Middle Rio Grande Conservancy District Irrigation Efficiency and Metering

Preliminary Report and Plan for Comprehensive Evaluation

S.S. PAPADOPULOS & ASSOCIATES, INC.
Boulder, Colorado

September 2001

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Prepared for:

New Mexico Interstate Stream Commission

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History

Irrigation has been practiced for centuries in the Middle Rio Grande valley of New Mexico. Many of the practices and rules governing irrigation in earlier times, both by Indians and Spanish settlers, are continued into the present day.

The Middle Rio Grande Conservancy District (MRGCD) was formed in accordance with the New Mexico Conservancy Act of 1923, as amended, as a political subdivision of the State of New Mexico, with all the powers of a public or municipal corporation. Petitions for the organization of the MRGCD were originally filed in the District Court of the Second Judicial District, County of Bernalillo in 1923. The Court officially entered a successful decree of organization in 1925. The Official Plan of the MRGCD (Burkholder, 1928) was approved by the court in 1928.

The MRGCD was formed in response to deterioration of the irrigation systems and flooding of irrigated and other lands in the Middle Rio Grande Valley. Between 1925 and 1935, the MRGCD constructed six major diversion structures, as well as canals headings, and many miles of distribution channels, river levees, and main irrigation canals.

In 1950, the Middle Rio Grande Project was authorized by Congress, to rehabilitate the MRGCD facilities as well as to control sedimentation and flooding on the Rio Grande. The U.S. Bureau of Reclamation (USBR) planned and funded the rehabilitation of El Vado Dam, rehabilitation of irrigation and drainage works, and river channel maintenance. Diversion structures originally constructed by the MRGCD and rehabilitated by the USBR include the Isleta and San Acacia diversion structures. The Corps of Engineers constructed reservoirs and levees for flood control, and replaced the Cochiti Diversion structure with a larger flood-control dam (which the MRGCD also uses for irrigation diversions). From 1951 to 1977, a system of Kellner jetty-jack fields was installed along the river to protect levees and to aid in flood control and channel stabilization. Extensive rehabilitation work was performed on canals, laterals, drains, and acequias by the USBR between 1953 and 1961. In 1999, the MRGCD completed repayment of USBR Middle Rio Grande Project contract obligations.

District Configuration

The MRGCD encompasses approximately 150 river miles from Cochiti Dam to the northern boundary of the Bosque del Apache National Wildlife Refuge. Its irrigation facilities divert water from the Rio Grande, the Low Flow Conveyance Channel (LFCC) and drains within the Rio Grande valley. The MRGCD's 1930 water rights applications (Nos. 1690 and 0620) to the New Mexico Office of the State Engineer (OSE) were for storage of water in El Vado Reservoir and irrigation of 123,267 acres. The acreage referenced in this permit included 80,785 acres of pre-MRGCD lands for which the points-of-diversion were to be consolidated and which were to be served with MRGCD facilities, and 42,482 acres of lands that the MRGCD expected to recover and render irrigable through the creation of drainage works. These acres include 22,734 acres of Pueblo land (New Mexico Office of State Engineer, 1930a, b). The average irrigated

acreage reflected on USBR Form 7-2045, *Crop Production and Water Utilization Data*, including Pueblo land, for the period 1989 to 1998 is approximately 54,000 acres.

A portion of the water used by the MRGCD is stored in El Vado Reservoir, located upstream of the District on the Rio Chama, a tributary to the Rio Grande. El Vado Reservoir storage rights, pursuant to OSE permit application No. 1690 filed by MRGCD in 1930, were assigned to the U. S. Bureau of Reclamation (USBR) by MRGCD in 1963. The reservoir is owned by the MRGCD, except for the outlet works and emergency spillway, which are owned by USBR. This reservoir was constructed in 1935 with a total storage capacity of 198,110 acre-feet, since reduced by sedimentation to approximately 180,000 acre-feet. It is currently operated by the USBR under agreement with the MRGCD. The District specifies the releases from this reservoir to meet its water demands.

Today, the MRGCD is divided into four divisions: Cochiti, Albuquerque, Belen, and Socorro. Each division is served by main canals beginning at diversion structures at the head of the division. These main canals feed smaller canals and ditches, and in some locations, the divisions use water from drainage channels. The MRGCD divisions obtain water from the diversion structures described below:

- The Cochiti Division obtains water from canals with headings at Cochiti Dam. Cochiti Dam is owned by the U.S. Army Corps of Engineers, and was constructed primarily for flood and sediment control.
- The Albuquerque Division diverts water from the Angostura Diversion structure.
- The Belen Division diverts water from the Isleta Diversion structure.
- The Socorro Division diverts water from the San Acacia Diversion structure and from three un-permitted locations on the LFCC.

In addition to river diversions, inter-divisional flow occurs in some locations where drains from one division feed directly into canals of an adjacent downstream division.

Several other water users rely on MRGCD diversion and conveyance facilities, including the La Joya Acequia, the New Mexico Department of Game and Fish refuges at Bernardo and La Joya, and the Bosque del Apache National Wildlife Refuge (BDANWR). BDANWR, the largest of these water users, is located just downstream of the MRGCD, and diverts water both from MRGCD canals carrying water diverted at San Acacia; as well as from the LFCC and other drains collecting return flow from the MRGCD.

MRGCD generally operates with main canals full throughout the irrigation season (March 1 through October 31 in most years). However, during years that the MRGCD experiences water shortages, water saving measures such as farm-delivery rotation may be practiced.

Cropping Patterns

The acreage under irrigation within MRGCD is determined annually by MRGCD, at the end of each growing season, by reconciliation of ditchrider logs with the MRGCD

assessment maps. These acreage data are subdivided by crop, and are reported to the USBR annually, as well as in annual Agriculture Experiment Research Reports published by New Mexico State University (i.e., NMSU, 1994). An example of the USBR Crop and Water Use report is included in Appendix A. Tables summarizing crop acreages from these data for the available period of record are in preparation. According to the MRGCD, there is uncertainty associated with these data, and the District has efforts underway to improve the reporting of irrigated acreages.

As part of the USBR's Middle Rio Grande Water Assessment (USBR Assessment), Land Use Trend Analysis (Bell et al, 1994, Supporting Document 13) aerial photographs were interpreted to estimate cropping patterns in June 1992. Also as part of the USBR Assessment, these data are summarized and compared to the NMSU (1994) estimates (Supporting Document 6). In this comparison, the percentage of various crop types is compared for each of the counties served by the MRGCD: Sandoval, Bernalillo, Valencia and Socorro. While some differences are apparent in the two estimations of cropping pattern, and, cropping patterns vary by county, the following approximate percentage of cropped area attributed to specific crop types is noted:

- Alfalfa - 40 to 60 %
- Planted pasture - 15 to 25 %
- Vegetables & Field - 5 to 15 %
- Corn - 2 to 10%
- Sorghum, grain and other - 1 to 10 %
- Barley and small grains - 1 to 8 %
- Native pasture - 1 to 5 %
- Orchard and vineyards - 1 to 5 %
- Winter wheat, dry beans - < 1 to 2 %

Irrigation Application Methods

In a statewide report summarizing water use in New Mexico (Wilson and Lucero, 1997), the OSE summarizes the irrigation application methods, by county. For each of the counties Bernalillo, Sandoval, Valencia and Socorro, within which the MRGCD operates, all surface-water irrigated acres are reported to employ flood irrigation methods. As used in the OSE report, flood irrigation includes furrow, border-strip, level-basin and wild flooding. No surface-water irrigated acres are reported to be irrigated by drip or sprinkler methods.

