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TR-324
2008

Ponding Test Results
Seepage and Total Losses,
North Alamo Main Canal
Hidalgo County Irrigation District No. 2

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February 4, 2004

Texas Water Resources Institute
make every drop count

PONDING TEST RESULTS

SEEPAGE AND TOTAL LOSSES

NORTH ALAMO MAIN CANAL

HIDALGO COUNTY IRRIGATION DISTRICT NO. 2

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February 4, 2004

IRRIGATION TECHNOLOGY CENTER
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SUMMARY

This report summarizes the results of ponding tests conducted in Hidalgo County Irrigation District No. 2 (HCID2) to measure losses in three segments of the North Alamo Main Canal. The ponding tests took place during November 20-22, 2003.

The North Alamo Main is a concrete-lined canal located centrally within the district and varies from 4.3 to 5.8 feet deep in the testing area.. The main canal begins just south of Moore Road and running north ending at Minnesota Road (see Fig. 2). Test segments were located as follows:

- test segment SJ9 was located between Earling Road and Minnesota Road
- test segments SJ10 and SJ11 were adjacent to each other, located between Sioux Road and Eldora Road

Test results are summarized in Table 1. The seepage loss of test segment SJ10 was 0.57 gal/ft^2/day. Test segments SJ9 and SJ11 had valves which may have contributed to the total loss rates of 2.05 and 0.55 gal/ft^2/day, respectively. Table 2 lists the loss rates in terms of water level change.

Table 1. Summary of ponding test results of the North Alamo Main Canal.

Test ID	District's canal ID number	Soil*	Average width (ft)	Length (ft)	Test Type	Loss rate Gal/ft^2/day	Total Loss in Canal (ac-ft/mile) per day	per year
SJ9	AL 13 AL 14	Sandy clay loam	15.3	2426	total**	2.05	0.58	211.0
SJ10	AL 11	Sandy clay loam	16.0	880	seepage	0.57	0.17	61.0
SJ11	AL 10	Sandy clay loam	16.2	2345	total**	0.55	0.16	59.0

* Soil type of the surrounding area from the Soil Survey for Hidalgo County (USDA 1978)
** values located within the test segment may have contributed to losses

Table 2. Test results for the North Alamo Main Canal in terms of change in water level.

Test ID	ft/hr	ft/day	in/hr	in/day
SJ9	0.015	0.351	0.18	4.20
SJ10	0.004	0.098	0.05	1.18
SJ11	0.004	0.092	0.05	1.10

Figure 1. Photograph of test segment SJ9 of the North Alamo Main Canal.

