drought.

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Table 8-6. State and Federal Funding Sources
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Program Title / *Agency* / Web Site or Contact [a]	Funding Areas				Description
	Water Supply Conservation	Development and Infrastructure	Water Supply Protection	Water Resources Management	
Safe Drinking Water Act Revolving Loan Program *New Mexico Environment Department, Construction Programs Bureau* Santa Fe: 505-827-2806 http://www.nmenv.state.nm.us/cpb/cpbtop.html http://www.nmenv.state.nm.us *U.S. EPA* toohttp://www.epa.gov/safewater/dwsrf.html		■	■		Water infrastructure improvements, for small and disadvantaged communities and for pollution prevention to ensure safe drinking water.
Water and Waste Loans and Grants *USDA Rural Development* Albuquerque: 505-761-4955 Socorro: 505-835-1710, ext. 4 http://www.rurdev.usda.gov/nm/index.html http://www.usda.gov/rus/water/programs.htm		■	■		Development or improvement of water or wastewater disposal systems in rural areas.
Snow Survey and Water Supply Forecasting Program *USDA Natural Resources Conservation Service* Socorro: 505-835-1710, ext. 3 Albuquerque: 505-761-4407; 1-800-410-2067 http://www.nrcs.usda.gov. http://www.nrcs.usda.gov/programs/snowsurvey/				■	Monitoring of climatic and hydrologic elements necessary to produce water supply forecasts.
Reclamation Wastewater and Groundwater Study Program *U.S. Bureau of Reclamation* Albuquerque: 505-248-5323 http://www.cfda.gov/static/p15504.htm	■	■			Appraisal and feasibility studies on water reclamation and reuse projects.

[a] Web site address as of November 2002; address and information found there is subject to change.

Table 8-6. State and Federal Funding Sources
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Program Title / *Agency* / Web Site or Contact [a]	Funding Areas: Water Supply Conservation	Development and Infrastructure	Water Supply Protection	Water Resources Management	Description
Small Watershed Program *USDA Natural Resources Conservation Service* Socorro: 505-835-1710, ext. 3 Albuquerque: 505-761-4407; 1-800-410-2067 http://www.nrcs.usda.gov/programs/watershed/	■		■	■	Agricultural water management, municipal and industrial water supply, groundwater recharge, and watershed protection projects.
Environmental Quality Incentives Program (EQIP) *USDA Natural Resources Conservation Service* Socorro: 505-835-1710, ext. 3 Albuquerque: 505-761-4407; 1-800-410-2067 http://www.nrcs.usda.gov/programs/eqip/	■		■		Practices to address soil, water, and related natural resource concerns on farm and ranch lands.
Socorro Soil and Water Conservation District Cost Share Program Socorro SWCD: 505-835-1710, ext. 5 http://www.socorroswcd.com	■		■	■	Cost share for small irrigation improvement and brush control projects, similar to those funded under EQIP.
Emergency Water Supplies *USDA Rural Development* Santa Fe: 505-476-9600 http://www.dps.nm.org/emergency/em_index.htm Socorro: 505-835-1710, ext. 4	■		■		Provision of emergency water supplies to communities that may run out of adequate drinking water.
Finance Authority Emergency Funding and Water and Wastewater Grant Program *NMFA* Contact: NMFA at (505) 984-1454 toll free, 1-877-ask-nmfa		■			Provision of emergency water supplies.

