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Memorandum

Date: September 23, 2002

From: Karen Lewis, Debbie Hathaway

To: Socorro-Sierra Regional Water Planning Group

Subject: **Proposed Planning Alternatives – Preliminary Analysis of Hydrologic Impacts**

Background

The Socorro-Sierra Regional Water Planning group has developed an initial list of water planning alternatives (“long list”). By letter of June 8, 2002, the Socorro Soil & Water Conservation District requested that the ISC authorize SSP&A to provide preliminary review comments regarding many of the alternatives on this “long list”. By letter of July 8, 2002, the ISC authorized SSP&A to provide a general review and discussion of the noted alternatives (as part of work for the Middle Rio Grande Water Supply Study, Phase 3). Following subsequent screening of the alternatives by the Socorro-Sierra Planning Region, SSP&A will provide more detailed and specific analyses of alternatives on a “short list”. SSP&A has been requested to focus general comments at this stage of evaluation on the amount of water that can be gained or saved, and the overall hydrologic impacts of the “long-list” alternatives. The comments provided herein are provided at a reconnaissance level, and are not intended to be exhaustive or quantitative.

The list of alternatives submitted to SSP&A for preliminary hydrologic evaluation is provided below. Following the list is a discussion of the likely hydrologic impacts of each item on the list. Finally, the Socorro-Sierra Planning Region has asked for a qualitative ranking of water gained or demand reduced for consideration in development of a scoring matrix. This ranking, based on reconnaissance-level review, also is provided in this memo.

Socorro-Sierra Long-List Alternatives Identified for SSP&A Preliminary Review

1. Increase or preserve water supply
    a. Reclamation, treatment, and use of saline water.
    b. Wastewater treatment and reuse
    c. Commercial and residential on-site water recycling
    d. Storage of reservoir water at higher altitudes/latitudes
    e. Evaporation control through reduced water surface areas in engineered and natural areas
    f. Aquifer storage and recovery
    h. Restriction of groundwater supply wells in sensitive areas

3. Reduce urban and agricultural water demand
    e. Improve efficiency of surface water conveyance systems to agricultural land
        - Implement conveyance alternatives (e.g. concrete-lined ditches, pipelines)
        - Improve irrigation scheduling

- Meter and manage surface water diversions and returns

f. Develop and implement alternative irrigation methods on croplands (e.g. drip)
g. Use precision agriculture techniques such as soil moisture monitoring and weather forecasting
h. Reduce agricultural consumptive use; test, develop and promote use of low (or lower) water use crops, implement protective agriculture where practicable
i. Improve on-farm irrigation efficiency

4. Improve water-use efficiency and management
   b. Control brush and weeds along water distribution system and drains
   d. Remove exotic vegetation on a wide-scale
   e. Restore bosque habitat and manage vegetation to reduce evapotranspiration
   g. Delay start-up of irrigation system
   h. Control competitive brush species

7. Implement legal, institutional, and economic improvements to water use and management
   a. Develop local markets for higher value, low-water use alternative crops (3h)
   b. Assess the hydrologic reality of water transfers, both within and outside of the region
   c. Develop a viable water banking system to facilitate transfer of water within the planning region
   i. Preserve, but continue to draw, deep well water for drinking purposes only
   j. Restrict domestic well use

Discussion of Hydrologic Impacts

The hydrologic impacts of these proposed alternatives are reviewed at a reconnaissance level. The goal of this review is to briefly describe each alternative in terms of its impact on the amount of water needed at the diversion point and on the amount of water consumed. Table 3 provides a score for each alternative, focusing on the opportunity to save (or gain) water both from a diversion and a consumptive perspective. While changes in diversions without commensurate consumptive changes typically don't impact the basin supply (or ability to meet Compact obligations), there may be benefits to modifying diversions at a regional or local level, particularly when considering cost and environmental issues. Where possible, comments are also offered on technical, economic and political feasibility.

This memo is intended to provide regional planners with a view of the relative hydrologic costs and benefits of each alternative, and to aid planners in further refining their chosen alternatives to maximize the efficiency and success of the water planning process in the region.