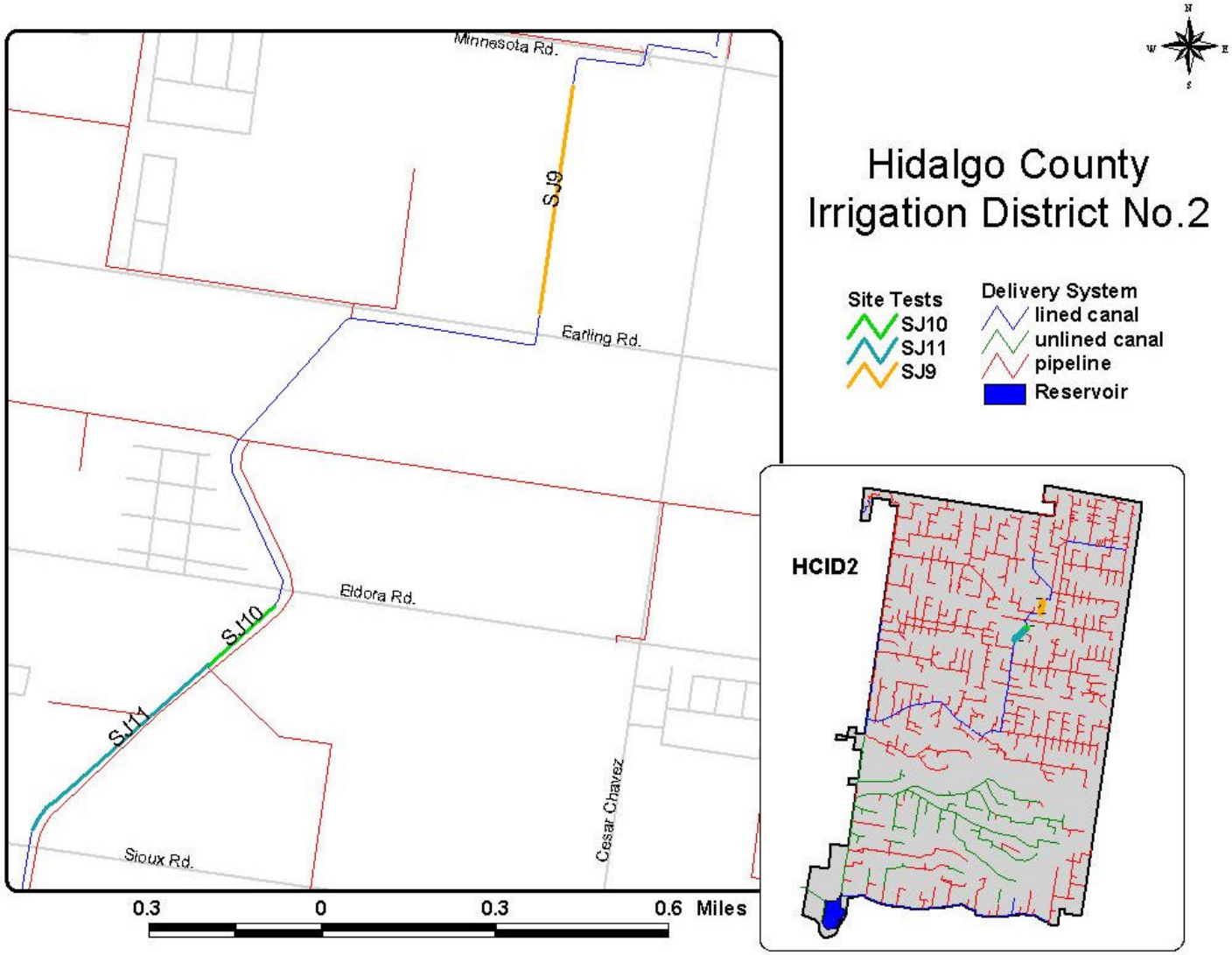

Figure 2. District Map and locations of test segments.

MATERIALS AND METHODS

Canal loss rates were measured using the ponding method. In this method, the two ends of a canal segment are closed or sealed with earthen dams as shown in Figures 3 and 4. Once sealed, water elevations are taken for approximately 48 hours. Due to vandalism (Fig. 5), tests SJ10 and SJ11 were terminated after 43 hours. Two to three staff gauges (Fig. 6) were placed in each test segment, and stage levels were recorded manually. Canal dimensions and water spans were also surveyed during the test.

TEST RESULTS

Test segment SJ10 did not contain valves or gates within the canal; thus, the *seepage rate* was measured. Test segments SJ9 and SJ11 contain several turnout valves which may have leaked during the test; thus, we classify these as *total loss* tests.

Tables 3-5 provide details on the test segments; data collected and recorded changes in water depths during the test. The canal cross-sections for each of the staff gauges are illustrated in Figures 7-9 for test SJ9, Figures 10-11 for test SJ10, and Figures 12-13 for test SJ11. Also shown on these charts are the water depths at the beginning of the test.

Figure 3. Photograph of district's backhoe constructing earthen dam for ponding tests.

Figure 4. Close up photograph of earthen dam use to seal test segment.

Figure 5. Photograph of damage to the dam between segments SJ10 and SJ11 that caused early termination of test.

Figure 6. Free standing staff gauge stand use in recording water levels.

