Characterization of Conveyance Losses

In Irrigation Distribution Networks

In the Lower Rio Grande Valley of Texas

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SUMMARY

This report summarizes our current understanding of the distribution networks of irrigation districts located in the Lower Rio Grande Valley (LRGV) of Texas, and the potential water savings from district renovations and changes in on-farm irrigation

The LRGV irrigation districts main distribution networks total 917.3 miles, including 344.1 miles of unlined canals, 350.1 miles of lined canals, 142.8 miles of pipelines, and 74.8 miles of resacas.

Conveyance efficiencies as supplied to us by the districts range from 40 to 95%. It should be noted that most districts do not have good data on sources of water losses that affect efficiency. In addition, questions have been raised on the accuracy of the basic information districts use to determine conveyance efficiency.

Our analysis indicate a potential water savings of **230,000 ac-ft/yr** could result from increasing the conveyance efficiency of districts to 90%. This 90% goal would require significant investment in the districts, but would have the added benefit of solving the "head" problem experienced on about half the irrigated fields (insignificant volume and/or water pressure at the field outlet). Insufficient head prevents good water management, causes low on-farm irrigation efficiency, and can reduce potential crop production and yields.

On-farm practices of metering, gated pipe water delivery, and improved water management and/or technology could result in a water savings of **200,000 ac-ft/yr**. To achieve these on-farm water savings, an intensive technical assistance and education program would be needed. Additional on-farm savings would result from a correction of the head problem as discussed above.

This report also contains a literature review on conveyance losses and the results of seepage loss tests conducted in the LRGV by the DMS (District Management System) project group.

Funding is being sought to continue and expand this research as described in the Appendix.

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BACKGROUND

About 98% of all the water used in the Lower Rio Grande Valley (LRGV), in both Texas and Mexico, is from the Rio Grande River. The region is undergoing rapid population and industrial growth. The Texas Water Development Board (TWDB, 1997) projects that by the year 2050, the population of the LRGV will more than double, and municipal and industrial water demand will increase by 171% and 48%, respectively (Table 1), not including expected increases in Mexico. Agriculture holds about 90% of the U.S. water rights. Water to meet future demand will likely come from agriculture.

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DESCRIPTION OF THE IRRIGATION DISTRICTS

This study examines 28 water districts in Hidalgo, Cameron and Willacy Counties. These districts hold authorized agricultural water rights totaling 1,468,314 ac-ft (Table 2). Based on water rights holdings, the districts vary greatly in size, with the smallest district having 625 ac-ft of water rights and the largest district 174,776 ac-ft.

- The 4 largest districts (Mercedes, Delta Lake, San Benito, and San Juan) account for 44% of the all agricultural water rights.

- The largest 8 districts (adding Harlingen, Donna, Edinburg, and Santa Cruz) account for 69% of the total.

Generally, these districts classify their water distribution networks into two categories: the "mains" and "laterals." Figures 1- 4 and Tables 3-6 detail our understanding of the district boundaries and the irrigation water distribution networks.

- Figure 1 shows the district boundaries and main distribution networks.

- The total miles of the main canals, sizes (based on top width), and lining status are given in Table 3 and shown in Figures 2 and 3.

- The extent of pipelines in the main distribution networks and their diameters and types are given in Table 4 and shown in Figure 4.

- Table 5 details the extent of the main distribution networks which include 666.6 miles of canals, 142.8 miles of pipelines, and 74.8 miles of resacas, a total of 917.3 miles.

Along with the main distribution networks, districts have an extensive network of smaller canals and pipelines which carry water from the mains to individual fields ("laterals").

- Figure 5 shows the entire distribution system, including many of the laterals, for eight irrigation districts. Canals are color-coded by lining material and pipelines by type.

- Table 6 gives the total extent of both mains and laterals for 26 of the districts.

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SEEPAGE AND CONVEYANCE LOSSES

Literature Review

We conducted a review of the scientific literature on canal seepage losses and improvements in district efficiencies from rehabilitation projects. All data found is summarized Tables 7 - 9.