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Table 8-6. State and Federal Funding Sources
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Program Title / *Agency* / Web Site or Contact [a]	Funding Areas: Water Supply Conservation	Funding Areas: Development and Infrastructure	Funding Areas: Water Supply Protection	Funding Areas: Water Resources Management	Description
Emergency Conservation Program *USDA Farm Services* Socorro: 505-835-1710, ext. 2 *Albuquerque : 505-761-4407; 1-800-410-2067* http://www.fsa.usda.gov/pas/disaster/ecp.htm	■				Rehabilitation of farm lands and conservation facilities.
Public Assistance /Emergency Measures Program *New Mexico Emergency Management Center* Regional Office Main Number (940) 898-5399 Santa Fe: 505-476-9600 http://www.dps.nm.org/emergency/em_index.htm http://www.fema.gov/reg-vi/		■		■	Activities to alleviate consequences of the subject of a Presidential Emergency or Major Disaster Declaration (such as drought).
Economic Adjustment Program: Sudden and Severe Economic Dislocation Components *U.S. Department of Commerce EDA* http://www.osec.doc.gov/eda/				■	Prevention of serious economic dislocations or reestablishment of employment opportunities after a sudden and significant dislocation.
Conservation Reserve Program *USDA Natural Resources Conservation Service* http://www.nrcs.usda.gov/programs/crp/ Socorro: 505-835-1710, ext. 3	■				Helps farmers and ranchers address water resource concerns on their lands.
Emergency Watershed Protection *USDA Natural Resources Conservation Service* http://www.nrcs.usda.gov/programs/ewp/ewp.html Socorro: 505-835-1710, ext. 3			■	■	Emergency recovery measures to relieve imminent hazards to life and property as a result of natural disasters.

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Table 8-6. State and Federal Funding Sources

Program Title / *Agency* / Web Site or Contact [a]	Funding Areas				Description
	Water Supply Conservation	Development and Infrastructure	Water Supply Protection	Water Resources Management	
Emergency Well Construction and Water Transport *USACE* *U.S. Army Corps of Engineers Albuquerque District Office* Albuquerque: 505-342-3109 http://www.spa.usace.army.mil		■	■		Construction of wells or transport of water drought-distressed areas.
Water Quality Program *USDA CSREES* http://www.reeusda.gov/nre/water/water.htm			■		Provide watershed- based information for assessing and improving sources of water quality impairment in targeted watersheds.
Unsolicited proposals *U.S. Geological Survey* http://www.usgs.gov/contracts/grants/unsolbk.html	■			■	Research proposals in many earth science areas, including hydrology and conservation.
State-EPA NPS Partnership *U.S. Environmental Protection Agency* http://www.epa.gov/owow/nps/partnership.html			■		Focus on nonpoint source topic-specific needs including: watershed planning and implementation.
Land and Water Conservation Fund Grants to States *National Park Service* http://www.ncrc.nps.gov/PROGRAMS/LWCF/index.html			■		Matching grants to states and local governments for the acquisition and development of public outdoor recreation areas and facilities.
Water Reclamation and Reuse Program *U.S. Bureau of Reclamation* http://www.usbr.gov/tcg/guidelines/		■			Projects for reclamation and reuse of municipal and other wastewaters and naturally impaired waters.

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The State Water planning process will define the future of regional water planning, public participation, regional input into water management decision making, as well as funding. The region should continue to actively participate in the formulation of the state water plan and lobby for an ongoing role for the regions to provide input to the state water plan.

8.16 Summary Recommendations and Implementation Schedule

As discussed previously, the feasibility of the alternatives discussed in Sections 8.2 through 8.15 was discussed at Steering Committee and public meetings. Additionally, the entire list of alternatives developed by the Steering Committee was discussed at meetings held in 2003. Based on these discussions, specific recommended actions for implementation of the regional water plan alternative were developed. These actions, along with the responsible party and time frame for implementation, are presented in Table 8-7.

Table 8-7. Implementation Schedule and Recommended Actions for Alternatives to Meet Future Supply Needs
Page 1 of 8

	Alternative [a]	Implementation Priority [b]	Action	Responsible Party [c]
	General actions	1	• Seek funding to implement regional water plan • Review implementation/recommended actions annually	Steering committee
1	***Increase or preserve water supply***			
1a	Reclamation, treatment, and use of saline water [b]	3	• Support ongoing research to improve technology • Support pilot desalination projects	Steering Committee New Mexico Tech
1b	Wastewater treatment and reuse	2	• Where feasible, reuse wastewater for landscape watering (balancing against return flow concerns)	Municipalities MDWCAs Alamo
1c	Commercial and residential on-site water recycling	2	• Encourage implementation of residential and commercial gray water systems in accordance with the provisions of the 2003 gray water legislation	Counties Municipalities
1d	Store Elephant Butte reservoir water at existing higher-elevation/latitude reservoirs	1	• Pursue this alternative only if any adverse impacts to Elephant Butte recreational users can be avoided or mitigated. • Include Elephant Butte and Truth or Consequences in long-term water management planning for the State • Establish a minimum recreation pool at Elephant Butte (would require transfer of water rights for that purpose) • Consider options to reduce evaporative losses by storing more water at higher elevations in wet years where there won't be a large impact on recreational users • Research feasibility of smaller storage facility between El Vado and Socorro • Research implementation options and how to mitigate downstream impacts	Elephant Butte Truth or Consequences Steering Committee Sierra County