1 a) Reclamation, treatment, and use of saline water

Desalination is a fairly new technology, with only a few plants on-line, but is rapidly growing. Prices at desalination plants around the world currently range from $1,220 to $2,900 per acre-foot per year ($3.75 to $9.00 per 1,000 gallons). However, new plants proposed for Tampa Bay, FL (http://www.tampabaywater.org/MWP/MWP_Projects/Desal/Desal.htm) and

Los Angeles, CA anticipate pricing on the order of $760 per acre-foot per year ($2.08 per 1,000 gallons).

In the Rio Grande region, Sandia National Laboratory and the US Bureau of Reclamation are working toward a research desalination plant in the Tularosa Basin (http://wrri.nmsu.edu/tbndrc/tbndrc.html). They are currently preparing a feasibility study and forecast having a plant initially on line in 2004 and at full operation in 2005. There is also proposal in progress for a private desalination plant using water from the Estancia Basin. Following the progress and results of these projects will allow Socorro-Sierra to assess the viability of desalination in their region.

New Mexico has large reserves of brackish water and is therefore a likely candidate for desalination should it become economically competitive and be ecologically sound. The potential for application of desalination technology within the Socorro-Sierra region is significant – there are large saline groundwater reservoirs that could be tapped. Saline groundwater basins that are not connected to the Rio Grande could be pumped with no hydrologic impact on the Rio Grande Compact deliveries. However, an assessment of local effects would still be required, including impacts on any adjacent freshwater aquifers and the potential for ground subsidence. Ecological and financial concerns will include options for disposal of the high concentration brine by-product.

If brackish water from non-tributary basins could be developed, these supplies would augment the supply available for both diversion and for consumptive use. Significant flexibility in controlling the timing of augmented supplies would also be advantageous. From a physical perspective, this option has high potential for improving the water supply to the region. However, the favorable qualitative scores reflected on Table 3 will be tempered by less advantageous cost and feasibility scores.

1 b) Wastewater treatment and reuse

Wastewater reuse will not change consumptive use; it will only change water use efficiency. Wastewater treatment and reuse is primarily of value to communities that are limited in the ability or capacity to divert water for treatment. (e.g. limited groundwater sources, or for downstream users where there is no surface-water flow-through).

Wastewater reuse will reduce return flow. In cases where municipal diversions are from groundwater, and returns accrue to surface water (i.e., City of Socorro), wastewater reuse will reduce river returns and may have a negative impact over the short-term on supply in the river (Compact deliveries). Over the long term, this negative impact would be offset by reduced river depletion, assuming that pumping rates were reduced due to the demand met by reuse. However, if the reused water were used to satisfy new consumptive uses and pumping rates were not reduced, the negative impact on the river would continue.

In the case of groundwater sources, reuse of wastewater will reduce the demands on the aquifer and will result in a savings in pumping. This may be of value if conserving groundwater resources is desired. However, if the aquifer is directly connected to the river and recharges quickly, it may not be worth the cost to treat and reuse wastewater since the linked surface/groundwater system is currently performing a similar role.

The concept of wastewater reuse (without treatment) is fundamental to the design and present operation of the agricultural conveyance system. Agricultural return flow (both surface and subsurface) is routed to or intercepted by drains that provide part of the supply for downstream diversions. The magnitude of reuse could be increased through engineered modifications to the conveyance and drainage system. Such changes would not reduce net consumptive use but would reduce the diversion demand.

Wastewater treatment and reuse will be of value primarily for specific cases such as areas currently mining groundwater where a reduction in mining is desired, or for areas that need to reduce diversions from the river (for example, for habitat needs or to minimize seasonal shortages).