- Table 7 summarizes the seepage loss rates by canal type and lining materials. Included in this table is work by De Maggio (1990) who computed seepage rates in the San Luis unit area of California based on a complete characterization of conveyance facilities in four different districts. Also included is data from Nayak et al. (1996) who studied a main canal in a district located in Orissa, India and reported seepage rates in lined and unlined trapezoidal channels.

• Table 8 contains data from a 1963 Bureau of Reclamation study in Boise, Idaho on seepage rates from canals before and after lining. The results of this study show a marked decrease in canal seepage rates.

• Table 9 gives infiltration losses from field ditches in the Southern High Plains of Texas. The infiltration losses reported this study were calculated as 25% of the permeability range of the soil.

Many studies (see Bramley, 1987; Chohan et al., 1989; El- Shibini et al., 1995; Johnson et al., 1979; Kratz, 1975; U.S. Department of Agriculture, 1991; and Yoo and Busch, 1985) provide general discussions on the relationship between inefficient conveyance systems and high seepage rates, improper calibration of measurement devices leading to errant volume calculation, and canal construction in soils with high infiltration rates. Generally, these publications state the potential for water savings by system improvement, but do not furnish any data on seepage rates before and after improvement.

Most strategies for reducing seepage losses include installing a liner. The lining materials discussed include geotextiles, synthetic membranes, compacted earth, various putties, and concrete. Among the most popular are geotextiles, synthetic membranes, and concrete. The use of liners has met with mixed success. A study conducted by Murray et al. (1995) indicated that, while performance was improved from lining two secondary canals, it was not enough to justify costs. Other studies have indicated that lining does increase system efficiency (Mitchell et al., 1995).

A common theme through these publications is the need for proper selection and installation of lining materials. Researchers attribute the mixed results from lining to differences in installation methods and the basis used for calculating economic benefits. For example, improper installation of a synthetic liner covered with concrete panels can lead to tears in the liner material, resulting in continued canal seepage.

The need for properly calibrated water level and discharge measurement equipment is also discussed in several publications (Khan et al., 1995; Koruda and Cho, 1988; Manz, 1990; Murray et al., 1994; Wehry et al., 1988;). By identifying the hydraulic conditions of canals, the discharge through various control structures could be calculated more accurately; or the need for additional control structures justified (Bramley, 1987; Chohan et al., 1989; Kraatz, 1975; Wehry et al., 1988). Repair or replacement of turn-out structures may be needed to allow for accurate measurement of field deliveries.

Seepage Losses in the Lower Rio Grande Valley

Table 10 gives seepage losses measured in five irrigation districts in South Texas, including the United and San Benito Irrigation Districts, by the Texas Board of Water Engineers (1947). During the summer of 1998, we measured seepage losses in five canals and one pipeline network using the ponding method. This testing was conducted in and with assistance from four districts. The results of the ponding tests are summarized in Table 11. The three lined canals had very high seepage loss rates compared to the scientific literature, indicating problems with their construction or maintenance. The seepage rates of the two unlined canals fell in the ranges reported in the scientific literature (Tables 7&10). The pipeline network measurements took place in the Brownsville Irrigation District and showed very little seepage during the 24 hour test.

Figure 6 shows a general soil map of the region. We created this map with the GIS software *ArcView* from NRCS soil survey maps. Soil types are color coded by possible seepage rates based on soil type (Tables 7&10). Smaller, unlined canals in the more permeable areas are likely to have significant seepage rates. As the laterals of districts are mapped, unlined canals in these areas can be identified for further investigation. However, the Valley is an alluvial region, and soils type can very dramatically over small distances. In addition, actual seepage loss depends on many factors in addition to soil type, including construction techniques, maintenance, distance to the shallow water table, and silt deposits. Thus, canals should be evaluated individually to determine seepage losses and potential benefits from lining or pipeline replacement.

Conveyance Efficiency and Water Duty

The term *conveyance efficiency* (or *water duty*) is a measurement of all the losses in an irrigation distribution system from the river (or diversion point) to the field. Conveyance efficiency is calculated from the total amount of water diverted in order to supply a specific amount of water to a field (6 inches for most districts in the Valley).

Districts express conveyance efficiency in terms of efficiency, the percent of water lost, or amount of water pumped (in feet). For example, District A must pump 8 inches from the river in order to deliver 6 inches to the field. District A's losses can be expressed as a:

- conveyance efficiency of 75%,
- water duty of 25%, or
- water duty of 0.67 ft.