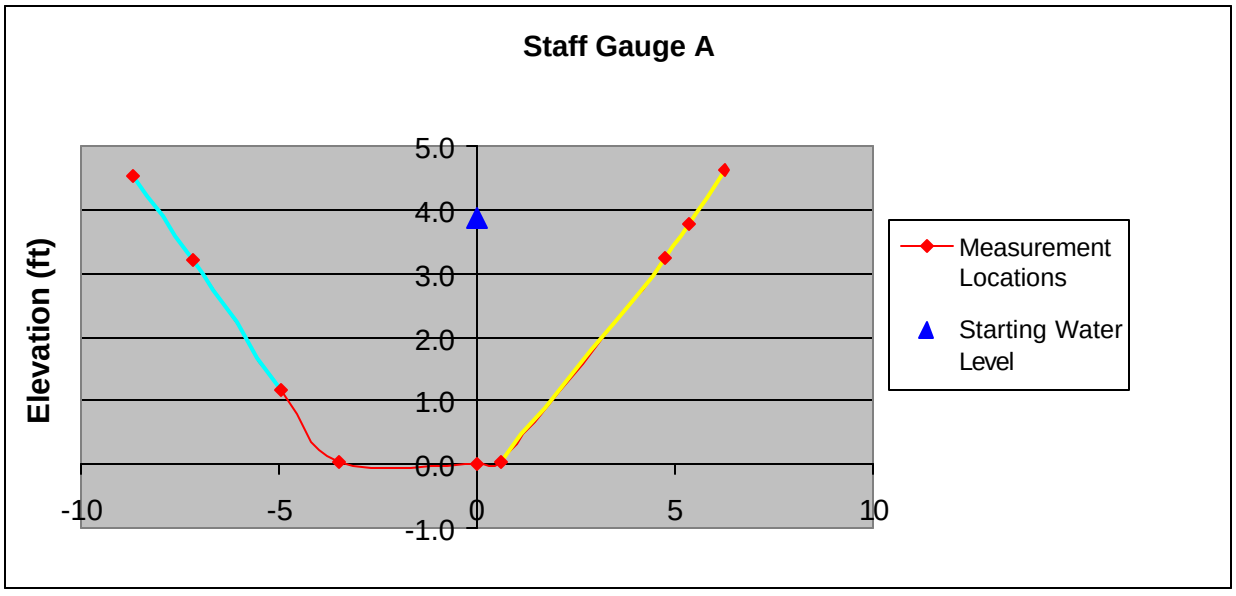

Figure 7. Cross-section at Staff Gauge A, SJ9.

Table 3. Data for Test SJ9: North Alamo Main Canal, segments AL13 & AL14.

District: Hidalgo County Irrigation District No. 2	**Test ID:** SJ9
Canal: North Alamo Main Canal	**Lining Type:** Lined
Starting Water Span Widths: **A:** 13.39 feet, **B:** 14.81 feet, **C:** 15.08 feet	**Date:** Nov 20-22, 2003
Test Segment Length: 2426 feet	**Start Time:** 11:18 am **Finish Time:** 11:23 am
Test Starting Depths: A: 3.87 feet, **B:** 4.10 feet, **C:** 4.25 feet	
Location: Between Earling Rd and Minnesota Rd, west of N. Cesar Chavez Rd.	

Staff Gage Readings

Date	**A**		**B**		**C**	
	Time	**Feet**	**Time**	**Feet**	**Time**	**Feet**
Nov 20	**11:18**	**5.61**	**11:20**	**5.72**	**11:24**	**5.92**
	12:19	**5.57**	**12:21**	**5.68**	**12:24**	**5.88**
	13:38	**5.54**	**13:40**	**5.66**	**13:41**	**5.86**
	16:50	**5.48**	**16:47**	**5.59**	**16:45**	**5.80**
Nov 21	**10:26**	**5.20**	**10:03**	**5.30**	**10:00**	**5.52**
	13:14	**5.16**	**13:18**	**5.26**	**13:20**	**5.46**
	14:46	**5.14**	**14:43**	**5.26**	**14:43**	**5.46**
Nov 22	**11:23**	**4.91**	**11:20**	**5.02**	**11:17**	**5.22**
True depth adjustment factor (ft)		**-1.74**		**-1.58**		**-1.63**

Figure 8. Cross-section at Staff Gauge B, SJ9.