<u>1 c) Commercial and residential on-site water recycling</u>

See 1b) – water recycling will not reduce consumptive use and will not, therefore, result in water "savings" for the region. However, on-site reuse of gray-water will reduce the volume of wastewater requiring treatment and could result in a cost-savings for local municipalities. It will also allow for reduced river diversions and/or reduced municipal groundwater pumping, similar to option 1b, but will result in reduced wastewater returns to the river. A reduction in diversion via groundwater pumping with a concurrent reduction in wastewater returns to the river would result in a timing discrepancy; over an initial period of time the river would experience a greater impact from reduced wastewater returns than would be offset by reduced groundwater diversions, due to the distance of the wells from the river.

<u>1 d) Storage of reservoir water at higher altitudes/latitudes</u>

Potential savings in consumptive use would occur to the extent that evaporative losses were reduced by the alternate storage location. Presumably, this option is considering the large evaporative losses occurring from the Elephant Butte and Caballo Reservoirs. However, a complex suite of Congressional authorizations, and the Rio Grande Compact, control storage, releases and deliveries associated with these and other reservoirs. These institutional controls are substantial; alteration of these institutional controls is likely beyond the scope of the regional planning process.

<u>1 e) Evaporation control through reduced water surface areas in engineered and natural areas</u>

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.

The open-water area in the Elephant Butte delta is a function of reservoir level and groundwater elevation. The LFCC provides drainage in the region from San Acacia to the delta, and was designed to improve the delivery of diverted river water and intercepted drainage water to the reservoir. The lower part of the LFCC through the delta area is currently not functioning due to siltation and channel breaches; if the LFCC becomes functional again in this area, some reduction in evaporation from marshy areas will occur. However, it is not clear when the channel might be rebuilt. Once rebuilt, these changes are best viewed as a return to "status quo" operations established prior to the high water and breached conditions of the 1980s and 1990s, rather than a source of "new" water. Regardless, these maintenance activities are of prime importance in avoiding reduction of the water supply available to the entire Middle Rio Grande. It should be recognized that reduction of open water areas may not achieve the water savings anticipated, if the reclaimed area is colonized by riparian vegetation tapping shallow groundwater. Finally, maintenance of drainage conditions (and reduction of marshy areas) may be considered problematic for Southwest Willow Flycatcher habitat in some areas.

1 f) Aquifer storage and recovery

Aquifer storage and recovery can be a useful water banking approach if there is "extra" water available at predictable times. For the Middle Rio Grande region, the only years in which there is "extra" water is during spill years, which have occurred 5 times since the Rio Grande Compact was signed. It is unclear if aquifer storage is financially viable given this type of return period for flows.

Analysis of the projected cost of an aquifer storage project vs. the probable water available for storage and predicted value of that water is required to assess the economic viability of this option. The total volume of water spilled since 1982 is approximately 1.4 million acre feet, an annual average value of 70,000 acre feet. However, the 1982-2001 period has been particularly wet, having experienced 4 of 6 historic spills, and is therefore biased toward overestimating available water. Based on this very wet 20-year period, the benefit to the entire Middle Rio Grande region (Cochiti to Elephant Butte) is about 70,000 acre-feet per year, assuming all of the spill water could be captured. Given the low frequency and high volume of occurrence, successful capture of the spill water for aquifer storage would be difficult.

1 h) Restriction of groundwater supply wells in sensitive areas (shallow alluvial aquifers)

Restricted pumping from shallow alluvial aquifers will minimize near-term reductions in the surface water supply. If, as a consequence, water were drawn directly from the river, no change to the overall water supply and little change in the timing of river impacts would occur. Alternatively, if water were drawn from more distant wells, the negative impacts of pumping on the river would be shifted into the future. The impact of the restriction depends on how it is paired with compensating actions. One potential compensating action, moving pumping to more distant locations, is discussed below.

Restricting groundwater pumping from shallow alluvial aquifers may be paired with shifting pumping to deeper or more distant aquifer locations, thus delaying impacts to the river (unless wells are restricted from any area hydraulically connected to the river). Implementation of this alternative may result in a short-term increase in supply for diversion, through utilization of groundwater in storage. As the impacts translate to the river (as steady-state conditions are approached) this increase in supply will diminish, as the portion of supply met by river depletion increases. Furthermore, the amount of groundwater depleted from storage will be carried forward as a "debt" to the aquifer – when and if pumping ceases, the depleted storage will slowly be replaced (the debt will be physically repaid) by the river.

