Vision

The mission of the regional water plan, targeted by this scenario, is to balance water use with renewable supply. The region is presently substantially out of balance. The average annual consumption is estimated to be 316 thousand acre-feet. Study estimates of the average annual deficit range from 41 to 70 thousand acre-feet per year. We are using 55 thousand as our working estimate of the deficit, which is 17% of our consumption. To achieve balance we will need to reduce our use and/or increase supply.

This plan presents the region's position on water development, water conservation, and some environmental issues affecting water resources and water quality. A main goal of this document is to help water managers, planners, legislators and other parties formulate the management strategies and policies needed to direct their efforts into the new century. This document should also be a valuable resource for those in the general public interested in contributing to water-related decisions at all levels of government. There are a number of actions suggested.

We know that we must live within the constraints imposed by the Rio Grande Compact and that we must cease depletion of the aquifer so it can be used to even out fluctuations in our annual supplies. We must respect water right holders. Potential lawsuits by downstream neighbors, issues of water quality, sharing water with tribal entities when their rights have not been quantified, Endangered Species Act requirements, and variability in weather are other considerations. Population increases will add new users, adding further demands.

To fulfill the mission of the water plan, and lessen the long-term consequences of ongoing deficit spending, the deficit between supply and demand of 55,000 acre feet must be curtailed as soon as possible. Unless new sources of water are found, any new uses of water will have to come from existing uses and achieve this reduction goal.

The Middle Rio Grande Water Budget (Appendix B), from which this reduction goal was derived, was prepared in 1999. The results of continuing to add annual deficits to the accumulated debt of approximately half a cubic mile, or 1.7 million acre feet, is illustrated in a recent USGS report. "The recent (1999 to 2002) water levels presented in this report indicate that beneath the Albuquerque metropolitan area, ground water on either side of the Rio Grande currently flows toward the major pumping centers from all directions" (Bexfield and Anderholm 2003). In order to keep this accumulating debt from affecting our own water future --in addition to our children's—we need to balance the budget now, rather than delay what needs to be done any further.

Inflows/Rainfall Assumptions

The scenario requires a projection of the level of surface inflows and within-region rainfall for the planning period. As with any projection, there are substantial uncertainties in what will really happen. The projected levels of inflows and rainfall are important because they guide the intensity of remedial actions recommended to meet the mission within its constraints. A projection that is too wet will set the region up for ongoing "emergencies"; a projection that is too dry will impose unnecessary costs upon the region. The Preferred Scenario contains two different projections. We consider the implications of both. The two projections are termed "Recent Historical" and "Tree Ring", based on the key sources of data for each. Rechecking these projections should be a particular focus of updates to this regional water plan. Global climate change modeling, may have further impact on the accuracy of the projections (Karl and Trenberth 2003). In order to refine our projections of the future, we recommend that a small study be funded to confirm or refute the hypothesized proportionality between tree ring rainfall data and surface inflow data.

Recent Historical Prediction

We have three main choices in our selection of recent historical data for the scenario prediction. These are the last quarter of the twentieth century, the last half of the twentieth century, and the entire twentieth century. The last quarter was clearly a very wet period. The last half included some drought times and some wet times. The whole century is similar to the last half, but has some incompleteness in available data. We

choose to use the last half of the century approach for the Recent Historical Prediction in this scenario. Specifically, we choose to use the recorded data from 1950 through 1998, which averaged 9 inches per year in the MRG Region.

Tree Ring Prediction

A broadly published tree ring study conducted at El Malpais (southwest of Grants, NM) reports year-by-year rainfall for the past 2200 years. For our tree ring prediction, we hypothesize that rainfall levels at El Malpais were approximately proportional to the MRG Region's inflows and rainfall. In essence, we hypothesize that when El Malpais went through long dry (or wet) periods, the MRG and southern Colorado also were dry (or wet). For the Tree Ring Prediction in this scenario, we choose the inflows and rainfall to be based on 8 inches of precipitation (94% of the Recent Historical Prediction). However, this tree ring scenario is a secondary scenario, not the baseline.

Drought Planning

For the purpose of drought planning, we conjecture a relatively short period of reduction in inflows and precipitation. For reference, we consider the historical period from 1950 to ~~1959~~1956, the famous 1950s drought. For drought planning we will assume a ten-year drought period with inflows and precipitation being ~~8~~ 6 and ~~7~~ 5 inches respectively (~~89~~67% of the above two projection patterns). This pattern may still be optimistic in terms of intensity and of duration of drought.