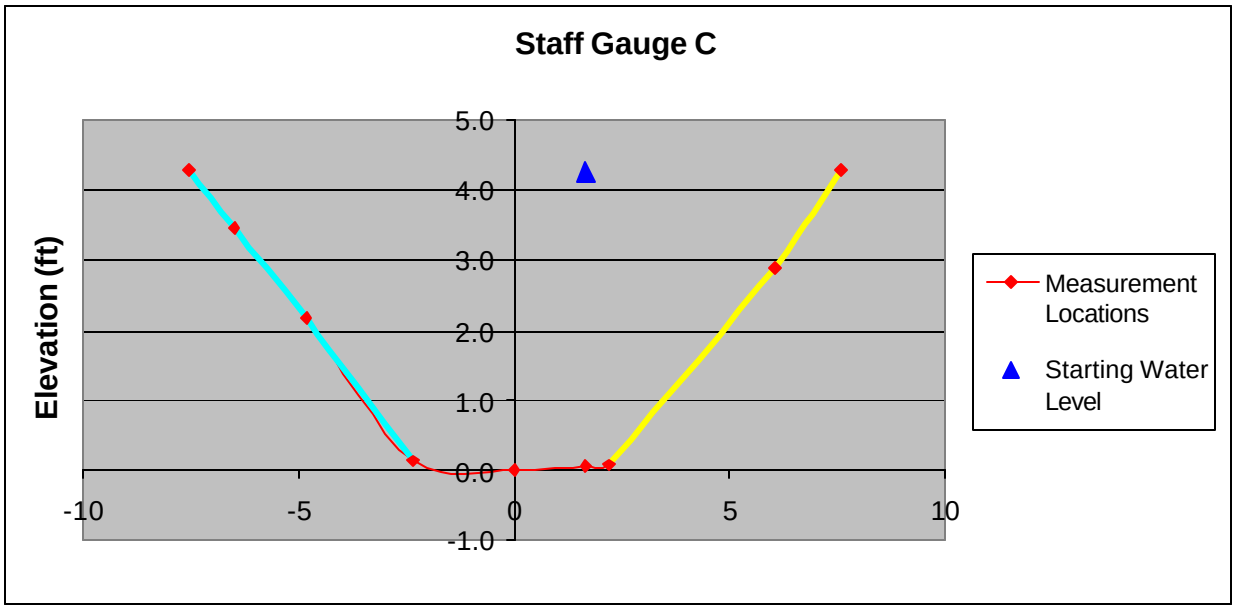

Figure 9. Cross-section at Staff Gauge C, SJ9.

Table 4. Data for Test SJ10: North Alamo Main Canal.

District: Hidalgo County Irrigation District No. 2	**Test ID:** SJ10
Canal: North Alamo Main Canal	**Lining Type:** Lined
Starting Water Span Widths: **A:** 13.41 feet, **B:** 15.11 feet	**Date:** Nov 20-22, 2003
Test Segment Length: 880 feet	**Start Time:** 16:41 am **Finish Time:** 11:34 am
Test Starting Depths: A: 4.78 feet, **B:** 4.93 feet	
Location: South of El Dora Rd to next check structure, west of N. Cesar Chavez Rd.	

Staff Gage Readings

Date	A		B	
	Time	**Feet**	**Time**	**Feet**
Nov 20	**16:41**	**2.56**	**16:43**	**3.09**
	17:40	**2.55**	**17:43**	**3.08**
Nov 21	**10:34**	**2.46**	**10:33**	**3.00**
	13:03	**2.46**	**13:05**	**2.98**
	14:51	**2.44**	**14:50**	**2.96**
Nov 22	**11:34**	**2.38**	**11:31**	**2.92**
True depth adjustment factor (ft)		**2.232**		**1.836**