Conveyance loss includes a number of factors besides seepage and evaporation. Table 12 shows our classification system for conveyance losses which is composed of Transportation, Accounting, and Operational losses.

Table 13 lists the conveyance efficiencies as reported to us by 19 districts. The remaining 9 districts did not respond to survey and telephone requests for this information. The highest efficiencies are reported in smaller districts with extensive pipeline systems, while the lowest efficiencies are in larger districts which have undergone little rehabilitation. **It should be noted that most districts do not have good data on their current conveyance efficiencies, and more work is needed to quantify these losses in order to target renovation programs.**

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POTENTIAL WATER SAVINGS FROM DISTRICT IMPROVEMENTS

Here, the potential water savings is calculated as the difference between the existing conveyance efficiencies and the efficiencies that which could reasonably be achieved through renovation projects. Here, we assumed that a conveyance efficiency of 90% is obtainable for all districts.

Starting with our best estimate of the current conveyance efficiency of the districts (Table 14), we calculated the potential water savings if all districts were brought up to 90% conveyance efficiency. **The**

total average water savings from conveyance efficiency improvement for all districts is 230,000 ac-ft/yr. This estimate is based on assuming an average annual diversion of 985,000 ac-ft/yr. This diversion rate corresponds to the actual agricultural diversions for the years 1989, 1990, 1991, 1993 and 1994, and represent the 5 highest annual diversions during the period of 1986-1998.

Uncertainties in Estimate

There is some question about the accuracy of the basic information that districts use to estimate conveyance efficiency, particularly:

- the amount of water pumped or diverted into the system, and
- the actual amount of water delivered to the field.

The doppler flow meters currently used at many river pumping plants were "calibrated" for each site based on estimates of pumping rate, pumping plant capacity, or engine/motor and pump performance. Due to the physical layout of the pumping plants, it is difficult to independently verify these rates. Likewise, little metering is done at the field turn-out, and the amount delivered is also an estimate in most districts.

ON-FARM POTENTIAL WATER SAVINGS

On-farm irrigation efficiency is defined as the ratio of the amount of water beneficially used by a crop to the amount of water supplied to a field by irrigation and rainfall. These numbers are adjusted for effective rainfall and leaching requirements. Generally, surface irrigation systems, such as found in the Lower Rio Grande Valley, have low efficiencies, and typically range from 60 to 70%. Various practices and field improvements can increase this efficiency to 70 - 80%, or even higher with good management and improved technology.

Table 15 provides the observed water savings reported in 6 districts from recent experiments with layflat tubbing replacement of siphon tubes and on-farm metering. In some cases, surge flow irrigation and improved water management practices were also implemented. The numbers reported for Donna and La Feria are for metering only.

These observations and supporting information show that significant water savings at the farm level is possible in the Lower Rio Grande Valley. However, one major limiting factor is that in about half of the area, water is delivered to the field with inadequate "head" (insufficient volume and/or pressure) to allow for efficient furrow irrigation. Without improvements in the distribution systems, on-farm water saving potential in about half the irrigated land will be limited.

For this analysis, we classified potential on-farm water savings into three components:

- metering
- gated pipe replacement of field ditches and siphon tubes, and
- high water management and/or improved irrigation technology.

Table 16 gives the expected range of water savings for each practice and the factor used in this analysis. Table 17 summarizes the assumptions used in applying these factors to this region. For example, the first two factors (metering and gated pipe) were not applied to the area currently under the practice. In addition, benefits from high water management were not applied to the half of the area with head problems. Increased on-farm efficiency can only be achieved in these areas by improvements in the distribution systems and/or adoption of pumped and pressurized irrigation systems such as drip and sprinkler irrigation.

We estimate **a potential on-farm water savings of 200,000 ac-ft/yr.** However, an intensive technical assistance and education program would be needed to achieve such savings.

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Table 1. Population and water demand projections in the Lower Rio Grande Region1 of Texas. Water demand is expressed in acre-feet per year.