[a] Shaded alternatives identified as priority alternatives
[b] 1 = Begin implementing immediately
2 = Begin implementing in 1 to 10 years
3 = Begin implementing in 10 to 40 years
[c] Primary responsible parties; others may also be involved.

MDWCA = Mutual domestic water consumers association
Alamo = Alamo Chapter of the Navajo Tribe
ISC = Interstate Stream Commission
NMBGMR = New Mexico Bureau of Geology and Mineral Resources
MRGCD = Middle Rio Grande Conservancy District
URGWOM = Upper Rio Grande Water Operations Model

SWCD = Soil and Water Conservation District
NMED = New Mexico Environment Department
OSE = Office of the State Engineer
EBID = Elephant Butte Irrigation District
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Table 8-7. Implementation Schedule and Recommended Actions for Alternatives to Meet Future Supply Needs
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	Alternative [a]	Implementation Priority [b]	Action	Responsible Party [c]
1e	Control non-reservoir surface water evaporation by reducing surface water areas in engineered and natural locations	1	• Improve Elephant Butte low flow conveyance channel	ISC Bosque del Apache
1f	Aquifer storage and recovery	3	• Support ongoing research to improve technology • Consider storage projects in very wet years to reduce long-term evaporative losses	Steering Committee New Mexico Tech
1g	Restriction of groundwater supply wells in sensitive areas (shallow alluvial aquifers)	3	• Identify sensitive areas needing protection • Consider regulations or policy guidelines regarding development of new wells in sensitive areas	NMBGMR Counties Municipalities OSE Alamo
2	***Implement conservation plans and programs***			
2a	Adopt and implement local water conservation plans and programs, including drought contingency plans	1	• Develop and implement individual water system conservation and drought contingency plans, including leak reduction and reduced water use programs	Municipalities MDWCAs MRGCD EBID Alamo
2b	Implement local government programs that offer subsidies for adoption of water-efficient technologies and water-saving devices	2	• Develop municipal water conservation plans that are appropriate for each community	Municipalities Counties MDWCAs SWCDs
2c	Establish educational programs to encourage voluntary conservation of water and teach conservation techniques	2	• Develop municipal water conservation plans that are appropriate for each community	Municipalities Counties MDWCAs SWCDs Bosque del Apache Alamo

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Table 8-7. Implementation Schedule and Recommended Actions for Alternatives to Meet Future Supply Needs

	Alternative [a]	Implementation Priority [b]	Action	Responsible Party [c]
2d	Promote state funding of acequias to develop and implement water conservation programs	1	• Support legislative efforts to fund conservation programs	Steering Committee Acequias SWCDs
3	***Reduce urban and agricultural water demand***			
3a	Increase rates for water, sliding rates	2	• Develop municipal water rate structures that provide incentives for conservation that are appropriate for each community	Municipalities Counties MDWCAs
3b	Promote xeriscaping and drip irrigation	2	• Promote xeriscaping and drip irrigation through education workshops • Provide conservation resources to each community	Municipalities Counties MDWCAs Bosque del Apache Alamo
3c	Improve outdoor watering schedules	2	• Develop municipal water conservation plans, including watering schedules, that are appropriate for each community • Provide conservation resources to each community	Municipalities Counties MDWCAs
3d	Promote use of low-flow shower heads, toilets, and fixtures	2	• Promote use of low-flow shower heads, toilets, and fixtures by modifying development codes and providing incentives for retrofits or paying for retrofits	Municipalities Counties MDWCAs Alamo
3e	Improve efficiency of surface water irrigation conveyance systems • Implement conveyance alternatives (e.g., concrete-lined ditches, pipelines) • Improve irrigation scheduling • Meter and manage surface water diversions and returns	1	• Develop funding for continued improvement of irrigation conveyance systems, including metering systems and ditch lining, pipelines, and automated check gates • Provide tax credits for meter installation	MRGCD Acequias Support from the Steering Committee EBID SWCDs