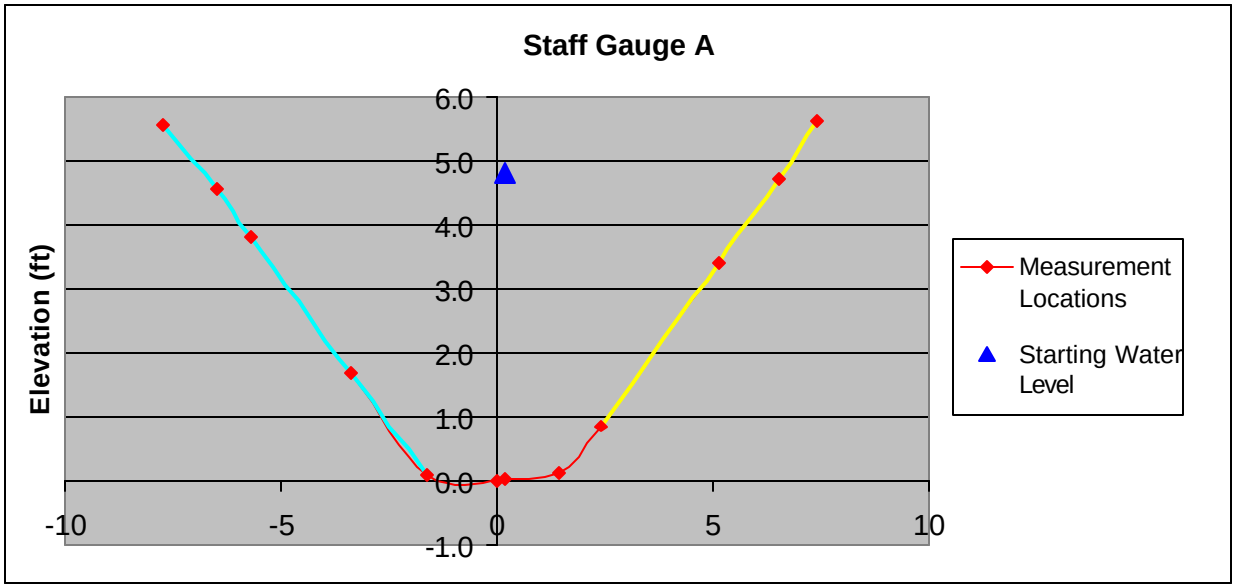

Figure 10. Cross-section of Staff Gauge A, SJ10.

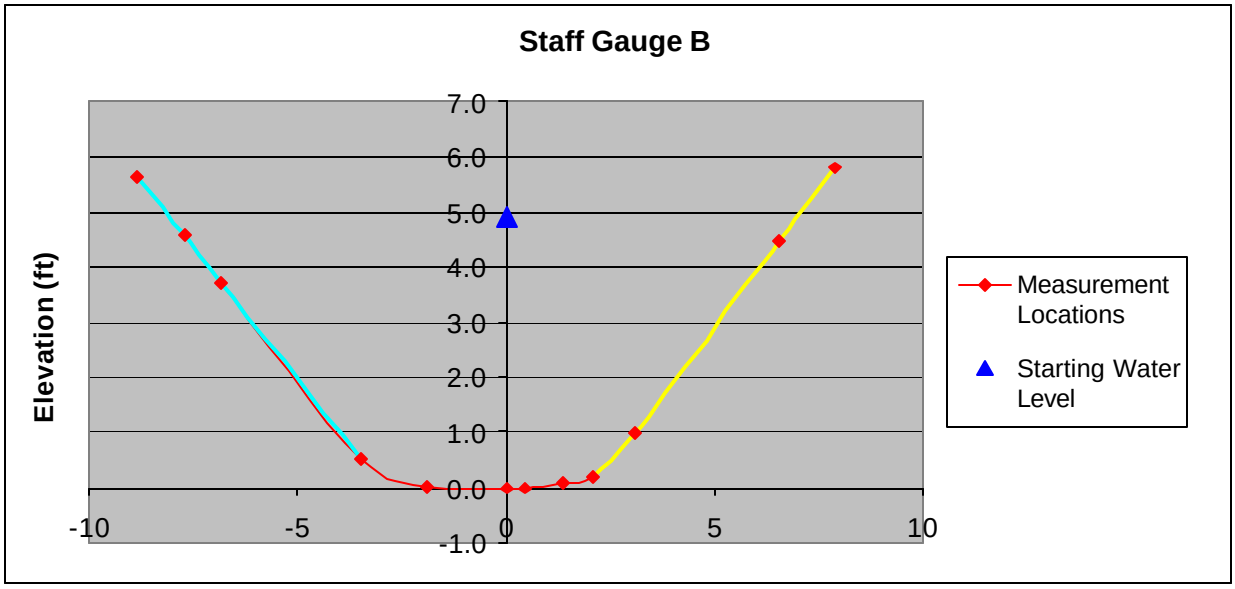

Figure 11. Cross-section for Staff Gauge B, SJ10.