Population Assumptions

The Preferred Scenario assumes that population growth will occur over the 50-year planning horizon at rates projected by the Bureau of Business and Economic Research at the University of New Mexico. Using these rates, the regional population grows from about 710,000 people in 2000 to about 1.27 million people in 2050. We recognize that resource limitations, demographic evolution, and/or policies we recommend, if implemented, might affect the fulfillment of the BBER population projections. The projections therefore need to be monitored over the years on a regular basis.

Imported San Juan-Chama Project Water Assumptions

In the Preferred Scenario, the Albuquerque Drinking Water Project is assumed to come on line as planned in 2006. The amount currently contracted to users within the Middle Rio Grande is approximately 70,400 af. Contracted amounts into the region are currently allocated as follows: Albuquerque 48,200, Bernalillo, 400, Belen 500, Los Lunas 400, and MRGCD 20,900 afpy. Physical conditions and permitting may affect the annual amount actually delivered.

9.3.2 Urgent Shortfall Reality

The initial scheduling of actions in the scenario may leave us with a Rio Grande Compact shortfall for ten to twenty years. Consequently, we would need to accelerate the implementation of our water planning actions. We would need to eliminate any projected short-term deficits in our compliance with the Rio Grande Compact until the plan's actions have had time to take effect. All users, municipal and rural, should share in the substantial contributions to the effort. The state and the region should work openly and cooperatively to address this issue. Specific urgent actions should be identified, studied, evaluated and implemented that are focused on increasing river flow to avoid defaulting on the Rio Grande Compact. These actions will have urban and rural economic impacts, but such impacts should be temporary. Unless there is a priority call, w~~W~~ater right holders must be fairly compensated for any temporary loss of use rights when water is reallocated to meet compact delivery requirements.

9.3.3 Urban and Rural Conversation Activities

The Preferred Scenario features rigorous conservation efforts including the installation of low flow appliances (e.g. showerheads, ~~sinks~~faucets, toilets, and clothes washing machines) in 80 percent of existing

properties, with low-flow appliances installed in all new properties. It also calls for converting 30 percent of existing landscaping to xeriscape and requiring xeriscaping for all new construction. This scenario also assumes that 25% of existing homes will collect water through rooftop rain harvesting and that all new homes will have rooftop rain harvesting systems. Additionally, 5 percent of existing homes will convert to on-site gray water re-use, and gray water re-use will be standard in all new homes. There will be a 5% reduction in landscaped acreage in commercial properties and growth rate of water use for future parks and golf courses would be reduced by 80% from the current growth rate (A-18, A-21, A-22, A-56, A-24, A-27, A-44, A-61).

Governments in the region should develop, adopt and implement sustainable water resource management plans coordinated with the Water Resources Board, and the Water Providers Council, and the State Engineer that could include:

- reduce water consumption;
- minimize impact on water resources;
- encourage conservation-oriented economic development;
- ensure adequate water supplies for any proposed development, and consider the carrying capacity and location of development.
- integrate with other major plans in the region

9.3.4 Water Resource Planning and Management

The Preferred Scenario includes a variety of initiatives that will need to be undertaken and implemented at various governmental levels from local through federal (A-58). These initiatives include:

- Identify, quantify, and adjudicate all water rights and all wet water quantities in the water planning region within 25 years, via negotiation (A-71).
- Seek additional legislation in order to extend the regional capacity for leasing and other forms of water banking. An education component is necessary in order to make leasing and banking generally acceptable and understood. This educational component should include clear definitions and/or principles detailing what is intended. As part of this scenario, water banking would be implemented within the region to maximize beneficial use and to permit the water right to stay with the owner while the water is leased for a period of time (A-67).
- Address groundwater/surface water interactions more explicitly in the statutes for administering water rights and reconcile conflicts in the law (conjunctive management) (A-144).
- Establish a state-based dedicated recurring revenue stream for water projects, planning and conservation (A-59). Augment with federal money such as a national infrastructure program and revenue stream for water planning and conservation.
- Request OSE/ISC to propose an equitable distribution of evaporative losses of Rio Grande water among regions on the river and among compact states (A-51). Spring 2004 information from the ISC indicates that the compact has already apportioned the waters of the basin; evaporative losses are considered neither an asset nor a liability. Therefore, this does not seem to be a viable option.
- Encourage active water resource administration by the OSE/ISC, including native, imported, surface, ground, and reused waters, to encourage that only the necessary water be drawn (A-143).
- Establish and integrate a regional Geographical Information System (GIS) database of publicly accessible information on water resources and photo imagery covering the water planning region (A-73).
- Implement local and regional watershed management plans through all land and water agencies in the area to increase water yield, to prevent erosion, to protect and improve forest health and to protect recharge zones (A-66).