A test plot of underground drip-tape irrigation was operated to grow alfalfa during the 2000 irrigation season on the Travis Harris farm in the Socorro Division. This test plot was funded by the USBR, and designed and managed by the National Resource Conservation Service (NRCS). This drip-tape irrigation method is reportedly working well for growing chiles in some parts of New Mexico, avoiding both chile mold and evaporative losses. While this technique is believed by some local farmers to be economical for chile, it may not be as cost effective for alfalfa, since alfalfa is a lower-

value crop. Also, according to the MRGCD, maintenance problems due to high sediment loads may be another drawback of this irrigation method.

Measurement

Historically, the MRGCD has gaged major diversions to the irrigation conveyance system and select drain returns and mid-system conveyances. For the period of 1974 to 1995, records generally consist of handwritten tables of recorded daily flows at 13 to 15 stations. The MRGCD believes that similar records might exist, in warehoused boxes, for the years prior to 1975. In addition, several gages of MRGCD diversions are operated by the USGS. The stations with recorded measurements within the 1974 – 1995 period (some with only partial records) are listed below.

Cochiti Division

Gage Name	***Operator***	***Gage ID***
Cochiti East Side Main Canal	USGS	CCCN5
Sili Main Canal	USGS	SILN5
Cochiti Main at San Felipe	MRGCD	COCCN

Albuquerque Division

Gage Name	***Operator***	***Gage ID***
Albuquerque Main Canal	MRGCD	ALBCN
Atrisco Feeder	MRGCD	AFTCN
Algodones Riverside Drain	MRGCD	ALGDR
Arenal Main Canal	MRGCD	ARECN
Armijo Acequia	MRGCD	ARMCN
Atrisco Ditch	MRGCD	ATDCN
Albuquerque Riverside Drain @ Central Avenue	MRGCD	ALBDR
Corrales Main Canal	MRGCD	CORCN

Belen Division

Gage Name	***Operator***	***Gage ID***
Belen Highline Canal	MRGCD	BELCN
Peralta Main Canal	MRGCD	PERCN
Chical Lateral	MRGCD	CHICN
Chical Acequia	MRGCD	CHACN
Cacique Acequia	MRGCD	CACCN
Lower San Juan Riverside Drain	MRGCD	LSJDR

Socorro Division

Gage Name	*Operator*	*Gage ID*
Socorro Main Canal	USGS; MRGCD has new gage here beginning 2001	SOCCN

Diversions from the Low Flow Conveyance Channel gaged intermittently by USGS

A summary of MRGCD diversions is reflected in Water Distribution Reports, submitted to the USBR on an annual basis by the MRGCD. These records, prepared for each division within the MRGCD, include net supply (monthly diversions to major canals), estimated waste (water returned to the river through wasteways and drains), estimated loss (defined as evaporation, phreatophyte consumption and seepage to groundwater) and estimated deliveries to farms. Table 1 summarizes the MRGCD Water Distribution Data as reflected in USBR reports. Examples of these data reports are provided in Appendix B. Table 2 compares the reported net supply (understood to be gross diversion) to the sum of diversions reflected in the MRGCD hand-written spreadsheets. Further research is needed to understand the differences between these reported values.

More recently, the MRGCD, in cooperation with the NMISC and the OSE, has embarked on an expanded monitoring program, with the goal of measuring additional diversion points within the irrigation system and measuring all outfall and drain return flows. MRGCD anticipates that by the end of the year 2002 all of the major diversions from and returns to the river will be gaged. Additionally, the MRGCD is implementing an electronic data storage and retrieval (telemetry) system. Additional monitoring stations that have been installed or are scheduled for installation by the year indicated include the following (D. Gensler, personal communication, 2000):

Cochiti Division

No gages in the Cochiti Division are being installed at this time.

Albuquerque Division

Gage Name	*Operator*	*Installation Date*	*Gage ID*
Upper Corrales Riverside Drain	MRGCD	2001	UCRDR
Corrales Main Canal Wasteway	MRGCD	1997	CORWW
Central Avenue Wasteway	MRGCD	2000	CENWW
Atrisco Riverside Drain	MRGCD	1977	ATRDR
Lower Corrales Riverside Drain	MRGCD	2000	LCRDR
Albuquerque Riverside Drain	MRGCD	1997	ARSDR
Sandia Lakes Wasteway	MRGCD	2000	SANWW
Bernalillo Acequia	MRGCD	2001	BERCN

Belen Division

Gage Name	*Operator*	*Installation Date*	*Gage ID*
Peralta Main Wasteway	MRGCD	1999	PERWW
Feeder #3 Wasteway	MRGCD	2000	FD3WW
240 Wasteway	MRGCD	Scheduled for March 2001	240WW
Belen Riverside Drain	MRGCD	2000	BELDR
New Belen Drain Wasteway	MRGCD	Scheduled for February 2001	NBLWW
Lower Peralta Riverside Drain #1	MRGCD	2001	LP1DR
Lower Peralta Riverside Drain #2	MRGCD	Scheduled for March 2001	LP2DR
Lower San Juan Wasteway	MRGCD	Installed (no date)	LSJDR
Sabinal Riverside Drain	MRGCD	2001	SABDR
Storey Wasteway	MRGCD	2001	STYWW
San Francisco Riverside Drain	MRGCD	Scheduled for February 2001	SFRDR
Unit 7 Drain	MRGCD	Installed (no date)	UN7DR

(Note: Access for monitoring the Isleta Riverside Drain has not been granted by Isleta Pueblo)

Socorro Division

No gages are being installed in the Socorro Division at this time. However, the MRGCD and the ISC are currently negotiating a Joint Powers Agreement (JPA) for the construction of such gages. Several others gages are also proposed to be constructed. The proposed gages in the Socorro Division are described below.

Proposed gages for the Socorro Division	*Proposed completion date*
Socorro Main Canal Wasteway	December 31, 2002
Escondida Wasteway off Socorro Main Canal	December 31, 2002
Socorro Wasteway	December 31, 2002
Brown Arroyo Wasteway	December 31, 2002
San Antonio Riverside Drain at Bosque del Apache	December 31, 2002
Socorro Main Canal South at Bosque del Apache	March 1, 2002
San Antonio Ditch at Bosque del Apache	March 1, 2002
Elmendorf Drain at Bosque del Apache	March 1, 2002

The diversions from the Low Flow Conveyance Channel listed below have been proposed as part of the RFP for engineering services in the Middle Rio Grande Valley or may be performed as a separate JPA.

Lemitar Diversion (designated LEMDV for future metering purposes)
Socorro Diversion (designated SOCDV)
Neil-Cupp Diversion (designated NCPDV)

The MRGCD does not measure flow to individual farms or fields, nor does it time irrigations. However, some MRGCD ditchriders schedule irrigation deliveries to individual farms based upon the time required to deliver the amount of water needed for a given area to be irrigated. Ditchrider records may provide a means of estimating the delivery to individual farms. The Bosque del Apache National Wildlife Refuge operates its own gage on the Elmendorf Drain as it enters the Refuge but the MRGCD does not have access to the collected data.

Efficiency

For purposes of this study, efficiency terms will be defined as in Wilson and Lucero, 1997. These definitions are presented below:

Off-farm conveyance efficiency: The ratio, expressed as a percentage, of the quantity of water delivered to the farm headgate by an open or closed conveyance system, to the quantity of water introduced into the conveyance system at the source or sources of supply.

On-farm irrigation efficiency: The ratio, expressed as a percentage, of the average low-quarter depth or volume of irrigation water infiltrated and stored in the root zone to the depth or volume of water diverted from the farm headgate or a source of water originating on the farm itself, such as a well or spring. So that the reader may clearly understand what the low quarter means, let's assume that we have measured the change in soil moisture in the root zone after an irrigation at 12 sampling sites on a field. The low quarter would be the average of the three lowest values recorded. The on-farm efficiency reflects the efficiency of the on-farm distribution system and application system and includes deep percolation losses necessary as a beneficial use for leaching excess salts from the root zone….