Category	1990	2010	2030	2050	Change 1990-2050
Population	919,505	1,598,851	2,403,624	3,020,871	228.5%
Municipal Water Use	187,839	312,439	415,970	508,814	170.9%
Industrial Water Use	11,036	13,132	15,047	16,355	48.2%
Irrigation Water Use	1,358,284	1,354,031	1,254,706	1,162,737	-14.3%
Irrigation Adjustment	0	(188,366)	(194,992)	(208,040)	-29.8%
Total Water Use	1,557,159	1,491,236	1,490,731	1,479,866	-4.9%

1 Cameron, Hidalgo, Maverick, Starr, Val Verde, Webb, Willacy.
2 Irrigation water use adjustment reflects estimated levels of ground water availability.
Source: Water for Texas, Texas Water Development Board, August 1997

Table 2. The official and common names of 28 irrigation and water supply districts in the Hidalgo, Cameron and Willacy Counties and their authorized agricultural water rights.

Official Name	Common Name	Authorized Water Right (ac-ft)
Adams Gardens Irrigation District No. 19	Adams Garden	18,737
Bayview Irrigation District No. 11	Bayview	17,978
Brownsville Irrigation and Drainage District No. 5	Brownsville	34,876
Cameron County Irrigation District No. 3	La Feria	75,626
Cameron County Irrigation District No. 4	Santa Maria	10,182

Cameron County Irrigation District No. 6	Los Fresnos	52,142
Cameron County Water Improvement District No. 10	Rutherford-Harding	10,213
Cameron County Water Improvement District No. 16	Cameron #16	3,913
Cameron County Water Improvement District No. 17	Cameron #17	625
Cameron County Water Improvement District No. 2	San Benito	151,941
Delta Lake Irrigation District	Delta Lake	174,776
Donna Irrigation District Hidalgo County No. 1	Donna	94,063
Engleman Irrigation District	Engleman Gardens	20,031
Harlingen Irrigation District No. 1	Harlingen	98,233
Hidalgo and Cameron Counties Irrigation District No. 9	Mercedes	177,151
Hidalgo County Improvement District No. 19	Sharyland Plantation	11,777
Hidalgo County Irrigation District No. 1	Edinburg	85,615
Hidalgo County Irrigation District No. 2	San Juan	147,675
Hidalgo County Water Irrigation District No. 3	McAllen #3	9,752
Hidalgo County Irrigation District No. 5	Progresso	14,234
Hidalgo County Irrigation District No. 6	Mission #6	42,545
Hidalgo County Irrigation District No. 16	Mission #16	30,749
Hidalgo County Irrigation District No. 13	Baptist Seminary	4,856
Hidalgo County Water Control and Irrigation District No. 18	Monte Grande	5,505
Hidalgo County Municipal Utility District No. 1	MUD	1,120
Santa Cruz Irrigation District No. 15	Santa Cruz	82,008
United Irrigation District of Hidalgo County	United	69,491
Valley Acres Water District	Valley Acres	22,500
		TOTAL 1,468,314

Table 3. Canal sizes and lining status of the main irrigation water distribution networks.		
Top Width (feet)	**Canal Type (miles)**	
	concrete	**earth**
<10	51.56	2.42
10 - 20	138.60	10.30
20 - 30	28.24	59.53
30 - 40	11.10	45.40
40 - 50	0	79.31
50 - 75	2.51	49.63
75 - 100	0.19	0.98
>100	0	21.38
Unknown Widths	118.53	75.13
Total Miles	350.72	344.07

Table 4. Types and extent of pipelines in the main distribution networks listed by joint material.									
		Flexible Joints		**Mortar Joint**	**Unknown Joints**				
Dia. In.	**Total**	**PVC**	**Reinforced Concrete**	**Concrete**	**PVC**	**Steel**	**Concrete**	**unknown**	**Not in Service**
<10	0	0	0	0	0	0	0	0	0
10 - 20	125.05	5.05	11.98	88.32	5.09	0.06	12.22	0.29	2.05
20 - 30	89018	0.86	20	37.2	0	0	30.22	0	0.9
30 - 40	57.44	0	20.4	18.97	0	0	18.08	0	0
40 - 50	23.13	0	10.48	7.56	0	0	5.09	0	0
50 - 75	14.42	0	3.73	4.34	0	0	6.35	0	0
75 - 100	0	0	0	0	0	0	0	0	0
>100	0	0	0	0	0	0	0	0	0
Unknown	654.97	0	0	0	0.28	0	654.69	0	0
Total	964.19	5.91	66.59	156.39	5.38	0.06	726.65	0.29	2.95