Table 5. Data for Test SJ11: North Alamo Main Canal.

District: Hidalgo County Irrigation District No. 2	**Test ID:** SJ11
Canal: North Alamo Main Canal	**Lining Type:** Lined
Starting Water Span Widths: **A:** feet, **B:** feet	**Date:** Nov 20-22, 2003
Test Segment Length: 2345 feet	**Start Time:** am **Finish Time:** am
Test Starting Depths: A: feet, **B:** feet	
Location: North of Sioux Rd to next check structure, west of N. Cesar Chavez Rd.	

Staff Gage Readings

Date	**A**		**B**	
	Time	**Feet**	**Time**	**Feet**
Nov 20	**16:33**	**3.05**	**16:24**	**5.66**
	17:39	**3.05**	**17:24**	**5.66**
Nov 21	**10:39**	**2.98**	**10:36**	**5.58**
	12:57	**2.96**	**13:00**	**5.56**
	14:37	**2.96**	**14:35**	**5.56**
Nov 22	**11:39**	**2.89**	**11:35**	**5.49**
True depth adjustment factor (ft)		**1.412**		**-1.184**

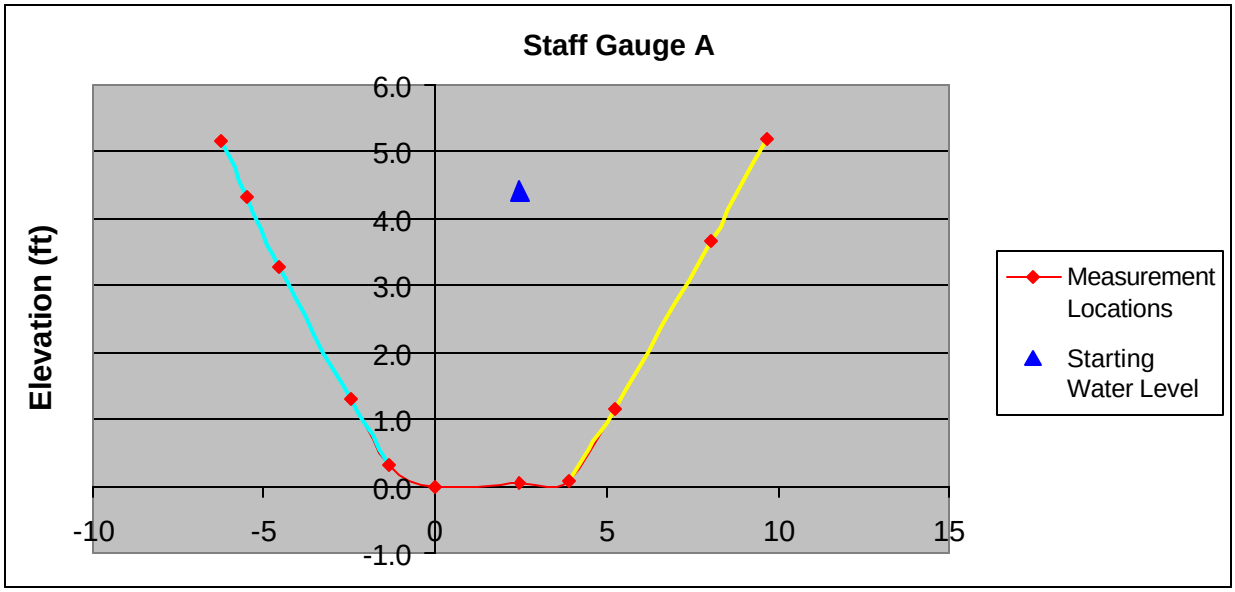

Figure 12. Cross-section for Staff Gauge A, SJ11.