This alternative could help with water supply management by flexibly timing groundwater extraction to optimize the regional supply through climatic cycles. In some periods (i.e., when river/reservoir conditions are abundant) it might be advantageous to tap the shallow alluvial aquifers and incur an immediate effect on the river. When river and reservoir supplies are low, the delay of impacts through use of more distant well fields might be desirable. However, attempts at managing and favorably timing well impacts could be undermined by an unexpectedly long period of drought.

3 e) Improve efficiency of surface water conveyance systems to agricultural land by implementing conveyance alternatives (e.g. concrete-lined ditches, pipelines), improving irrigation scheduling, and metering and managing surface water diversions and returns

Potentially large reductions to the agricultural diversion demand are possible through improvements in irrigation efficiency, though irrigation-related consumptive use reductions will be minimal (only ensuing from reductions in incidental depletions associated with efficiency improvements). In particular, selective lining of canals and rotational delivery operations show promise for achieving efficiency improvement. With significant reductions in diversion demand, water could be retained in upstream storage reservoirs longer and provide timing advantages for irrigation (or ancillary needs/benefits).

3 f) Develop and implement alternative irrigation methods on croplands (e.g. drip)

A well-designed drip irrigation system or subsurface drip irrigation system will lose practically no water to runoff or deep percolation and very little to evaporation. (There will be some evaporative losses, but they should be small. Water delivered by the drip emitters and not used by the crops will move upward due to the lower matrix potential of the drier surface soils and eventually evaporate.) Under this alternative, the consumptive demand would be reduced in an amount nearly equal to the elimination of evaporation from the flooded fields. The diversion demand would be reduced by the total of the reduction in consumptive demand and the reduction in return flow from excess applied water.

If we assume that evaporation from a flood irrigated field is equal to open water evaporation for one day for each flooding event, and evaporation per event is roughly 0.38 inches per day (average daily March 1-Oct 30 open water evaporation for Elephant Butte Reservoir), we can calculate water saved by multiplying by the number of irrigation events in a season (March 1-Oct 30). If we assume irrigation every other week, we have a savings of 0.032 acre-feet per acre for each of 16 events, or 0.51 acre-feet per acre. If this amount were salvaged over 12,000 acres (the approximate reported irrigated acres, not including fallow and idle lands, in 1997-1998 in the Socorro division of the MRGCD -- MRGCD Crop Census Reports, 1997, 1998) the consumptive demand would be decreased by 6,120 acre-feet.

The reduction in diversion demand would equal the reduction in consumptive demand plus conveyance losses plus excess applied water that otherwise would become return flow. If one acre-foot per acre of the farm delivery is assumed to become return flow, a significant portion of this might be eliminated with drip irrigation. However, some water may be needed for soil flushing and this full amount would not likely be available for salvage.

3 g) Use precision agriculture techniques (soil moisture monitoring and weather forecasting)

Soil moisture monitoring and weather forecasting are already being conducted at a preliminary level throughout the MRGCD through the use of district climate stations and rain gages. If more accurate assessments and forecasts were available, it is possible that a few irrigation events could be eliminated each summer. Elimination of an irrigation event would result in a water savings of roughly 0.032 acre-feet per acre (see 3f). It is unlikely that more than 3 irrigation events could be eliminated in any given summer, for a maximum potential consumptive demand reduction of 1,150 acre-feet. This reduction in consumptive demand would be associated with a reduction in diversion demand of this amount, plus the conveyance losses and return flow associated with the eliminated irrigation events.

3 h) Reduce agricultural consumptive use; test, develop and promote use of low (or lower) water use crops, implement protective agriculture where practicable.

The crop breakdown for the Socorro Division of the MRGCD for 1997 and 1998 is shown in Table 1. The consumptive use of several crops grown in various regions of New Mexico is shown in Table 2. As can be seen in Table 1, the dominant crop in the Socorro division is alfalfa. From Table 2 it can be seen that alfalfa is the highest water user of the listed crop. Consequently, any shift toward low water use alfalfa or toward almost any alternative crop will result in an immediate water savings for the region.