Project or system irrigation efficiency: The combined efficiency of the entire irrigation system, from the ultimate diversion point to the crop root zone. In mathematical terms it is the product expressed as a percentage of the on-farm efficiency and the off-farm conveyance efficiency…

Relationship between Efficiency and In-Stream Flow

It often is assumed that an increase in MRGCD irrigation efficiency will translate to an increase in flow in the Rio Grande. Clearly, this will be true to the extent that incidental depletions associated with water conveyance or use will be reduced. However, to the extent that improved efficiency simply reduces the diversion and subsequent return flow back to the river, assessing the benefit of improved efficiency is more complex. The relationship between efficiency improvement and in-stream flow will depend on the location and timing of return flow. Conceivably, lagged return flows might be beneficial during some seasons, under some water supply conditions. Options for improvement in irrigation efficiency should be considered in light of the timing and location of return flow, in addition to the opportunity for reduction in incidental depletions. Finally,

efficiency improvement may result in reduced El Vado Reservoir releases, with associated impacts on in-stream flow.

Recent Efficiency Assessments

Several authors have reviewed the records presented in Water Distribution Data Reports, available from the USBR from the 1950s to the present. These records, generated by the USBR and/or reported to the USBR by the MRGCD (depending on the time frame) include tabulations of net supply, waste, operational losses and farm delivery. Although these quantities are in many cases only estimated, nonetheless they serve as a starting point for understanding historic water usage at a gross level. Off-farm conveyance efficiencies calculated using these records are frequently cited, although the accuracy of the reported quantities is unknown. Some of the recent reviews of these records include:

- ACOE/ISC Middle Rio Grande Water Supply Study, 2000 (S.S. Papadopulos & Associates, Inc., 2000)
- Alliance for Rio Grande Heritage, 2000
- Hernandez, 1997
- Office of the State Engineer, 1997 (Wilson and Lucero)
- MRGCD, June 5, 2000 (Letter to Subhas Shah, MRGCD Chief Engineer, from W. Peter Balleau, Balleau Groundwater, Inc.)

Using these records, the first three of the studies listed above calculate off-farm irrigation conveyance efficiencies on the order of 30%. A tabulation of off-farm efficiency computed by dividing the farm delivery by the net supply is shown on Table 3. Wilson and Lucero (1997) report off-farm efficiency of 49%, using the same records, but by dividing the farm delivery by the sum of the farm delivery and the operational losses (Wilson, personal communication, 2001). This approach rests on the assumption that wasteway returns are immediately returned to the river, and for practical purposes, do not constitute part of the project supply. Some authors have characterized the MRGCD irrigation system as inefficient based on evaluation of the USBR records.

Evaluation of these records by the MRGCD (Balleau Groundwater, 2000) employed a different approach and resulted in different conclusions. In this approach, Balleau subtracted an assumed tailwater return to the river from the diversions before dividing the diversions by the acreage irrigated. Balleau noted that of the average of 621,000 acre-feet of total MRGCD diversions in 1997/1998, 367,000 acre-feet on average were returned to the river, and much was re-diverted. Balleau did not calculate values for project efficiency but nonetheless concluded that the MRGCD has a “highly efficient management operation”.

Division Characterization

An estimation of diversion rate for each division (obtained by dividing the net supply from USBR reports, or amount diverted, by the number of irrigated acres in the division) yields rates ranging from 9.6 acre-feet per acre for the Belen division to 18.7 acre-feet per acre for the Cochiti division, with an average of 12 acre-feet per acre for the entire

MRGCD. However, such an estimation of diversion rate reflects some "double counting" of inter-division, unmetered flow – these estimates should be refined during the proposed study.

Quantification of Crop Acreage and Consumptive Use

Absent measurement of all system returns, determination of on-farm or total system efficiency requires quantification of crop acreage and consumptive use. These estimates are subject to significant uncertainty. Table 4 identifies crop acres reported by the USBR for the Middle Rio Grande region, based on 1992 aerial photography. These acreages include some additional acreage beyond that within the MRGCD system. Table 5 provides estimated crop consumptive use for this region as developed by the USBR and reported in the web-based ET Toolbox. The estimated total consumptive use is 248,096 acre-feet per year, or a consumptive irrigation requirement of about 227,000 (accounting for effective precipitation estimated at 4 inches per acre).

Uncertainties

Understanding what is actually represented by records in the USBR reports is a more difficult task than conducting cursory calculations with these records. Several authors suggest that efficiency is low, and has decreased over the years. However, the numbers supporting these conclusions are poorly understood, and may represent a series of assumptions and calculations, rather than actual data. Some uncertainties are discussed below.

Net Supply: Taken to represent total diversions, these numbers should match the sum of diversions metered by the District. As noted previously, these numbers do not match. Part of the difference may be attributable to inclusion or exclusion of water diverted for sluicing sand near the canal headings. Another part may be attributable to direct flow between divisions that is not metered at the diversions from the river. For some years, USBR Monthly Water Distribution reports reflect different quantities for diversions than do the USBR Annual Statistical reports. Follow-up interviews with MRGCD and the USBR; and, further examination of these figures are needed to better characterize the "net supply". Better understanding of the derivation of the various reported numbers for diversion or supply is needed to determine whether these can be meaningfully used to address historical trends in diversion or efficiency.

Wasteway Returns: Significant flow back to the river occurs via wasteways, sometimes close to the main diversion point. Return flows that rejoin the river near the diversion (such as for sluicing sand) should be removed from gross diversion to calculate efficiency. However, the quantity of these and other wasteway flows have not historically been metered. Field inspection of wasteway locations and discussion with division managers may shed some light on the relative quantities of return flow at different locations.

Operational Losses:
Operational losses as reported to the USBR are an estimated parameter, assumed to represent evaporative and seepage losses. These numbers should be re-assessed using

independently derived estimates of these quantities, or as the difference between metered diversions and farm deliveries, as system metering becomes more complete. Seepage studies along major canals would be useful in this regard.

Farm Delivery:
Farm delivery within the MRGCD is estimated, but is not measured, and therefore is subject to uncertainty. The values reported for annual farm deliveries are understood to be estimated using MRGCD ditchrider visual estimates of flow and time required for delivery; and extrapolation of these estimates to time frames for which ditchrider estimates were not developed.

Crop Consumptive Use:
Absent measured farm delivery, the efficiency of the conveyance system can be inferred from estimates of irrigated acreage and assumptions of consumptive irrigation requirement, also poorly quantified parameters. Present estimates of crop consumptive use are vastly different, i.e., the calculated consumptive irrigation requirements (CIR) for the Middle Valley using Blaney-Criddle (USBR, 1995) versus those obtained with the modified Penman approach (USBR ET Toolbox, 1999).

Other unresolved discrepancies in reported quantities for diversions and the irrigated acreage remain. The Rio Grande Joint Investigation (1938) records similar acreages (approx. 59,000 acres) and total diversions (619,989 acre/feet per year) in 1936 as are recorded today, suggesting that over the long term, the system has not changed significantly. However, citing the FWS National Ecology Research Center GIS interpretation of 1935 conditions, the USBR MRG Assessment (1995) reports that in 1935, 28,000 acres were irrigated above San Acacia, an amount significantly below the present irrigated acreage above San Acacia.

District Configuration/Operations and Irrigation Efficiency

The MRGCD irrigation efficiency will be impacted both by structural conditions and system operation. This section provides a brief discussion of some aspects of both of these factors that may have an effect on the use and consumption of water within the MRGCD.