- Encourage local jurisdictions to integrate the land use, transportation, economic development, and water components of each of their comprehensive plans; and to integrate their comprehensive plans with the Regional Water Plan (A-52, A-30, A-28).
- Establish erosion prevention measures and use soil and vegetation management techniques to reduce runoff and increase infiltration throughout the watershed, including forested mountains and uplands (A-33).
- Create, enhance and expand local government storm water management plans and programs on a region-wide basis to minimize erosion, control runoff, enhance infiltration and recharge, and prevent pollution of surface and ground water (A-34).
- Establish region-wide educational programs, including school curricula and projects, to encourage full awareness of the full range of water issues among the citizenry, and voluntary conservation of water (A-56).
- Ensure that water planning continues through open, inclusive and deliberative processes that provide for in-depth consideration of policy issues by diverse stakeholders to enable participants to come to informed recommendations (A-53).
- Establish regular and continuous monitoring of the plan and update as necessary the provisions of this plan.
- Establish performance measures to gauge the ability of local governments to implement this plan and regularly report back to the public.

9.3.5 Water Monitoring and Measurement

The Preferred Scenario also states that all uses of water in the MRG Region should be measured. Although controversial, this scenario calls for metering all water supply wells, including domestic wells, and all surface water flows through irrigation systems, throughout the water-planning region (A-7, A-8, A-73).

9.3.6 Agriculture

The scenario includes lining 150 of the 750 miles of MRGCD irrigation conveyances, chosen after consideration of the extent of leakage, impact on recharge to the underground reservoir, preservation of riparian use, impact on water quality, impact on wells, and impact on habitat. It also includes, when feasible, laser leveling irrigated fields, lining on-farm irrigation canals, and developing drip irrigation on irrigated acres under cultivation (A-10, A-7, A-9). Funding for acequia conservation programs is encouraged (A-60).

Provide education for farmers, ranchers, newcomers, and delivery system operators on available support programs and means of operating efficient water conveyance systems in New Mexico.

Neither total crop acreage nor crop-type distribution is altered in the Preferred Scenario (A-11). But, with no policy changes, there is likely to be a 25-30% reduction in irrigated acreage by 2050 (MRGCOG 2001).

The scenario would permit emergency leasing of agricultural water to meet Rio Grande Compact obligations and environmental needs and would develop protective mechanisms to support the overall value of agricultural lands, including:

- benefits to ecosystem health
- potential in terms of recharge, compact delivery, food security and economics
- cultural and historic value
- contribution to the quality of regional airshed and viewshed
- agricultural economy (A-60)

9.4.2 Illustration of the Preferred Scenario Implications

An illustration of the implications of the Preferred Scenario is provided below using Version 3.2.2 of the MRG model, but it is, indeed, only an illustration. No formal evaluation of the Preferred Scenario has been prepared because final agreement on the Preferred Scenario presented in Section 9.3.2 did not explicitly rely upon the MRG model. All of the previous scenario modeling results were available to participants in the joint Water Assembly and Water Resources Board workshops which produced the Preferred Scenario, but discussion, compromise and eventual agreement focused directly and exclusively on the textual description of the draft Preferred Scenario, rather than numerical analysis of its implications. Participants in the workshops were left to rely upon or not rely upon the previous numerical model output, at their individual discretion.

In part, this final step in the negotiation of a Preferred Scenario simply reflected the ad hoc evolution of the workshop discussions as participants sought ways of compromising differing points of view into wording which all could accept. In part, this final step reflected a concern among at least some participants in the workshops that the model itself should not constrain the final selection of a Preferred Scenario. A few words of explanation of this latter concern may be helpful.

Computer models of water systems relevant to the MRG Region exist in various forms pertinent to the purpose for which they were constructed. The U.S. Geological Survey has constructed a highly detailed model of the aquifer in order to gauge the effect of past and future pumping. The Office of the State Engineer now utilizes another version of this model in reaching its decisions regarding ground-water permitting. The New Mexico Interstate Stream Commission and the U.S. Army Corps of Engineers contracted with S.S. Papadopulos & Associates to construct a ~~surface flow~~probabilistic model of the water supply available to the Middle Rio Grande to assist those agencies and the regional water planning effort in understanding the effect of different policies or practices on the water budget~~stream flow~~. Finally, the Bureau of Reclamation is constructing the Upper Rio Grande Water Operations Model (URGWOM) to assist it in actual management decisions in the Upper Rio Grande.