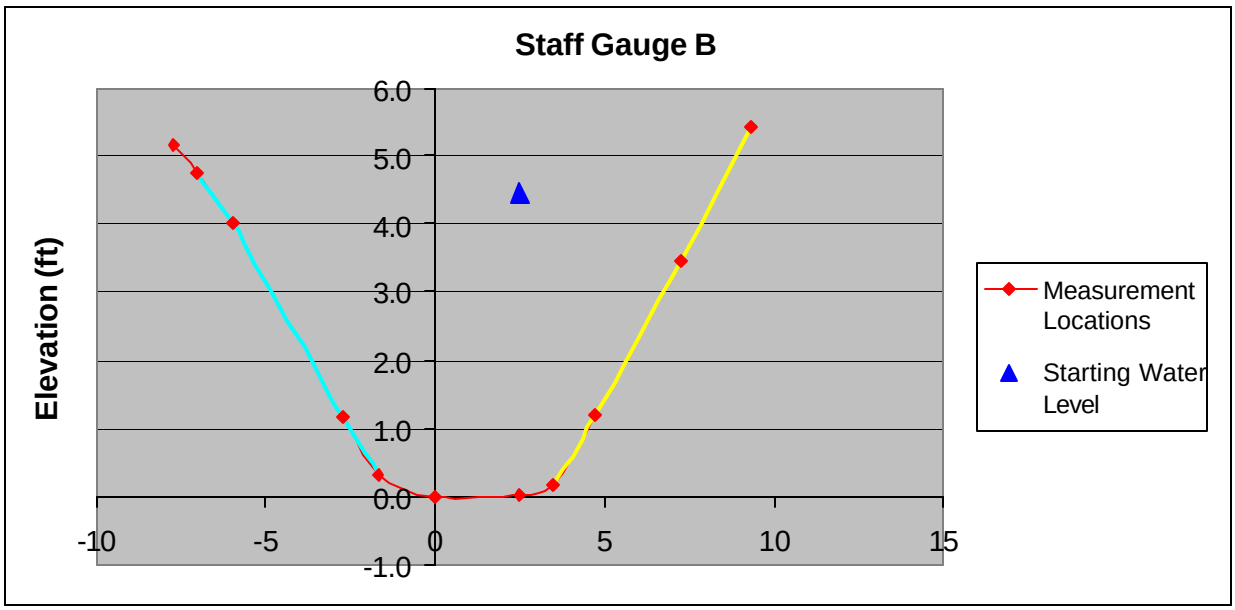

Figure 13. Cross-section for Staff Gauge B, SJ11.

SOIL DESCRIPTIONS

General Soil Series

1 – Hidalgo: Deep, moderately permeable soils that typically have dark grayish brown sandy clay loam surface layer (source: Soil Survey of Hidalgo County, Texas USDA, 1978).

Detailed Soil Units

Table 6. Soil Series Key Codes and Permeability Ranges.

Soil Unit	Permeability (in/hr)
52 - Raymondville clay loam	0.06 – 0.6
28 – Hidalgo sandy clay loam	0.6 – 2.0

OTHER TEST RESULTS

Texas Cooperative Extension has conducted approximately 50 total loss tests and seepage loss tests in the Lower Rio Grande River Basin since 1998. The results are summarized in Tables 7 – 9. Table 10 gives seepage rates versus lining type as reported in the scientific literature.

Table 7. Results of seepage loss tests conducted by Texas Cooperative Extension in the Lower Rio Grande River Basin.

