ATechnical and Physical Feasibility Fact Sheet
Alternative 10: Irrigation Efficiency

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1. Definition of Alternative

A-10: Develop and employ alternatives to maximize irrigation efficiency on all irrigated land in the region.

2. Summary of the Alternative Analysis

The measures introduced and outlined in this fact sheet as part of the Alternative 10 analysis offer the potential for relatively large reductions in total water diverted for irrigation purposes in the study area. However, coordinated planning is needed to ensure that, together with the measures outlined in the fact sheets for Alternative A-7, *Agricultural Metering*, and A-9, *Agricultural Conveyance*, these improvements are feasible at the farm level. Also, the planning of all irrigation system improvements should start with an examination of expected responses from and impacts to farmers and farms.

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 (farm water delivery requirement [FDR]). Reduction of farm water deliveries will reduce diverted irrigation water quantities at the system level (intake point of diversion). It does not, however, result in "new" water because the irrigation consumptive requirement (CIR) does not change unless irrigated acreage is reduced or lower water use crops are introduced. However, on-farm efficiencies will slightly reduce incidental depletions.

The study area for this alternative includes the MRGCD system and the smaller community ditch and acéquia systems in Sandoval County, referred to in this analysis as "small Sandoval systems." From interviews with farmers and agricultural professionals in the planning region, it is likely that many large and some small farmers in all three counties have already implemented some of the measures proposed in this fact sheet. Therefore projected efficiency gains presented in this analysis are only estimates and should not be considered hard data. Much additional study of on-farm water management, farming methods, and farm infrastructure should be completed to determine which on-farm improvements would be most suitable for the different types of irrigation that occur within the MRGCD as well as the small Sandoval systems.

Acreages used to develop this alternative analysis are taken from existing publications. For the small Sandoval systems, Saavedra (1987) was used. MRGCD 2000 data is used as the basis for acreages within the MRGCD system. Table 10A-1 (Exhibit 10A) lists available data and also shows the estimated number of farms in the MRGCD and in the small Sandoval systems. This estimate is extrapolated from uncertain data and should only be viewed as a best guess.

2.1 On-Farm Water Efficiency

On-farm water efficiency (E_f) is a simple ratio of the quantity of water taken up or consumed by crops, including evapotranspiration (ET), divided by the quantity of water delivered to a farm. Both SS Papadopulos & Associates, Inc. (SSPA, 2002) and Wilson (1997 and 1999) report on-farm efficiencies throughout the planning region at 50 percent. This means that 50 percent of water delivered to a typical farm turn-out is taken up by crops, while the remaining 50 percent resulting in incidental on-farm losses (consumption), deep percolation seepage, and drainage away from the farm that returns to source.

On-farm efficiency is affected by several factors (Kay, 1986):

- *Farm layout*: The shape and slope of the farmed areas used in basin (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 five to ten 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.

- *On-farm water management (OFWM):* A broad term that means supplying crops with the right amount of water at the right time, without wasting water and as economically possible.

- *Irrigation scheduling*: Scheduling of on-farm water deliveries can help maximize crop yields.

- *Methods of irrigation:* These include flood (basin), border, furrow, or micro-irrigation.

On-the-job training for farmers also contributes to improved on-farm water efficiency (FAO, 1990).

On-farm water conservation is also related to the type of crop that is being grown, as crops have different water requirements and some crops lend themselves more readily to efficient irrigation methods than others. Within the planning region, much of the irrigated agricultural land is planted in forage crops such as alfalfa and hay; basin (flood) and border irrigation are the most common methods of irrigation for these crops. Although flood irrigation is generally considered wasteful compared to furrow or other micro-irrigation methods, border irrigation can be as much as 80 percent efficient, while flood or basin on-farm irrigation can be as much as 90 percent efficient (Kay, 1986). In other words, with border or flood irrigation, 80 to 90 percent of the FDR could be taken up in crop ET (consumption) with 10 to 20 percent of the FDR resulting in seepage or drainage.