In this modeling context, considerable sensitivity surrounds the validation of any particular model relative to the purposes to which it is applied, and this is the case with the MRG model. There was broad consensus that the MRG model was very valuable in educating both the public and the planners themselves on the nature of the regional water situation and the actions which could be taken to fulfill the mission, goals and objectives of the plan. However, that consensus did not extend to vesting the model with final measurement authority as to the likely results of a Preferred Scenario. Some planners placed great stock in the actual values predicted by the model; others did not.

It is unlikely that these differences in judgment could have been resolved within the time period available to complete the plan, nor was it necessary to achieve that resolution. The plan is not intended to be a forecast of the water future of the MRG Region. Rather, it is a guide to actions which need to be taken to make that future as propitious as possible for the region. The model has been a valuable instrument in achieving the plan, but the final decisions are properly left to the planners and the public generally rather than the model per se.

This perspective should also guide interpretation of the illustrated results of the Preferred Scenario below. Namely, the illustration is put forth purely as one possible embodiment of the agreed upon scenario rather than as a set of specific quantified actions to which planners have collectively assented. For some planners the model settings listed in Table 9-6 may be close to what they would like to see actually occur. For others, these settings may not be viewed as desirable, achievable or even acceptable.

Table 9-6 contains the computer model settings based upon the Preferred Scenario. In the model, all actions are deemed to occur within 15 years. Please note that while the Preferred Scenario does not always contain numbers, the computer model requires such to operate. For example, the laser leveling of fields when feasible, as suggested in Section 9.3.6 was modeled by laser leveling 22,000 acres. The assumed (not recommended) reduction in agriculture of 25-30% mentioned in Section 9.3.6 was modeled by reducing alfalfa and pasture acreage proportionally. A further note to consider when reducing agricultural lands is that if all reductions occur on non-Pueblo lands, then the reduction is far greater than 25-30%. For more information on the model, calculations, values and settings, see Cooperative Water Resources Modeling in the Rio Grande Basin (Passell, et al 2003).

In establishing getting the settings of Table 9-6, the model required some settings which did not explicitly appear in the Preferred Scenario. The following values were assumed.

- Reduce Irrigated Acreage of Yards in New Homes 40%
- Desired Farm Acreage to Laser Level 22,000 ac
- Desired Farm Acreage to Line/Pipe Delivery Canals 7,500 ac
- Desired Drip Irrigation Acreage 2,500 ac
- Transfer from Socorro & Sierra Crop Acreage 7,500 ac
- Cost to Retire an Acre of Farm Land $20,000
- Treatment time horizon 15 years
- Interest rate 6%
- Payback time horizon 30 years

The assumptions by the evaluators for the Preferred Scenario and below for Sensitivity Check Scenario are for purposes of example only. They may not represent the thoughts of the Water Assembly or of the Water Resources Board. The assumptions used here will be evaluated during the implementation of the plan and revised if needed.

The results of running the Sandia model, Version 3.2.2, with the Preferred Scenario illustrative settings are reported in Figure 9-3. With these settings, the model projects a significant cumulative shortfall in Compact deliveries (up to almost 450,000 acre feet) before the effects of the water-saving measures are achieved, but by 2050 a surplus of about 750,000 acre-feet is produced. Aquifer depletions are also arrested followed by accumulating recharge until stabilizing toward the end of the planning period.

9.4.3 Second Illustration, Sensitivity Check Scenario

When the evaluators ran the model as associated with the Preferred Scenario for the first illustration (with settings as in Table 9-6) they noted that the settings for a number of the "preferred" attributes might be more likely achievable considering political and cultural issues. Accordingly, the evaluators modified several of the settings to see their effect on the results for cumulative aquifer depletion and for Rio Grande Compact cumulative balance. They called the result the "Sensitivity Check Scenario". The complete set of Sensitivity Check Scenario settings are in Table 9-7. Most settings were left unchanged from the Preferred Scenario. Selected settings were modified as follows:

- Convert Existing Residential Property to Low Flow Appliances from 80% to 15%
- Convert Existing Homes to On-Site Greywater Use from 5% to 20%
- Convert Existing Commercial Property to Low Flow Appliances from 80% to 15%
- Reduce Growth in Water Use by Parks and Golf Courses from 80% to 20%
- Desalination from 22,500 af/y to 7,500 afpy
- Years Drought Will Last from 10 to 25
- Drought Intensity from 11% to 17%
- Transfer from Socorro & Sierra Crop Acreage from 7,500 ac to 0 ac
- Agricultural Acreage Reduction from 25%-30% to no change

The evaluators' reasoning in choosing the changes for the sensitivity check scenario were as follows:

The change from 80% to 15% in conversion to low flow appliances to achieve better realism (residential and commercial) is based upon previous experience in low-flow programs. To date the City of