Table 1: MRGCD Socorro Division Irrigated Crop Census, 1997 and 1998

	1997 Irr. Acres	1998 Irr. Acres
Alfalfa	7173	7544
Chili Peppers	387	377
Corn	407	532
Fallow	0	0
Family Garden	28	12
Fruit Trees	1	1
Grapes	8	
Grass	0	1
Grass Hay	0	43
Irrigated Pasture	3010	2820
Oats	454	365
Onions	91	35
Pond	0	0
Sudan	100	20
Trees	0	1
Vegetables	0	9
Wheat	81	125
Yard/Lawns	0	1
Total	11740	11886

Specific plans regarding crop conversion and/or low water use crops should be assessed to provide accurate quantitative numbers for potential water savings. Converting from alfalfa to grass hay would save about 0.42 acre-feet per acre of water; converting from alfalfa to corn, sorghum or cotton would save about 0.84 to 1 acre-foot per acre of water. Consequently, conversion of the 7,000 acres of alfalfa current grown in the Socorro division of the MRGCD to alternate crops could save (reduce consumptive demand) on the order of 3,000 to 7,000 acre-feet of water per year. This reduction would translate similarly to a reduction in diversion demand.

Table 2: Computed normal consumptive use of water in inches for selected crops and various irrigated areas in New Mexico. (From Technical Report 32 New Mexico State Engineer Santa Fe, NM. *Consumptive use and water requirements in New Mexico*, Blaney and Hanson, 1965.)

Crop	Albuquerque	Belen	Bernalillo	Socorro	T or C
Alfalfa	29	32	29	35	39
Grass Hay					34
Deciduous orchards	22	25			
Spring small grain	16	16	15	15	
Sorghum	22	22	21	23	23
Corn	21	21	21	23	23
Cotton		22		25	27
Beans			13		

3 i) Improve on-farm irrigation efficiency

Improvements in on-farm efficiency reduce diversion through the farm turnout primarily by reducing runoff and percolation to the aquifer. Smaller reductions are also effected through reducing ponding and, if sub-surface drip irrigation is used, by reducing evaporation out of the surface soil layer. Of these, only the smaller reductions (by reducing ponding and evaporation from soils) represent changes in consumptive use and have potential to reduce consumptive demand.

Other improvements to on-farm efficiency will reduce diversion demand through reducing return flow. If on-farm efficiency were improved from 50% to 75%, the farm delivery demand would decrease by one third, which would exceed one acre-foot per acre. The diversion demand would decrease also by a similar amount, plus conveyance losses.

With the exception of laser leveling fields, 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.

4 b) Control brush and weeds along water distribution system and drains

The Socorro Division of the MRGCD is estimated to have 200 miles of canals (134 measured miles, times 1.5 to account for smaller, unmeasured ditches and laterals). If we assume an average canal and associated riparian corridor width of 30 feet and an average open water/riparian ET for that width of 4 feet per year, canal evapotranspiration for the division is about 3,000 acre-feet per year (about 15 acre-feet per canal mile). Regular mowing of canal vegetation might reduce riparian ET by an estimated 50%. If we assume that half of the 30-foot width is open water and the other half riparian vegetation, the overall savings resulting from mowing is at most 25%, depending on the existing vegetation and the frequency of mowing. Piping would reduce losses for the stretch to zero.

Evapotranspiration from brush along drains, if we assume the same values, is 865 acre-feet/year (estimated 58 miles of drains). This alternative offers a potential reduction in consumptive use of perhaps a thousand acre-feet per year. While not a large sum, this alternative would be relatively simple to implement and would seem to be worth further investigation as part of an overall regional conservation program. As described above, this reduction in consumptive demand would be associated with a reduction in diversion demand of this amount, plus the conveyance losses to seepage.