2.2 On-Farm Water Efficiency in the MRG Planning Region

A more realistic “best case” on-farm efficiency target for the MRGCD and the small Sandoval systems is probably between 65 to 70 percent. In general, operators of large “production agriculture” type farms are better able to invest resources into improving on-farm infrastructure that result in high efficiency rates. However, the MRG region has many “part-time” farmers who are less likely to have sufficient capital to make the investments needed to maximize efficiency, thus, the overall expected efficiency will be lower.

Table 10A-2 (Exhibit 10A) summarizes possible diverted water savings that might accrue as a result of on-farm water management improvements. These include improved land preparation activities, laser leveling, on-farm metering, and improved on-farm water management practices such as on-farm canal lining and/or piping. Sources for estimated on-farm efficiency gains that might be achieved are provided in Table 10A-2.

In addition to availability of water and water use, other factors that influence the feasibility of implementing on-farm efficiency in the study area include:

- *Farm and farmer data*: A profile of farming and farmers in the region is needed to understand which measures are most feasible, would likely produce the most diverted and/or consumptive water reduction, and would be most cost-effective. For example, in the MRGCD system irrigation is provided for production farms, supplemental-income generating farms, and other uses such as landscaped areas and non-agricultural field watering. Feasible on-farm and on-site efficiency and conservation measures are likely to be different for each of these types of irrigation

- *Agricultural markets*: In addition to factors such as crop water usage, agricultural markets must be considered. Although alfalfa, one of the major regional crops, has a relatively high crop water requirement, it also has a strong local and regional market. In 1999, alfalfa sales alone netted the study area close to $11 million (USDA and NMASS, date unknown). Whether other lower consumptive use type crops could be grown on smaller farms in the planning area is discussed in fact sheet for A-11, *Low-Water Crops.*

- *Farm labor*: Farm labor is both scarce and expensive in the study area. Conservation and efficiency measures might change the manner in which irrigation occurs requiring more farm labor to prepare the land, plant the seed, irrigate, apply fertilizers and pesticides, maintain on-farm canals and earthen structures, and generally manage irrigation and drainage water flows. Production farmers in the region may have more access to and can more easily afford additional labor. Smaller farmers will be unable to readily locate or afford this labor.

Table 10A-3 (Exhibit 10A) outlines an OFWM project that could be funded and implemented within the planning area to address many of the technical on-farm issues as well as some of the other feasibility issues mentioned. The goal of such a project would be improve water management in a manner that sustains agriculture in the MRG planning region (MRGCD and the 21 small Sandoval systems).

For purposes of this fact sheet, known on-farm water conservation and irrigation efficiency measures (Kay, 1986, CNA, IMTA, and IWRA, 1994; Vickers, 2001) have been applied to both the MRGCD and the small irrigation systems in Sandoval County (Tables 10A-2 and 10A-3 in Exhibit 10A). These measures include on-farm irrigation technologies (NMSU and WRRI, 2001; Hulsman, 1983; Garcia et al., 1999) and improved OFWM techniques such as:

- Improving flood and border irrigation practices
- Lining and or piping on-farm conveyance canals
- On-farm metering
- Land leveling and improved land preparation

Such initiatives must be tailored for each of the three following categories of farms/farmers as each views farming and onsite infrastructure in a separate manner.

- Production farms (farming provides a primary income source). Farmers better understand investment for future return as part of their business.

- Supplemental-income generation farms (farming is carried out by users who have other jobs or who are retired individuals). Farmers depend on income from small farms to support their families and/or way of life, but in general, they do not view farming and farm system investments as a business decision.)

- Non-agriculture areas (users apply irrigation water to landscaping or grass).

Assistance from the New Mexico Acéquia Association might be sought in developing such an OFWM program. The success of such a program in the small Sandoval systems may relate as much to the social and economic well-being of the rural communities and people who live in these areas as well as to the ability to save and use water more efficiently (see social and cultural fact sheet for A-10 alternative in *Evaluation of Alternative Actions for Social and Cultural Implications*).

3. Alternative Evaluation

3.1 Technical Feasibility

Enabling New Technologies and Status

The technology exists to carry out this program. The program does, however, require what might be viewed as thinking "out of the box" to focus more attention on farms and farmers. New Mexico State University and associated agricultural extension agencies would also be able to offer technical assistance in this area as well. Two universities that have extensively researched the methods used to achieve on-farm efficiencies are Colorado State University and Utah State University.