The MRGCD's conveyance system consists primarily of unlined ditches with attendant high seepage and native riparian evapotranspiration losses. Metering is used for informational purposes; meter-based automated control of diversions is not employed. Ditch riders control water delivery manually.

Generally, the MRGCD operates its system to provide continuous-flow water-delivery service. The system's various canals, ditches and laterals are frequently kept full during the irrigation season. In most areas, irrigation occurs both during the day and night. However, operations throughout the District reflect historical traditions and cultures in the middle Rio Grande Valley prevalent at the time of the establishment of the MRGCD in 1925, and therefore some variations in operating procedures do occur, with potential impact on water use. For example, according to Fred Rivera, MRGCD Cochiti Division

Manager, for cultural or religious reasons, irrigation of Indian lands within some Pueblos in the Cochiti Division only occurs during the day. This, in combination with the fact that the canals are maintained fully charged at night, may cause a lower efficiency within the Cochiti Division than would otherwise occur. This practice also would be expected to generate greater depletions due to increased evaporation of water applied during daytime hours.

As described earlier in this document, the MRGCD diversion and irrigation system was constructed during the 1930's and rehabilitated in the 1950's. Improvements to the system infrastructure, operation, and monitoring are ongoing. In some areas, and with success, irrigators within MRGCD have taken steps to improve efficiency. These include improvements funded by the U.S. Natural Resources Conservation Service to use pipelines, to line ditches, and to laser level fields. Some farmers have noted a significant drop in their water use following the replacement of dirt ditches with pipelines. The MRGCD's practice is to line portions of main canals, in critical areas where high seepage or erosion is identified.

If an evaluation of the location and timing of return flows and evaluation of incidental depletions indicates the desirability of improved efficiency, improvements might include additional farmer educational efforts toward improved water management, simple irrigation scheduling, improved delivery systems, or automated systems. Additionally, incorporation of regulating reservoirs, or utilization of surface or subsurface storage may be worth considering. The latter may be particularly important if major changes to infrastructure are contemplated, for example, as may be associated with alternative methods of supply. Economic benefit and the demonstration of such would be critical to the success of any program involving change to the present mode of operation.

Plan for MRGCD Irrigation Efficiency and Metering Study

The following tasks have been identified based on the understanding of available data developed during the preliminary assessment. During the comprehensive study, data gaps may be encountered that will impact the level of effort practical for some tasks.

Task 1: Review Basic Data

The goal of this task is to assemble all documentation prepared or relating to water use in the MRGCD, and to supplement available metadata. Available data on the MRGCD system and operations will be reviewed and compiled. Through interviews with division managers, and other MRGCD staff, the presently available metadata for MRGCD data (SSPA, 2000) will be augmented. Differences between reported diversions to the USBR and those in the MRGCD spreadsheets will be reconciled, if possible. This effort will focus on acreage and diversions records, unless information is revealed to support other reported quantities. This task will be broken down into a division-by-division analysis.

This exercise will result in easily referenced tables of data and metadata. Subtasks that will be part of Task 1 include:

1.1 Compile monthly water distribution reports, enter into database;
1.2 Compile crop reports, enter into database; describe & reference available source material;
1.3 Prepare graphical comparisons of diversion data from monthly water distribution reports and gaged data (from MRGCD spreadsheets);
1.4 Review and evaluate ditchrider logs – how do these support the reported data, historical and present? Discuss logs with MRGCD personnel to determine how these logs are maintained, updated, and checked;
1.5 Interview division managers to determine how system-wide data are collected and compiled and how records are maintained.

Task 2: Develop Conveyance Channel Map and Schematic

Mapped coverage of the primary elements of the irrigation district conveyance system will be prepared in a format consistent with the existing GIS coverage of the Middle Rio Grande region. Existing products prepared by the MRGCD and the USGS will be reviewed prior to developing details of this product. In addition, a simplified schematic will be prepared indicating metered locations, canal service areas and numbers of acres in service areas. The simplified schematic will show where interconnection between canal service areas exists, identify where return flows originate in the system, and where they reach the river. Division managers, ditchriders, and MRGCD specialists in hydrology and GIS will be interviewed to assist in developing and verifying the schematic.

Task 3: Review Water Delivery Operation Procedures and Rationale

The procedures and rationale for water-delivery operations within each division of the district will be reviewed in Task 3. Daily flows at diversions structures will be reviewed and related to consumptive demand for canal service areas. Division managers, and ditchriders, where appropriate, will be interviewed regarding diversion needs and rationale for present diversion, routing and wasting procedures. Existing operational records will be reviewed to assess the consistency of system operations with operational goals. Historical water demand will be compared to historical water diversions and delivery. This information will be developed separately for each division.

Task 4: Evaluation of Metering Program

This task will involve an overall evaluation of the existing MRGCD metering system. Field visits will be made to all gaged locations. A gage report will be prepared at each location, identifying gage type and condition, quality of gaged section, and gaging problems that may be associated with the section. For each metered location, an analysis will be made of the working condition, accuracy, and potential use of the information collected from the gage. In addition, the system-wide metering program will be reviewed in light of system configuration, to determine whether the present program provides an accurate pictures of overall system operation, including all significant diversions from and returns to the river. Additional metering locations that could be provide information needed for better management of the irrigation system, or aid our understanding of system delivery or efficiency issues, may be recommended.

Task 5: Evaluation of Operations and Diversion/Conveyance Infrastructure

In Task 5, operational procedures for water delivery to water users will be documented and evaluated. Procedures employed by ditchriders to control and distribute water will be assessed. Also, the condition of diversion and control structures, as well as irrigation and drainage canals will be documented. These informational types will be compiled to allow an assessment of water losses or inefficiencies resulting from system infrastructure or operations. Options for improving efficiency through alternate operational procedures or improvement or additions to diversion or conveyance infrastructure will be evaluated. This task will include analysis of seepage run data collected by the district or others, if such data exist at the time this task is performed.

Task 6: Water Accounting and Systems Analysis; and Preparation of Report

In Task 6, information developed under the above tasks will be used to develop a simplified decision-support model. This model will be spreadsheet based, and involve evaluation of the system water budget using a monthly time step. Modified accounting models, assuming wet or dry conditions, and associated irrigation demands will be included in this analysis; as will limited diversions to computed ideal headgate requirements. The system will be analyzed from a systems engineering approach with the goal of optimizing use of the water supply available to the MRGCD. The model will then be employed to evaluate system performance and make recommendations for improvements. Due to lack of suitable calibration data regarding return flows and river gains and losses, this model will be considered a tool for evaluating possible ranges of conditions.

A draft report will be prepared summarizing the data compilation and review, evaluation of metering and efficiency, evaluation of infrastructure and delivery operations.

Recommendations will be made in the following areas, if warranted:

- Improvements or additions to system infrastructure to reduce system losses (possibly including the replacement of open ditches with pipes, improvement of land preparation, or cultivation of crops that have a lower water consumption);
- Any appropriate consolidations of water conveyance channels (or decommissioning of canals that are no longer necessary);
- Changes to system operations to improve system management and reduce system losses;
- Modification to water diversions from the river, based on a historical comparison of water demand and delivery; and
- Additional metering locations or other data collection that may be warranted, including data to support improved quantification of river/groundwater interactions within the district.