4 d) Remove exotic vegetation on a wide-scale

Using data compiled in the Middle Rio Grande Water Supply Study (SSP&A, 2000) from the ET Toolbox and other USBR information sources, riparian acreage between San Acacia and San Marcial is estimated at 13,000 acres; between San Marcial and Elephant Butte at 11,300 acres; average consumptive use from 1985 to 1998 was estimated at 3.71 acre-feet per acre for San Acacia to San Marcia, resulting in a riparian usage of 49,452 acre-feet per year. At the same rate of consumption, consumptive use from San Marcial to Elephant Butte was estimated at 41,971 acre-feet per year.

Studies of riparian evapotranspiration currently suggest that salt cedar consumptively uses about 4 acre-feet per acre per year of water, while an established bosque uses about 3 acre-feet per acre per year of water (King and Bawazir, *Riparian Evapotranspiration Studies of the Middle Rio Grande*, 2000). Based on these values, if salt cedar were removed and replaced with native bosque, the potential water savings is 1 acre-foot per acre. Since most of the riparian acreage below San Acacia is dominated by salt cedar, the water savings can be applied to the total riparian acreage, resulting in a potential savings of 24,300 acre-feet per year. Removing exotic species and leaving the land bare, if this were possible, would result in a savings of 4 acre-feet per acre.

There are several potential complications under this alternative. First, the removal of exotic vegetation may potentially conflict with Endangered Species Act over southwest willow-flycatcher habitat. Second, once non-native vegetation is removed, it will need to be maintained on a regular basis. Cost of on-going maintenance should be figured into the planning. Third, because non-native riparian vegetation, 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 water-logging and evaporative losses are not exacerbated upon removal of salt cedar. Water table response and alternatives for water table elevation management should be built in to any vegetation removal plan.

4 e) Restore bosque habitat and manage vegetation to reduce evapotranspiration

See 4d. Additionally, it should be recognized that restoration of bosque habitat in areas where the river has been channelized or where development has encroached on the river may increase the consumption of water through the reach.

4 g) Delay start-up of irrigation system

A delay in start-up of the irrigation system would shorten the growing and irrigation season. The reduction in consumptive demand would probably be less than commensurate with the pro-rated period of time during which irrigation is not occurring, since lower temperatures and shorter daylight hours result in reduced water needs during the early season. Regardless, there would be some savings in both consumptive and diversion demand, and possibly some timing benefits later in the season.

4 h) Control competitive brush species

See 4d and 4e.

7 a) Develop local markets for higher value, low-water use alternative crops

See 3h for an assessment of the hydrologic impact of altering the crop mix. The development of local markets for low water use alternative crops has no direct bearing on potential water savings. (From a hydrologic perspective, if low water use crops are grown, it doesn't matter if they are marketed locally, regionally or nationally.)

7 b) Restrict transfer of water out of the planning region

Transfers, within or beyond the planning region, must recognize hydrologic reality if the river is not to suffer detrimental impacts. Assessment of hydrologic reality includes quantification and comparison of incidental conveyance losses and return flows at both the "move-from" and the "move-to" locations. These assessments can be technically complex, and require evaluation of local hydrologic conditions throughout the impacted areas and river reaches. In many cases, a reduction in the diversion or consumptive use will be required to preserve the "status quo" water balance after the transfer occurs, to compensate for increased losses to the new point of use.

Transfers over large distances are particularly difficult to implement without risk to the existing hydrologic balance. First, certainty in evaluating comparative conveyance losses and return flows becomes more difficult to achieve when transfers occur across large distances, for example, as would occur with water transferred outside of the planning region. Second, some elements of the existing infrastructure are sensitive to the magnitude of use; for example, some canals require a given head or volume of water for efficient delivery. Substantial transfers out of one area may jeopardize the efficient continuation of present uses within the move-from area.

We are not aware of a mechanism for restricting water transfer out of the planning region, but would encourage the planning region to critically review any such proposals or transfer applications.