Infrastructure Development Requirements

An organization that can provide farm and farmer assistance is required. MRGCD is one entity that could oversee this program. If a different entity were created, it should be set up as a regional entity, not part of a federal or state agency.

Total Time to Implement

The proposed OFWM program introduced is for five years, although this will not be enough time to implement all needed activities. As the program moves forward, additional subsidized activities will be required.

3.1.1 Physical and Hydrological Impacts

Effect on Water Demand

If successful, this program would reduce the water required to be diverted into irrigation systems in the study area, which provides more water supply management options to the region. As shown in Table 10A-2 (Exhibit 10A), about 42,000 acre-feet of diversion water could be saved.

Effect on Water Supply (surface and groundwater)

The amount of water diverted for irrigation would be reduced. The question of what happens to the water that is no longer being diverted would be determined by legal considerations. For practical purposes, it is assumed that fewer water diversions would mean more water stays in El Vado reservoir since water used for irrigation in the MRGCD is stored there. If less water is needed for irrigation in the MRGCD, the result would be a reduction in the quantity of water released from the reservoir. Additional water in the reservoir could be used to extend the irrigation season and provide farmers with a full water supply. Administrative changes would likely be required before water, which is made available through efficiency improvements in the MRGCD, could be acquired, leased, or purchased by other entities.

Water Saved/Lost (consumption and depletions)

The consumptive use of irrigation water varies, mainly according to crop. Consumptive use changes due to crop changes are discussed in alternative A-11, *Low-Water Use*. Assuming that on-farm incidental depletions are about 5 percent of the total diversion savings of 42,000 acre-feet, on-farm incidental depletion savings are estimated to be 2,400 acre-feet per year (Table 10A-2 in Exhibit 10A). This estimate is based on a reduction in incidental on-farm depletions, which are a component of FDR.

Impacts to Water Quality (and mitigations)

Water quality impacts are difficult to predict but less water might mean higher concentrations of salt and agricultural chemical constituents in drainage water and in the soils. This needs further study.

Watershed/Geologic Impacts

Seepage will be reduced through the reduction of deep percolation and incidental losses on farms, and this will affect groundwater levels and recharge. Table 10A-4 (Exhibit 10A) examines a “before” and “after” scenario; the “after” scenario assumes that all of initiatives presented in Alternatives 7, 9, and 10 are implemented and indicates that there would still be significant water available for seepage.

Environmental Impacts

Changes in recharge to the shallow aquifer due to changes in flows through on-farm canals may impact the bosque and the types of ecosystem that may be established in the canals and drains of the MRGCD. However, flows in the system are already intermittent due to the seasonal nature of irrigation.

Increased water in storage could be released to enhance ecosystem functions, depending on ownership of the water.

Impact to Ecosystems

Ecosystem impacts should be minimal if on-farm projects are planned and designed to avoid impacts to on-farm ecosystems.

Implications to Endangered Species

Increased water supply management flexibility will provide more options for supporting endangered species habitat.

3.2 Financial Feasibility

3.2.1 Initial Cost to Implement

Table 10A-3 provides estimated costs for an initial five-year OFWM project and the design study necessary to develop it. This cost is estimated at nearly $27 million. The cost per acre-foot to reduce water diversions is approximately $620.

3.2.2 Potential Funding Source

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

3.2.3 Ongoing Cost for Operation and Maintenance

A group that focuses increased attention on farming should be one of the outcomes of the five-year OFWM project. Such an organization should have a staff of 12 to 15 professionals and an equal number of support staff and technicians (as well as vehicles, offices, and other support). This organization would also manage the introduction of new technology and lead an on-going information dissemination program, stimulating agricultural education, and monitoring and evaluating farm and farmer inputs in terms of water savings (conservation) and reduced use (efficiency). Costs could be around $700,000 to $2,000,000 per year to operate depending on the number of employees and the types of work carried out. The cost for this operation could be paid for through user charges and the local tax mill levy, which is how the MRGCD currently funds its operations.

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