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Table 1
Summary of MRGCD Water Distribution Data
Reported to USBR

Year*	Net Supply (acre-feet)	Operational Spills (acre-feet)	Transportation Losses (acre-feet)	Delivered to Farms (acre-feet)
1976	550,110	179,190	195,310	175,610
1979	547,726	178,586	209,878	159,262
1980	513,465	169,363	205,306	138,796
1981	475,590	154,160	189,740	131,690
1982	434,790	129,580	155,820	149,390
1983	465,330	135,290	159,300	170,740
1984	525,883	171,360	192,920	148,410
1985	468,930	187,860	163,540	117,530
1986	565,950	221,220	203,110	141,620
1987	588,670	176,300	205,670	205,670
1988	596,650	172,760	223,470	200,420
1989	567,650	187,300	198,670	181,680
1990	506,730	167,990	177,310	162,330
1991	554,450	185,900	192,120	176,430
1992	599,890	210,030	204,200	185,660
1993	609,050	213,160	200,970	194,920
1994	606,030	219,120	209,570	177,340
1995	617,530	214,920	203,970	198,640
1996	618,419	216,447	204,079	197,894
1997	653,872	228,855	215,778	209,239
1998	679,266	237,744	224,158	217,365
1999	612,120	214,242	202,000	195,589
Average	**561,732**	**189,608**	**197,131**	**174,374**

*records prior to 1975 and 1977-1978 were not located for this study, but should be available in USBR archived files

NOTE: For comparison purposes, 1936 diversions are reported as 619,989 in Table 72, Rio Grande Joint Investigation, 1938 for 59,159 irrigated acres

Source of Information:
1983, 1985 - 90, 1992-99: Monthly Water Distribution Reports
1991: Monthly Water Distribution and Annual Operation and Maintenance Costs
1976, 1979-82, 1984: 19__ Summary Statistics, Vol. 1, Water, Land and Related Data, USBR

Table 2
Comparison of MRGCD Reported Net Supply to Composite Diversions

Year	Net Supply Reported to USBR (acre-feet)	Composite MRGCD Diversions (acre-feet)
1976	550,110	
1979	547,726	
1980	513,465	
1981	475,590	
1982	434,790	385,742
1983	465,330	451,266
1984	525,883	470,751
1985	468,930	442,141
1986	565,950	564,762
1987	588,670	549,040
1988	596,650	418,340
1989	567,650	431,551
1990	506,730	517,144
1991	554,450	570,210
1992	599,890	
1993	609,050	600,109
1994	606,030	603,396
1995	617,530	613,071
1996	618,419	590,244
1997	653,872	
1998	679,266	
1999	612,120	

Table 3
MRGCD Irrigation System Delivery Efficiency

Year	Net Supply (acre-feet)	Delivered to Farms (acre-feet)	System Delivery Efficiency
1976	550,110	175,610	0.319
1979	547,726	159,262	0.291
1980	513,465	138,796	0.270
1981	475,590	131,690	0.277
1982	434,790	149,390	0.344
1983	465,330	170,740	0.367
1984	525,883	148,410	0.282
1985	468,930	117,530	0.251
1986	565,950	141,620	0.250
1987	588,670	205,670	0.349
1988	596,650	200,420	0.336
1989	567,650	181,680	0.320
1990	506,730	162,330	0.320
1991	554,450	176,430	0.318
1992	599,890	185,660	0.309
1993	609,050	194,920	0.320
1994	606,030	177,340	0.293
1995	617,530	198,640	0.322
1996	618,419	197,894	0.320
1997	653,872	209,239	0.320
1998	679,266	217,365	0.320
1999	612,120	195,589	0.320
Average System Delivery Efficiency:			**0.303**

Table 4
Crop and Riparian Acreage[1]

Reach	URGWOM Reach Number	Crop Acres	Riparian Acres
Cochiti to San Felipe	1	2,869	5,146
Jemez River	2		1,971
San Felipe to Central Avenue	3	7,085	8,388
Central Avenue to Bernardo	4	38,389	15,931
Bernardo to San Acacia	5	438	7,298
San Acacia to San Marcial	6	14,770	13,323
TOTAL		63,551	52,057

[1] Acreages from USBR ET Toolbox, based on 1992 LUTA coverage for URGWOM reaches 1 - 5. Riparian acres for reach 6 estimated from USBR/Forest Service 1999 aerial photographs; crop acres for reach 6 estimated by USBR from MRGDC crop reports and Fish and Wildlife crop reports (Al Brower, personal communication, May 4, 2000)

Table 5
Crop and Riparian Consumptive Use, Average from 1985 - 1998

Reach	URGWOM Reach Number	Crop Consumptive Use (acre-feet/year)	Riparian Consumptive Use (acre-feet/year)
Cochiti to San Felipe	1	10,221	20,529
Jemez River	2		9,624
San Felipe to Central Avenue	3	27,468	33,812
Central Avenue to Bernardo	4	152,396	63,921
Bernardo to San Acacia	5	1,491	27,191
San Acacia to San Marcial	6	56,520	49,452
Total above San Acacia	1 - 5	191,576	155,078
Total below San Acacia	6	56,520	49,452
TOTAL		248,096	204,529

Note: Consumptive use shown is not adjusted for effective precipitation.
Source: USBR ET Toolbox website, May, 2000

Appendix A

Examples of
MRGCD Crop Production Reports

NOTE: These documents were scanned in. If part of them looks chopped off or incomplete, it is simply because that is how our copy looks.

OMB Approval No.
Expires

CROP AND WATER DATA FOR 1999

REGION : UC ADP CODE 405930 CONG DIST

PROJECT: MRGCD DIVISION : GENERAL OFFICE - ALBUQ.

UNIT WATER DISTRICT:

STATE: NM COUNTIES: BERNALILLO, SOCORRO, VALENCIA, SANDOVAL

1 TOTAL DISTRICT ACRES 51,487

2 TYPE OF SERVICE [X] Full [ ] Supplement [ ] Temporary

IRRIGABLE ACRES FOR SERVICE

IRRIGATED ACRES: AGRICULTURAL : 44,302 MULTICROPPED ACRES

3 NON-AGRICULTURAL ACRES: 160

CROP PRODUCTION

	LINE CODE	CROPS HARVESTED IN IRRIGATION ROTATION	ACRES	UNIT	YIELD 5 PER ACRE	YIELD 5 TOTAL	VALUE OF CROPS 6 PER UNIT	VALUE OF CROPS 6 PER ACRE	VALUE OF CROPS 6 TOTAL
CEREALS	51	Barley		Bu					
	52	Corn		Bu					
	53	Oats		Bu					
	54	Rice		Cwt					
	56	Sorghums (sorgo, kaffir, etc)		Bu					
	57	Wheat		Bu					
	58	Other Cereals		Cwt					
	59	TOTAL CEREALS	0						
FORAGE	61	Alfalfa hay	22,523	Ton	5.10	114,867	121.00	617	13,896,944
	62	Other hay	1,756	Ton	1.90	3,336	98.00	186	326,968
	63	Irrigated pasture	14,880	AUM	4.30	63,984	119.00	511	7,614,096
	65	Silage or Ensilage	3,801	Ton	23.00	87,423	115.00	265	10,053,645
	70	Other Forage		Ton					
	71	TOTAL FORAGE	42,960						31,893,653
MISC FIELD CROPS	81	Beans, dry and edible		Cwt					
	82	Cotton, lint (Upland) 4		Bale					
	83	Cotton, seed (Upland)		Ton					
	84	Cotton, lint (American - Pima)		Bale					
	85	Cotton, seed (American - Pima)		Ton					
	86	Hops		Ton					
	87	Peppermint		LB					
	88	Spearmint		LB					
	89	Sugar Beets		Ton					
	90	Soybeans		Bu					
	91	Other miscellaneous field crops		Ton					
	92	TOTAL MISCELLANEOUS FIELD CROPS	0						