7 c) Develop a water banking system to facilitate transfer of water within the planning region

The advantage of a water banking system is increased flexibility to shift uses from one sector to another, to meet changes in demand in a timely fashion. The development of such a system would not be simple. Transfers, within any administrative system, must recognize hydrologic reality if the river is not to suffer detrimental impacts. Assessment of hydrologic reality includes quantification and comparison of incidental conveyance losses and return flows at both the "move-from" and the "move-to" locations. These assessments can be technically complex, and require evaluation of local hydrologic conditions throughout the impacted areas and river reaches. In many cases, a reduction in the diversion or consumptive use will be required to preserve the "status quo" water balance after the transfer occurs, to compensate for increased losses to the new point of use. The development of "rules" for transfer within and across hydrologic sub-zones may serve to provide sufficient flexibility for transfers, while maintaining the water balance. The Office of the State Engineer and the Interstate Stream Commission would need to ensure that any such banking systems did not result in actions contrary to state law, interstate compact, or other imperatives under their jurisdiction.

7 i) Preserve, but continue to draw, deep well water for drinking purposes only.

Assuming that this alternative is proposing to limit existing groundwater withdrawals from deep wells to drinking water only, the impact on the aquifer would be reduced from present levels. Impacts of pumping on the river would be delayed to some extent, providing flexibility in timing. Depletion of aquifer storage would not likely be a problem (depending on where wells were located) for many, many years, at such a limited rate of use.

Groundwater modeling can be used to provide a better understanding of the groundwater supply and impacts of various groundwater use scenarios. Such a study should quantify current usage, the rate at which water is currently being drawn down, and the rate of draw down that the region considers acceptable.

7 j) Restrict domestic well use

See 7i.

The State Engineer's office restricts irrigation from a domestic well to one acre or less. If a large number of domestic wells are currently used for irrigation purposes, clearly some savings would result from restrictions. The Socorro-Sierra region should assess the magnitude of irrigation from domestic wells to quantify the benefit of this option.

Table 3: Qualitative Ranking of Hydrologic Impacts

A qualitative hydrologic impact score is assigned relative to three criteria: reduction in water diversions, reduction in consumptive use and increased flexibility in the timing of water availability. The scores, as follows, do not reflect consideration of cost, feasibility, or other non-hydrologic constraints:

1 = no impact likely or not applicable
2 = modest improvements possible
3 = potentially helpful improvements
4 = potentially significant improvements
5 = potentially large improvements

Alt #	Alternative description	Score-Diversion	Score-Consumption	Score-Timing
1a	Reclamation, treatment and use of saline water	4	4	4
1b	Wastewater treatment and reuse	2	1	1
1c	Comm. / residential on-site water recycling	2	1	1
1d	Storage of reservoir water at higher alt./lat.	1	3	1
1e	Evaporation control -reduced water surface areas	3	3	2
1f	Aquifer storage and recovery	1	2	5
1h	Restriction of gw supply wells in sensitive areas	1	1	3
3e	Improve efficiency of sw conveyance to ag	5	2	3
3f	Alternative irrigation methods on croplands	3	2	1
3g	Use precision agriculture techniques	2	2	1
3h	Reduce agricultural CU (low water crops)	4	4	2
3i	Improve on-farm irrigation efficiency	3	2	1
4b	Control brush and weeds along water distribution system and drains	2	3	1
4d	Remove exotic vegetation on a wide-scale	3	5	2
4e	Restore bosque habitat and manage to reduce ET	1	2	1
4g	Delay start-up of irrigation system	3	3	1
4h	Control competitive brush species [1]	NS	NS	NS
7a	Develop local market for low-water crops (3h)	1	1	1
7b	Restrict transfer out of the planning region	3	1	1
7c	Develop a viable water banking system	1	1	4
7i	Preserve, but continue to draw, deep well water for drinking purposes	2	2	3
7j	Restrict domestic well use	2	2	1

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[1] We have not provided a ranking of alternative 4h. We are not entirely clear on what the planning group intents with this option. It appears 4h is a combination of options 4d and 4e. Rankings for 4d and 4e can be used to estimate a ranking for 4h.