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Table 8-7. Implementation Schedule and Recommended Actions for Alternatives to Meet Future Supply Needs
Page 4 of 8

	Alternative [a]	Implementation Priority [b]	Action	Responsible Party [c]
3f	Develop and implement alternative irrigation methods on croplands	2	• Support state-wide programs and funding to provide assistance to irrigators to voluntarily improve methods	MRGCD Acequias SWCDs EBID Support from the Steering Committee
3g	Use precision agriculture techniques • Soil moisture monitoring • Weather forecasting	2	• Develop funding and technical assistance programs to provide ongoing support to farmers for voluntary implementation of precision agriculture techniques	MRGCD Acequias EBID SWCDs Support from the Steering Committee
3h	Reduce agricultural consumptive use: test, develop and promote use of low (or lower) water use crops, implement protective agriculture where practicable	2	• Develop funding and technical assistance programs to provide ongoing support to farmers for voluntary implementation of lower-water-use crops • Support full funding of conservation security amendments to the 2002 farm bill • Identify commercially feasible low-water-use crops	MRGCD SWCDs EBID Acequias Support from the Steering Committee
3i	Improve on-farm irrigation efficiency	1	• Support state-wide programs, funding, and technical assistance to provide ongoing support to farmers for voluntary implementation of on-farm efficiency measures	MRGCD Acequias EBID Support from the Steering Committee
4	***Improve water-use efficiency and management***			
4a	Improve reservoir management for better coordination of flows with demand	2	• Support planning efforts such as the URGWOM effort to identify options for better flow management	Steering Committee

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Table 8-7. Implementation Schedule and Recommended Actions for Alternatives to Meet Future Supply Needs

	Alternative [a]	Implemen-tation Priority [b]	Action	Responsible Party [c]
4b	Control brush and weeds along water distribution systems and drains	2	• Continue mowing along canals and drains	MRGCD Acequias
4c	Manage watersheds to increase yield	2	• Support pilot projects (i.e., thinning) to increase yield at high elevations and monitor changes in yield	SWCDs New Mexico Tech OSE State Land Office BLM USFS
4d	Remove exotic vegetation (i.e., salt cedar, Russian olive) on a wide scale	1	• Continue with salt cedar removal program, making it a priority within the region • Develop monitoring programs to evaluate the quantitative impacts of salt cedar removal along the Rio Grande as well as the ephemeral tributaries • Monitor the effects of spraying herbicides and pesticides on water quality and public health	Socorro and Sierra SWCDs Bosque del Apache Save Our Bosque Task Force
4e	Restore bosque habitat and manage vegetation to reduce evapotranspiration	1	• Provide ongoing maintenance of habitat restoration projects • Support Save Our Bosque Task Force Socorro Floodplain Project • Seek funding from legislature and Water Trust Board	Socorro and Sierra SWCDs Bosque del Apache Save Our Bosque Task Force
4f	Develop economic potential of non-native species removal, harvest, and product output by local industries	2	• Support efforts of government and/or private organizations to develop markets for small-diameter timber	Socorro and Sierra SWCDs USFS

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Table 8-7. Implementation Schedule and Recommended Actions for Alternatives to Meet Future Supply Needs
Page 6 of 8

	Alternative [a]	Implementation Priority [b]	Action	Responsible Party [c]
5	***Maintain or improve water quality***			
5a	Identify, protect, and monitor areas vulnerable to contamination	2	• Support NMED monitoring programs • Support State funding for water quality monitoring and protection programs • Obtain funding for local surveys of water quality	NMED Support from Steering Committee Alamo
5b	Develop alternative re-use of wastewater	3	• Where feasible, reuse wastewater for landscape watering (balancing against return flow concerns)	Municipalities MDWCAs Alamo
6	***Plan for future growth***			
6a	Restrict new development, such as subdivisions, industry uses, golf courses, power plants, and chip plants, based on water use/efficiency	2	• Consider water use and conservation policies when updating comprehensive plans and subdivision regulations	Counties Municipalities
6b	Increase residential building densities and infill development through local government land use policies and regulations	3	• Evaluate appropriate density and infill policies when updating comprehensive plans and subdivision regulations	Counties Municipalities
6c	Ensure that the planning region is represented in water management decisions being made for the middle Rio Grande Valley	1	• Meet with ISC representatives to discuss regional concerns • Participate in URGWOM activities • Review and comment on the draft Middle Rio Grande Regional Water Plan • Participate in State Water Plan activities	Steering Committee
6d	Develop a sustainable and coordinated growth management plan for adoption and implementation by local governments in the planning region	2	• Coordinate discussion amongst counties and municipalities on the potential for growth management efforts • Obtain funding and expand and repair infrastructure to address development needs	Steering Committee