Table 5. Miles of canals, pipelines and resacas for the main irrigation water distribution networks.				
canals	**pipelines**	**resacas**	**unknown**	**total**
699.63	142.79	74.77	0.12	917.30

Table 6. Extent of the entire distribution networks of 23 districts based on survey responses.					
	Canals			Pipelines	Resacas
District	Total	Lined	Unlined		
Adams Garden	23.0	15.0	8.0	30.0	0.0
Bayview	16.0	7.0	9.0	76.0	14.0
Brownsville	2.0	0.0	2.0	190.0	0.0
CCID2	204.8	1.2	203.5	34.7	4.0
CCID16	3.5	0.0	3.5	0.0	1.0
Los Fresnos	37.2	25.0	12.2	25.0	10.0
Delta Lake	292.0	250.0	42.0	146.0	0.0
Donna	32.2	28.3	4.0	0.0	0.0
Engleman	0.0	0.0	0.0	23.5	0.0
Harlingen	74.0	28.0	46.0	155.0	0.0
Edinburg	107.2	86.5	20.8	92.0	0.0
HCID2	71.0	24.3	46.7	230.8	0.0
HCWID3	17.0	12.0	5.0	21.5	0.0
HCID5	0.5	0.0	0.5	78.0	0.0
HCID6	81.5	80.0	1.5	95.0	0.0
Mercedes	75.0	55.0	20.0	250.0	0.0
HCID13	0.0	0.0	0.0	3.5	0.0
HCID16	26.0	26.0	0.0	59.8	0.0
HCWCID19	5.5	2.0	3.5	10.0	0.0
La Feria	43.6	22.3	21.3	120.0	0.0
Santa Maria	3.0	0.0	3.0	14.0	0.0
United ID	28.5	18.5	10.0	45.0	0.0
Valley Acres	6.0	4.0	2.0	25.0	0.0
CCWID10	2.9	0.0	2.9	1.6	1.9
Santa Cruz	38.7	37.6	1.2	154.9	0.0

Table 7. Canal seepage rates reported in published studies.	
Lining/soil type	**Seepage rate (gal/ft^2/d)**
Unlined 1	2.21-26.4
Portland cement 2	0.52
Compacted earth 2	0.52

Brick masonry lined [3]	2.23
Earthen unlined [3]	11.34
Concrete [4]	0.74 – 4.0
Plastic [5]	0.08 – 3.74
Concrete [5]	0.06 – 3.22
Gunite [5]	0.06 – 0.94
Compacted earth [5]	0.07 – 0.6
Clay [5]	0.37 – 2.99
Loam [5]	4.49 – 7.48
Sand [5]	4.0 – 19.45

[1] DeMaggio (1990).
[2] U.S. Bureau of Reclamation (1963).
[3] Nayak, et al. (1996).
[4] Nofziger (1979).

Table 8. Seepage losses on two canal reaches before and after lining in Boise, Idaho [1]

	Unimproved (gal/ft^2/d)	**Improved [1] (gal/ft^2/d)**
Reach 1	20.42	0.22
Reach 2	4.03	0.15

[1] asphaltic prefabricated liners with fiber reinforcement
Source: U.S. Bureau of Reclamation (1963).

Table 9. Seasonal Infiltration losses from field ditches [1].

Soil Series	**Losses (gal/ft^2/day)**
Amarillo fine sandy loam	15.9
Amarillo loamy fine sand	18.7
Amarillo loam	11.2
Acuff Loam	14.6
Brownfield Fine Sand	28.1

Estacado Clay Loam	14.6
Mansker Loam	18.7
Mansker Fine Sandy Loam	28.1
Olton Loam	9.4
Portales Loam	18.7
Portales Fine Sandy Loam	28.1
Portales Loamy Fine Sand	37.4
Potter caliche soils	18.7
Pullman Clay loam	5.2
Pullman clay	3.0
Tivoli Fine Sand	86.0

1 Calculations based on infiltration rate, which was calculated as 25% of the published soil permeability range for each soil type.
Source: High Plains Underground Water Conservation District No. 1., 1999

Table 10. Canal seepage rates reported for the Lower Rio Grande Valley.