CROP AND WATER DATA FOR 1999

CROP PRODUCTION

	LINE CODE	CROPS HARVESTED IN IRRIGATION ROTATION	ACRES	UNIT	YIELD PER ACRE	YIELD TOTAL	VALUE OF CROPS PER UNIT	VALUE OF CROPS PER ACRE	VALUE OF CROPS TOTAL
VEGETABLES	101	Asparagus		Cwt					
	102	Beans (processing)		Ton					
	103	Beans (fresh market)		Cwt					
	104	Broccoli		Cwt					
	105	Cabbage		Cwt					
	106	Carrots		Cwt					
	107	Cauliflower		Cwt					
	108	Celery		Cwt					
	109	Corn, Sweet (processing)		Ton					
	110	Corn, Sweet (fresh market)		Cwt					
	111	Cucumbers		Cwt					
	112	Greens (kale, etc.)		Cwt					
	113	Lettuce:		Cwt					
		Melons:							
	114	Cataloupe, etc.		Cwt					
	115	Honey Ball, Honeydew, etc.		Cwt					
	116	Watermelon		Cwt					
	117	Onions, dry		Cwt					
	118	Onions, green		Cwt					
	119	Peas, green (processing)		Ton					
	120	Peas, green (fresh market)		Cwt					
	121	Peppers (all kinds)	449	Cwt	144	64,656	6.00	864	387,936
	122	Potatoes, early		Cwt					
	123	Potatoes, late		Cwt					
	124	Squash		Cwt					
	125	Tomatoes, (canning)		Ton					
	126	Tomatoes, (fresh market)		Cwt					
	127	Other Vegetables		Cwt					
	128	TOTAL VEGETABLES	449						387,936
	137	TOTAL NURSERY	713						
SEEDS	141	Alfalfa		Cwt					
	142	Clover (all kinds)		Cwt					
	143	Corn		Cwt					
	144	Grass (all kinds)		Cwt					
	145	Lettuce		Cwt					
	146	Onion		Cwt					
	147	Pea		Cwt					

CROP AND WATER DATA FOR 1999

CROP PRODUCTION

	LINE CODE	CROPS HARVESTED IN IRRIGATION ROTATION	ACRES	UNIT	YIELD PER ACRE	YIELD TOTAL	VALUE OF CROPS $ PER UNIT	VALUE OF CROPS $ PER ACRE	VALUE OF CROPS $ TOTALS
SEEDS	148	Potato (all kinds)		Cwt					
	149	Sugar beet		Cwt					
	150	Other seed		Cwt					
	151	TOTAL SEEDS	0						
FRUITS	161	Apples	180	Ton	4.0	720	42.00	168	30,240
	162	Apricots		Ton					
	163	Berries (all kinds)		Cwt					
	164	Cherries		Ton					
	165	Grapefruit		Cwt					
	166	Lemons and Limes		Cwt					
	167	Oranges and Tangerines		Cwt					
	168	Dates		Ton					
	169	Grapes, table		Ton					
	170	Grapes, wine		Ton					
	171	Grapes, raisin		Ton					
	172	Grapes, other		Ton					
	173	Olives		Ton					
	174	Peaches		Ton					
	175	Pears		Ton					
	176	Prunes and Plums		Ton					
	177	Strawberries		Ton					
	178	Other fruits		Ton					
	179	TOTAL FRUITS	180						30,240
NUTS	181	Almonds		Ton					
	182	Pecans		Cwt					
	183	Walnuts		Ton					
	184	Pistachios		Ton					
	185	Other nuts		Ton					
	186	TOTAL NUTS	0						
	192	TOTAL ALL CROPS	44,302						

1 Include ALL acres within district boundary - ie , farmsteads, roads, ditches, drains, dry cropped, idle, fallow, grazed, etc.

2 Acres classified as irrigable for which project works have been constructed and project water is available.

3 Irrigated non-agricultural acres include gardens, hobby farms, landscaped areas, etc.

4 Cotton seed is assumed to have been harvested on the same number of acres as lint

5 Enter either Yield per acre or Total Yield - not both

6 Optional Field - If data is available enter either Per Unit, Per Acre, or Total - not all

CROP AND WATER DATA FOR 1999

TYPE OF SERVICE [X] Full [ ] Supplement [ ] Temporary

LINE CODE	MONTH	NET SUPPLY	OPERATIONAL SPILLS	TRANSPORTATION LOSSES	NONAGRICLTURAL DELIVERIES		DELIVERED TO FARMS	ACRE-FEET PER ACRE
					MUNICIPAL INDUSTRIAL	MISCELLANEOUS		
	PROJECT WATER (Acre-Feet)							
201	January	0	0	0	N/A	N/A	0	
202	February	1,156	405	382	N/A	N/A	369	
203	March	74,452	40,952	21,594	N/A	N/A	11,906	
204	April	74,684	26,146	24,651	N/A	N/A	23,887	
205	May	77,520	24,679	26,080	N/A	N/A	26,761	
206	June	87,172	27,752	29,327	N/A	N/A	30,093	
207	July	82,371	26,224	27,712	N/A	N/A	28,435	
208	August	61,230	19,493	21,099	N/A	N/A	20,638	
209	September	77,026	24,522	25,914	N/A	N/A	26,590	
210	October	76,509	24,358	24,740	N/A	N/A	27,411	
211	November	0	0	0	N/A	N/A	0	
212	December	0	0	0	N/A	N/A	0	
213	**TOTAL PROJECT WATER**	612,120	214,531	201,499			196,090	
214	M&I population served							
	NONPROJECT WATER (Acre-Feet)							
216	Annual Data							
217	TOTAL PROJECT/NONPROJECT WATER	612,120	214,531				196,090	
	DRIP AND SPRINKLER IRRIGATION (Whole Numbers)							
231	Total acres Sprinkler irrigated							
232	Total acres Drip irrigated							
233	Footnotes							
234	Refrerences used - 1998 New Mexico Agricutural Statistics and 1999 Ditch Rider Logs for MRGCD							
235	Data does not include the Santa Ana, San Felipe, Santo Domingo, Isleta, Cochiti, Sandia Pueblo Crop Census for 1999.							
236								
237								

Middle Rio Grande Conservancy District
1999 Crop Census Report Without the Pueblo Data

Crop_Code	*Benef_Acres*	*Irrig_Acres*
ALFALFA		
Summary for 'Crop_Code' = ALFALFA (3885 detail records)		
Sum	23,316.01	22,522.83
APPLES		
Summary for 'Crop_Code' = APPLES (113 detail records)		
Sum	309.15	180.47
CORN		
Summary for 'Crop_Code' = CORN (266 detail records)		
Sum	3,629.18	3,510.97
FALLOW		
Summary for 'Crop_Code' = FALLOW (1565 detail records)		
Sum	4,107.23	0.00
FRUIT/TREE		
Summary for 'Crop_Code' = FRUIT/TREE (17 detail records)		
Sum	34.10	30.06
GARDEN		
Summary for 'Crop_Code' = GARDEN (47 detail records)		
Sum	30.07	16.46
GRAPES		
Summary for 'Crop_Code' = GRAPES (10 detail records)		
Sum	26.94	25.53
GRASS HAY		
Summary for 'Crop_Code' = GRASS HAY (150 detail records)		
Sum	325.87	279.35
IRRIG. PASTURE		
Summary for 'Crop_Code' = IRRIG. PASTURE (5459 detail records)		
Sum	16,164.20	14,880.24
MELONS		
Summary for 'Crop_Code' = MELONS (15 detail records)		
Sum	52.75	48.47
NURSERY		
Summary for 'Crop_Code' = NURSERY (62 detail records)		
Sum	346.27	318.42
OATS		
Summary for 'Crop_Code' = OATS (199 detail records)		
Sum	1,024.89	1,001.71

Crop_Code	Benef_Acres	Irrig_Acres
OTHER VEG		
Summary for 'Crop_Code' = OTHER VEG (121 detail records)		
Sum	305.62	274.83
PEPPERS		
Summary for 'Crop_Code' = PEPPERS (74 detail records)		
Sum	463.18	448.72
PONDS		
Summary for 'Crop_Code' = PONDS (2 detail records)		
Sum	303.74	0.00
SORGHUMS		
Summary for 'Crop_Code' = SORGHUMS (33 detail records)		
Sum	175.81	172.41
SUDAN		
Summary for 'Crop_Code' = SUDAN (14 detail records)		
Sum	118.92	116.51
WHEAT		
Summary for 'Crop_Code' = WHEAT (29 detail records)		
Sum	475.61	475.03
YARD/LAWN		
Summary for 'Crop_Code' = YARD/LAWN (354 detail records)		
Sum	277.48	160.04
Grand Total	51,487.01	44,462.06

Appendix B

Examples of
MRGCD Water Distribution Reports

NOTE: These documents were scanned in. If part of them looks chopped off or incomplete, it is simply because that is how our copy looks.