[a] Shaded alternatives identified as priority alternatives
[b] 1 = Begin implementing immediately
2 = Begin implementing in 1 to 10 years
3 = Begin implementing in 10 to 40 years
[c] Primary responsible parties; others may also be involved.

MDWCA = Mutual domestic water consumers association
Alamo = Alamo Chapter of the Navajo Tribe
ISC = Interstate Stream Commission
NMBGMR = New Mexico Bureau of Geology and Mineral Resources
MRGCD = Middle Rio Grande Conservancy District
URGWOM = Upper Rio Grande Water Operations Model

SWCD = Soil and Water Conservation District
NMED = New Mexico Environment Department
OSE = Office of the State Engineer
EBID = Elephant Butte Irrigation District
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Table 8-7. Implementation Schedule and Recommended Actions for Alternatives to Meet Future Supply Needs
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	Alternative [a]	Implementation Priority [b]	Action	Responsible Party [c]
6e	Ensure public involvement in water planning by establishing citizen planning committees and programs that regularly disseminate public information	1	• Maintain e-mail distribution to inform public of relevant meetings and publications • Assign a public involvement coordinator • Require agency dissemination of completed studies	Steering Committee SWCDs OSE
6f	Require proof of sustainable water supply for approval of new development	2	• Consider sustainable water supply criteria when adopting or revising County or City ordinances and when approving subdivisions	Counties Municipalities
7	***Implement legal, institutional, and economic improvements to water use and management***			
7a	Develop local markets for higher-value, low-water use alternative crops	2	• Develop funding and technical assistance to support development of local markets for low-water use crops • Identify low-water-use crops and conduct market research • Support agriculture experimental station/research within the region	SWCDs
7b	Encourage retention of water within the planning region	1	• Develop funding to buy water rights from willing sellers within the region • Develop area-of-origin and other ordinances to lessen impact to the region of transfers that move water outside the region.	SWCD Steering Committee Municipalities Counties
7c	Develop a viable water banking system to facilitate transfer of water within the planning region	2	• Research methods for constraining a water bank to avoid impairment within the region • Consider water banking during drought periods as a method of avoiding permanent loss of water rights in the region	Steering Committee
7d	Require environmental and economic analyses for all water transfers	2	• Support statewide policies that integrate environmental and economic analyses in water transfers	All
7e	Identify, quantify, and adjudicate all water rights and wet water quantities in the planning region	2	• Support OSE efforts to complete adjudications	OSE All

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	Alternative [a]	Implementation Priority [b]	Action	Responsible Party [c]
7f	Make water rights a non-condemnable resource	1	• Obtain funding; complete detailed legal analysis • Coordinate with other organizations around the state (this is a state-wide issue) • Support legislative efforts to make water rights non-condemnable	SWCDs Municipalities
7g	Establish a regional water management authority to provide professional water resource management and to administer or assist in a local water banking program	3	• Research mechanisms for implementing a regional management authority	Steering Committee
7h	Preserve, and protect deep, high-quality well water	1	• Support/implement monitoring programs to evaluate water level declines as needed to establish protections	Counties Municipalities MWDAs Alamo
7i	Establish dedicated and continuous funding for regional water planning as a basis for water management at local, regional, and state levels	1	• Work with the State Legislature and New Mexico Water Dialogue to show support	Steering Committee
7j	Restrict installation of new domestic wells	2	• Support state-wide domestic well legislation • Support efforts to limit new domestic wells on lands that agricultural water rights have been transferred from	OSE Municipalities Steering Committee

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