Soil Type	**Seepage Loss Rate (gal/ft^2/day)**
clay	1.5
silty clay loam	2.24
clay loam	2.99
silt loam earth	4.49
loam	7.48
fine sandy loam	9.35
sandy loam	11.22

Source: Texas Board of Water Engineers. 1946. Seepage Losses from Canals in Texas, Austin. July 1.

Table 11. Seepage rates measured by the DMS Team in 5 irrigation canal segments in the Lower Rio Grande Valley.

					Total

Test #	Canal Type	Top Width (ft)	Length (ft)	Seepage Rate (gal/ft^2/day)	Loss in Canal (ac-ft/mile)	
					per day	per year*
1	concrete	19	2557	4.28	0.81	243
2	earth (clay)	38	3342	1.62	0.82	246
3	earth (sandy clay loam)	45	6336	1.69	1.05	315
4	concrete	12	2583	2.12	0.20	60
5	concrete	12.5	9525	2.49	0.25	75

*based on 300 days per year.

Table 12. Classification of the sources of water loss in irrigation districts.

Transportation	Accounting	Operation
seepage in main, unlined canals	accuracy of field-level deliveries (estimates of canal riders/irrigators)	charging empty pipelines and canals
seepage in secondary territory unlined canals (laterals)	unauthorized use	spills (end of canals)
leakage from lined canals	metering at main pumping plant	partial use of water in dead-end lines
leakage from pipelines	water rights accounting system	
evaporation (canals and storage reservoirs)		

Table 13. Estimated conveyance efficiency as supplied by 19 districts.

District	Conveyance Efficiency (%)
Adams Garden	85
Bayview	85
Brownsville	90
CCID2 (San Benito)	40

CCID6 (Los Fresnos)	60
Delta Lake	75
Donna	58
Harlingen	85
HCID1 (Edinburg)	80
HCID2 (San Juan)	77
HCMUD	90
HCWID3 (McAllen)	90
HCWID5 (Progreso)	92
HCCID9 (Mercedes)	75
HCID16 (Mission)	85
HCWCID18	95
La Feria	75
Santa Cruz	75
Santa Maria	75

Table 14. Conveyance efficiencies of irrigation districts used for calculating water saving potential.

District	**Conveyance Efficiency (%)**
Adams Garden	80
Bayview	70
Brownsville	90
CCID2 (San Benito)	40
CCID6 (Los Fresnos)	60
CCID16	70
Delta Lake	70
Donna	58
Engleman	70
Harlingen	75
HCID1 (Edinburg)	70
HCID2 (San Juan)	70
HCMUD	90
HCWID3 (McAllen)	90
HCID5	92
HCID6	70

HCID9	70
HCID13	70
HCID16 (Mission)	80
HCWCID18	95
HCID19	70
La Feria	65
Santa Cruz	65
Santa Maria	65
Russel Plantation	70
United	70

Table 15. LRGV water savings observed or estimated from metering, poly pipe, and surge irrigation experiments during the 1990s.

district	**water savings observed**
Bayview	36% [1]
Brownsville	33% [1]
Donna	20% [2]
La Feria	10% [2]
Delta Lakes	33% [1]
San Benito	40% [1]

[1] may include additional benefits from implementing improved on-farm water management practices or due to changes in irrigation technology
[2] metering only

Table 16. Factors used for calculation of on-farm water saving potential.

technique	**expected water savings**	**factor used**
metering	0 - 15%	10%
poly/gated pipe replacement of field ditches/siphon tubes	5 - 20%	10%
high management/improved irrigation technology	10 - 30%	20%

Table 17. Assumptions for applying water savings factors in Table 16 to determine on-farm potential for irrigation districts.

technique	**assumptions for calculations**
metering	• 20% of land area is assumed to be metering • factor applied to remaining 80%
poly/gated pipe	• adopted in 90% of region • approximately 50% of region already using gated/poly pipe • factor applied to remaining 40% of Valley not currently using poly/gated pipe (0.9 - 0.5 = 0.4)
high management/improved irrigation technology	• adopted on 50% of region • approximately 20% of area currently under high management or using improved technologies • factor applied to 30% of area (0.5 - 0.2 = 0.3)

Figure 1 - The 28 irrigation districts and their main irrigation water distribution networks
in the Lower Rio Grande Valley.