MIDDLE RIO GRANDE CONSERVANCY DISTRICT

WATER DISTRIBUTION REPORT
IRRIGATION YEAR 1999

DISTRICT TOTAL

ALL NUMBERS IN ACRE-FEET

MONTH	WATER SUPPLIED TO ALL DIVISIONS*	% OF ANNUAL	MAIN CANALS		DELIVERED TO LATERALS	LATERALS		DELIVERED TO IRRIGATORS
			WASTE**	LOSS***		WASTE	LOSS	
JANUARY	0	0.00%	0	0	0	0	0	0
FEBRUARY	1156	0.19%	289	289	578	116	93	370
MARCH	74452	12.16%	37226	18613	18613	3726	2981	11906
APRIL	74684	12.20%	18671	18671	37342	7475	5980	23886
MAY	77520	12.66%	16304	19380	41836	8375	6700	26761
JUNE	87172	14.24%	18334	21793	47045	9418	7534	30093
JULY	82371	13.46%	17325	20593	44454	8899	7119	28435
AUGUST	61230	10.00%	12878	15307	33044	6615	5292	21137
SEPTEMBER	77026	12.58%	16200	19257	41569	8322	6657	26590
OCTOBER	76509	12.50%	16092	19127	41290	8266	6613	26412
NOVEMBER	0	0.00%	0	0	0	0	0	0
DECEMBER	0	0.00%	0	0	0	0	0	0
ANNUAL	612119.6	100.00%	153030	153030	305771	61212	48970	195589

NOTES: * INCLUDES BOTH NEW DIVERSIONS FROM RIVER AND RETURN FLOWS FROM UPSTREAM DIVISIONS

** RETURNED TO RIVER THROUGH WASTEWAYS AND DRAINS

*** EVAPORATION, PHREATOPHYTE CONSUMPTION, AND SEEPAGE TO GROUNDWATER

MIDDLE RIO GRANDE CONSERVANCY DISTRICT

WATER DISTRIBUTION REPORT
IRRIGATION YEAR 1998

DISTRICT TOTAL

ALL NUMBERS IN ACRE-FEET

MONTH	WATER SUPPLIED TO ALL DIVISIONS*	% OF ANNUAL	MAIN CANALS		DELIVERED TO LATERALS	LATERALS		DELIVERED TO IRRIGATORS
			WASTE**	LOSS***		WASTE	LOSS	
JANUARY	0	0.00%	0	0	0	0	0	0
FEBRUARY	0	0.00%	0	0	0	0	0	0
MARCH	58826	8.66%	29413	14707	14707	2941	2353	9412
APRIL	84260	12.40%	21065	21065	42130	8426	6741	26963
MAY	96485	14.20%	21475	24121	50889	10178	8142	32569
JUNE	97960	14.42%	21803	24490	51667	10333	8267	33067
JULY	85319	12.56%	18990	21330	45000	9000	7200	28800
AUGUST	84742	12.48%	18861	21185	44695	8939	7151	28605
SEPTEMBER	92958	13.69%	20690	23239	49029	9806	7845	31378
OCTOBER	78718	11.59%	17520	19679	41518	8304	6643	26572
NOVEMBER	0	0.00%	0	0	0	0	0	0
DECEMBER	0	0.00%	0	0	0	0	0	0
ANNUAL	679266.2	100.00%	169817	169817	339633	67927	54341	217365

NOTES: * INCLUDES BOTH NEW DIVERSIONS FROM RIVER AND RETURN FLOWS FROM UPSTREAM DIVISIONS

** RETURNED TO RIVER THROUGH WASTEWAYS AND DRAINS

*** EVAPORATION, PHREATOPHYTE CONSUMPTION, AND SEEPAGE TO GROUNDWATER

MIDDLE RIO GRANDE CONSERVANCY DISTRICT

WATER DISTRIBUTION REPORT
IRRIGATION YEAR 1997

DISTRICT TOTAL

ALL NUMBERS IN ACRE-FEET

MONTH	WATER SUPPLIED TO ALL DIVISIONS*	% OF ANNUAL	MAIN CANALS		DELIVERED TO LATERALS	LATERALS		DELIVERED TO IRRIGATORS
			WASTE**	LOSS***		WASTE	LOSS	
JANUARY	0	0.00%	0	0	0	0	0	0
FEBRUARY	0	0.00%	0	0	0	0	0	0
MARCH	69213	10.59%	34607	17303	17303	3461	2769	11074
APRIL	78047	11.94%	19512	19512	39024	7805	6244	24975
MAY	91051	13.92%	19653	22763	48635	9727	7782	31127
JUNE	90033	13.77%	19433	22508	48092	9618	7695	30779
JULY	93926	14.36%	20273	23482	50171	10034	8027	32109
AUGUST	77781	11.90%	16789	19445	41547	8309	6648	26590
SEPTEMBER	76170	11.65%	16441	19043	40687	8137	6510	26039
OCTOBER	77207	11.81%	16665	19302	41240	8248	6598	26394
NOVEMBER	444	0.07%	96	111	237	47	38	152
DECEMBER	0	0.00%	0	0	0	0	0	0
ANNUAL	653872	100.00%	163468	163468	326936	65387	52310	209239

NOTES: * INCLUDES BOTH NEW DIVERSIONS FROM RIVER AND RETURN FLOWS FROM UPSTREAM DIVISIONS

** RETURNED TO RIVER THROUGH WASTEWAYS AND DRAINS

*** EVAPORATION, PHREATOPHYTE CONSUMPTION, AND SEEPAGE TO GROUNDWATER

MIDDLE RIO GRANDE CONSERVANCY DISTRICT

WATER DISTRIBUTION REPORT
IRRIGATION YEAR 1996

DISTRICT TOTAL

ALL NUMBERS IN ACRE-FEET

MONTH	WATER SUPPLIED TO ALL DIVISIONS* (A)	% OF ANNUAL	(B) MAIN CANALS (C) WASTE**	(B) MAIN CANALS (C) LOSS***	DELIVERED TO LATERALS	(B) LATERALS (C) WASTE	(B) LATERALS (C) LOSS	DELIVERED TO IRRIGATORS
JANUARY	0	0.00%	0	0	0	0	0	0
FEBRUARY	0	0.00%	0	0	0	0	0	0
MARCH	72772	11.77%	36386	18193	18193	3639	2911	11644
APRIL	85164	13.77%	21291	21291	42582	8516	6813	27252
MAY	88107	14.25%	18546	22027	47534	9507	7606	30422
JUNE	82842	13.40%	17438	20711	44694	8939	7151	28604
JULY	70219	11.35%	14781	17555	37884	7577	6061	24246
AUGUST	80880	13.08%	17025	20220	43635	8727	6982	27927
SEPTEMBER	73912	11.95%	15558	18478	39876	7975	6380	25521
OCTOBER	64523	10.43%	13582	16131	34811	6962	5570	22279
NOVEMBER	0	0.00%	0	0	0	0	0	0
DECEMBER	0	0.00%	0	0	0	0	0	0
ANNUAL	618419	100.00%	154605	154605	309210	61842	49474	197894