Test ID	Year	Canal Width (ft)	Canal Depth (ft)	Class	Loss Rate	
					gal/ft2/day	ac-ft/mi/yr
Lined						
16HC2	03			M		
LF1	03	12	5	M	1.77	152.9
LF2	03	10	6	M	4.61	369.1
MA4	03	12	5	S	8.85	529.7
SJ4	00	15	4	M	1.17	111.2
SJ5	02	14	5	M	1.38	145.5
UN1	01	12	6	M	2.32	217.7
UN2	01	8	3	M	2.09	121.2
Unlined						
BR1	03	60	11	M	3.14	794.6
MA3	03	19	5	S	13.9	1690.1
RV1	03	38	4	M	0.15	23.0
SB4	02	16	4	S	0.64	68.3
SB5	02	18	3	S	1.67	188.3
SB6	02	20	5	S	1.44	189.0
SB7	02	16	4	S	0.42	47.4
SB8	02	20	5	S	0.83	104.0

Classification of canal: M = main, S = secondary

Table 8. Results of total loss tests in lined canals (leaking gates and valves may have contributed to measured loss rates) conducted by Texas Cooperative Extension in the Lower Rio Grande River Basin.

Test ID	Year	Canal Width (ft)	Canal Depth (ft)	Class	Loss Rate	
					gal/ft2/day	ac-ft/mi/yr
Lined						
16HC1	03	14	5	M	1.89	192.4
BV1	99	10	5	M	7.97	510.5
BV2	99	9	4	M	8.53	451.5
DL1	00	20	6	M	0.16	18.8
DL2	00	7	4	S	4.12	236.2
DO1	03	5	3	S	1.68	65.2
DO2	03	6	4	S	2.18	121.5
DO3	03	6	3	S	2.71	107.2
ED1	00	6	4	S	34.32	1519.6
ED2	00	6	4	S	21.5	858.2
ED3	00	3	2	T	10.22	308.2
ED4	00	4	3	S	18.72	567.7
ED6	99	9	4	M	8.53	451.5
HA2	00	10	4	M	2.26	135.2
HA3	98	15	2	S	0.64	45.5
ME1	98	38	7	M	1.26	281.9
ME2	98		4	M	1.88	163.5
SJ1	99	12	5	M	2.58	126.8
SJ6	03	12	3	M	1.88	1.63
SJ7	03	19	4	M	1.98	227.1
UN3	02	12	6	M	2.02	154.3

Classification of canal: M = main, S = secondary, T = tertiary

Table 9. Results of total loss tests in unlined canals (leaking gates and valves may have contributed to measured loss rates) conducted by Texas Cooperative Extension in the Lower Rio Grande River Basin.

Test ID	Year	Canal Width (ft)	Canal Depth (ft)	Class	Loss Rate	
					gal/ft2/day	ac-ft/mi/yr
BV3	99	55	8	M	0.15	53.4
ED5	02	105	7	M	2.39	1213.2
MA1	99	50	10	M	1.98	227.1
MA2	99	20	5	S	4.32	371.4
SB1	00	29	7	S	1.27	215.5
SJ2	00	23	6	M	2.74	293.2
SJ3	00	30	5	S	0.95	132.6

Classification of canal: M = main, S = secondary

Table 10. Canal seepage rate reported in published studies.	
Lining/soil type	**Seepage rate (gal/ft^2/day)**
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
Plactic[4]	0.08-3.74
Concrete[4]	0.06-3.22
Gunite[4]	0.06-0.94
Compacted earth[4]	0.07-0.6
Clay[4]	0.37-2.99
Loam[4]	4.49-7.48
Sand[4]	4.0-19.45

[1] DeMaggio (1990). Technical Memorandum: San Luis unit drainage program project files. US Bureau of Reclamation, Sacramento. [2] U.S. Bureau of Reclamation (1963). Lining for Irrigation Canals. [3] Nayak, et al. (1996). The influence of canal seepage on groundwater in Lugert Lake irrigation area. Oklahoma Water Resources Research Institute. [4] Nofziger (1979). Profit potential of lining watercourses in coastal commands of Orissa. Environment and Ecology 14(2):343-345.

ACKNOWLEDGEMENTS

Funding

A portion of this study was funded by Texas Cooperative Extension through the Irrigation Conservation in the Rio Grande Basin Initiative administered by the Texas Water Resources Institute of the Texas A&M University System with funds provided through a grant from Cooperative State Research, Education, and Extension Service, U.S. Department of Agriculture, under Agreement No. 2001-001-45049-01149.

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