Figure 2 - Main canals and lining status.

Figure 3 - Main canals color-coded by canal top widths.

Figure 4 - Main pipelines color-coded by pipe diameters.

Figure 5 - Water distribution networks of 8 districts including mains and laterals.

Figure 6 - Potential seepage loss rates of unlined canals based on soil type.

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The DMS (district management system) team under the direction of Dr. Guy Fipps:

Craig Pope, Extension Assistant
Eric Leigh, Research Assistant
Stewart Beall, Research Agricultural Technician
Kenneth Carpenter, Research Agricultural Technician
Rahul Verma, Research Assistant (former)
Dr. Jalal Basahi, Research Associate (former)
Kyle Chelik, Student Technician (former).
Shad McDainel, Student Technician (former)

Irrigation District Managers:

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APPENDIX: PROJECT PROPOSAL

Development of a District Assessment Tool For Rapid Determination of the Water Saving Potential in Irrigation Districts of the Lower Rio Grande Valley

OBJECTIVE:

Complete a District Assessment Tool (DAT) for quickly identifying the sources of water losses and potential savings in order to prioritize rehabilitation projects and detailed engineering analysis.

WORK PLAN:

- Complete GIS-mapping of irrigation distribution systems, including the laterals. Where necessary, digitize and geo-reference existing maps. Assemble as much information on distribution attributes as possible.

- Using various District Management System tools, extrapolate attributes data from known segments to other segments.

- Refine the Regional Soil Series map for localized variations in canal construction earthen material.

- Conduct pounding studies on representative segments and collect additional soil samples and hydrological data needed to accurately determine seepage rates. Use the District Management System to calculate directly seepage losses in distribution network.

- Working with districts, determine the ranges of other components of conveyance lost (transportation, accounting, operational) such as monitoring spell recovery, targeted deliveries, etc.

- Analyze past rehab projects to document any district-wide water savings.

- Conduct a detailed analysis of existing metering data.

- Review estimates on current technologies, field sizes, and adequacy of water deliveries for the irrigation districts.

- Determine the extent of water delivery problems and refine estimates of existing usage of improve irrigation methods.

- Adjust factors used to determine potential savings as necessary.

- Document benefits of existing on-farm metering, pricing and incentive programs by reviewing district records.

OUTLINE OF MAJOR TASKS

A. Complete GIS maps of districts including:

mains
laterals - canals and pipelines
drain canals
canals no longer in use.

Obtain existing maps of districts, digitize and geo-reference or redraw using DOQQ as a base.

B. Obtain attributes of distribution systems (sizes and materials). Develop a Condition Rating Procedure to classify the condition of all segments. In cooperation with district personnel, conduct field reconnaissance to obtain attribute data and rate the condition of segments.

C. Refine exiting general soil map and expand to include remainder of region. Conduct field reconnaissance to verify canal construction material in relation to surrounding soils.

D. Conduct seepage loss measurements in representative canal and pipeline segments though ponding tests. Contract earth moving equipment/crews for sealing off canal sections for tests. Extrapolate results from tested segments to similar segments

E. Quantify losses in distribution system through valves, gates and spills though direct monitoring and metering.

F. Conduct an analysis of losses through distribution system management.

G. Select and work with representative districts to complete mapping of water accounts and tie-in with district databases. Use district records to determine water balance as a check on reported water duty. Analyze potential water saving through conversions to alternate technologies based on actual field sizes and practices. Extrapolate results to other districts.

PERSONNEL REQUIREMENTS

(1) Field Team: 2 agricultural research technicians (1 full-time, 1 half-time), 1 GIS Specialist, headquartered at the Texas A&M Center in Weslaco.

(2) 2 GIS Specialists (1 full-time, 1 half-time), headquartered at Texas A&M.

FUNDING REQUIREMENTS

$200,000

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