NET SUPPLY

+ = SPILLS = TRANS LOSS

NOTES: * INCLUDES BOTH NEW DIVERSIONS FROM RIVER AND RETURN FLOWS FROM UPSTREAM DIVISIONS

** RETURNED TO RIVER THROUGH WASTEWAYS AND DRAINS

*** EVAPORATION, PHREATOPHYTE CONSUMPTION, AND SEEPAGE TO GROUNDWATER

B + B = OPERATIONAL Spills on sheet #5

C + C = TRANSPORTATION LOSSES on sheet #5

col 1+4 = oper spill
col 2+5 = trans. loss

MIDDLE RIO GRANDE CONSERVANCY-DISTRICT

1995

MONTHLY WATER DISTRIBUTION

Project _____ Area Irrigated _____ Year _____

QUANTITIES IN ACRE-FEET

MONTH	Diverted from Stream 1	Inflow from Reservoirs and other sources	Delivered to Reservoirs 2	Net Supply 3	Main Canal Waste 1	Main Canal Losses 2	Delivered to Laterals a 3	Lateral Waste 4	Lateral Losses 5	Non-Irrigation Deliveries 4	DELIVERED TO FARMS b	
											Total	Per Acre
January,												
February,												
	54120				27060	13570	13490	2540	2170		8780	
April,	72170				36090	18040	18040	3330	2890		11820	
May,	82540				15320	20,630 ~~20,680~~	46590	9310	7450 ~~7450~~		29830	
June,	86100				15990	21520	48590	9750	7770		31070	
July,	87090				16150	21770	49170	9060	7870		32240	
August,	86880				16140	21730	49010	9800	8010		31200	
September,	71950				13390	17990	40570	8110	6470		25990	
October,	76680				14230	19170	43280	8650	6920		27710	
November,												
December,												
Total,	617530				154370	154420	308740	60550	49550		198640	
Acre ft. per acre,												
Per cent Net Supply,					25%	25%	50%	10%	8%		32%	

1 Diversion amount exclusive of waste at head gates for sand sluicing, etc.

2 Reservoirs connected with distributing system only.

3 Diversions plus inflow from reservoirs and other sources less delivery to reservoirs.

4 Do not include power.

a Measured at _____

b Measured at _____

col 2+5 Dosso 248-53561

MIDDLE RIO GRANDE CONSERVANCY DISTRICT

All Divisions

MONTHLY WATER DISTRIBUTION

Project M.R.G.C.D. Area Irrigated _____ Year 1994

QUANTITIES IN ACRE-FEET

MONTH	Diverted from Stream 1	Inflow from Reservoirs and other sources	Delivered to Reservoirs 2	Net Supply 3	Main Canal Waste 1	Main Canal Losses 2	Delivered to Laterals a 3	Lateral Waste 4	Lateral Losses 5	Non-Irrigation Deliveries 4	DELIVERED TO FARMS b Total	Per Acre
January,												
February,												
March,	60,610				30310	15150	15160	3030	2430		9690	
April,	77100				38560	19280	19260	3850	3380		12030	
May,	76290				13460	19070	43760	9510	13820		20430	
June,	85340				15050	21330	48960	16050	7820		25090	
July,	91040				16050	22770	52220	10440	9160		32620	
August,	77750				13730	19450	44570	8930	7740		27900	
September,	70400				12430	17590	40380	8070	7020		25290	
October,	67500				11910	16890	38700	7740	6670		24290	
November,												
December,												
Total,	604030				151500	151530	303000	67620	58040		177340	
Acre ft. per acre,												
Per cent Net Supply,					25%	25%	50%	11%	10%		29%	

1 Diversion amount exclusive of waste at head gates for sand sluicing, etc.

2 Reservoirs connected with distributing system only.

3 Diversions plus inflow from reservoirs and other sources less delivery to reservoirs.

4 Do not include power.

a Measured at _____

b Measured at _____

TOTAL P.02

MIDDLE RIO GRANDE CONSERVANCY DISTRICT

1993

MONTHLY WATER DISTRIBUTION

Project All Divisions Area Irrigated 54,610 Year 1993

QUANTITIES IN ACRE-FEET

MONTH	Diverted from Stream 1	Inflow from Reservoirs and other sources	Delivered to Reservoirs 2	Net Supply 3	Main Canal Waste	Main Canal Losses	Delivered to Laterals a	Lateral Waste	Lateral Losses	Non-Irrigation Deliveries 4	DELIVERED TO FARMS b	
											Total	Per Acre
January,	—				—						—	
February,	—				—						—	
March,	43360				21,670	10,860	10,830	2,170	1,730	0	6,930	
April,	73870				36,950	18,460	18,460	3,690	2,960		11,810	
May,	85590				16,280	21,390	47,920	9,590	7,660		30,670	.56
June,	84,350				16,050	21,090	47,210	9,420	7,540		30,250	.55
July,	89,430				17,040	22,350	50,040	10,010	8,020		32,010	.59
August,	78,650				14,980	19,650	44,020	8,810	7,040		28,170	.52
September,	75640				14,400	18,910	42,330	8,470	6,780		27,080	.50
October,	78,160				14,870	19,530	43,760	8,760	7,000		28,000	.52
November,	—				—						—	
December,	—				—						—	
Total,	609050				152,240	152,240	304,570	60,920	48,730	0	194,920	3.59
Acre ft. per acre,									.89			
Per cent Net Supply,												

1 Diversion amount exclusive of waste at head gates for sand sluicing, etc.

2 Reservoirs connected with distributing system only.

3 Diversions plus inflow from reservoirs and other sources less delivery to reservoirs.

4 Do not include power.

a Measured at

b Measured at

MIDDLE RIO GRANDE CONSERVANCY DISTRICT

1992

MONTHLY WATER DISTRIBUTION

Spills
WASTE
20750
+2080
22830

Losses
10380
+2000
12380

22830
+12380
35210

Project All Divisions in Acre Ft. Area Irrigated _____ Year _____

Diverted From St
41500
35210
6290 Total +

QUANTITIES IN ACRE-FEET

MONTH	Diverted from Stream 1	Inflow from Reservoirs and other sources	Delivered to Reservoirs 2	Net Supply 3	Main Canal Waste	Main Canal Losses	Delivered to Laterals a	Lateral Waste	Lateral Losses	Non-Irrigation Deliveries 4	DELIVERED TO FARI	
January,	—											
February,	—											
March,	41500				20750	10380	10370	2080	2000		6290	
April,	77590				38760	19420	19410	3980	3530		11900	
May,	77560				14560	19310 ~~19410~~	43690	8730	8000		26960	
June,	90020				16910	22510	50600	10120	9110		31370	
July,	91210				17180	22800	51230	10230	9090		31910	
August,	76830				14480	19210	43140	8620	7720		26800	
September,	78890				14850	19720	44320	8870	7930		27520	
October,	66290				12430	16570	37290	7480	6900		22910	
November,	—											
December,	—											
Total,	599890				149920	149920 ~~150020~~	300050	60110	54280		185660	
Acre ft. per acre,												
Per cent Net Supply,					25%	25%	50%	10%	9%		31%	

1 Diversion amount exclusive of waste at head gates for sand sluicing, etc.

2 Reservoirs connected with distributing system only.

3 Diversions plus inflow from reservoirs and other sources less delivery to reservoirs.

4 Do not include power.

a Measured at _____

b Measured at _____

TOTAL PART E
OPERATIONAL SPILLS 210030 + TRANS. LOSES 321630 = 531660 − Net Supply 200000 = 68

Del
%