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Water Loss Test Results
Main 'J' Canal
Delta Lake Irrigation District

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January 29, 2007

Texas Water Resources Institute
make every drop count

WATER LOSS TEST RESULTS

MAIN 'J' CANAL

DELTA LAKE IRRIGATION DISTRICT

Report Prepared by:

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January 29, 2007

THE IRRIGATION TECHNOLOGY CENTER
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Summary

This report summarizes the results of the water loss test conducted for Delta Lake Irrigation District on a segment of the Main 'J' Canal on December 6 - 9, 2005.

The Main 'J' Canal (Figure 1), the concrete lined section of the main supply canal that feeds the City of Raymondville, flows west to east in the northeastern sector of the district (see figure 2); located approximately four miles west of US Hwy 77 and a mile north of FM 490.

The tested segment was approximately 2500 ft long, varying from 15.5 to 18.0 feet in width and 6 foot in depth.

The total water loss rate was measured at 0.35 gal/ft^2/day. Annual total water loss is estimated at 37.6 ac-ft/mi/year based on an in-service period of 365 days per year. Total water losses with evaporation included were estimated at 39.0 ac-ft/mi/year. Table 1 summarizes the test results using methods commonly used for characterizing water loss from canals.

Figure 1. Main 'J' Canal

Table 1.Total loss rates measured for the Raymondville Canal, Delta Lake Irrigation District

Test ID	Test Date	Total Loss Rates				Total Loss Rates with Evaporation (ac-ft/mile)	
		ft^3/ft^2/hour	gal/ft^2/day	(ac-ft/mile) per day	per year*	per day	per year*
DL3	Dec 2005	0.002	0.35	0.103	37.6	0.107	39.0

*Based on 365 days per year of operation

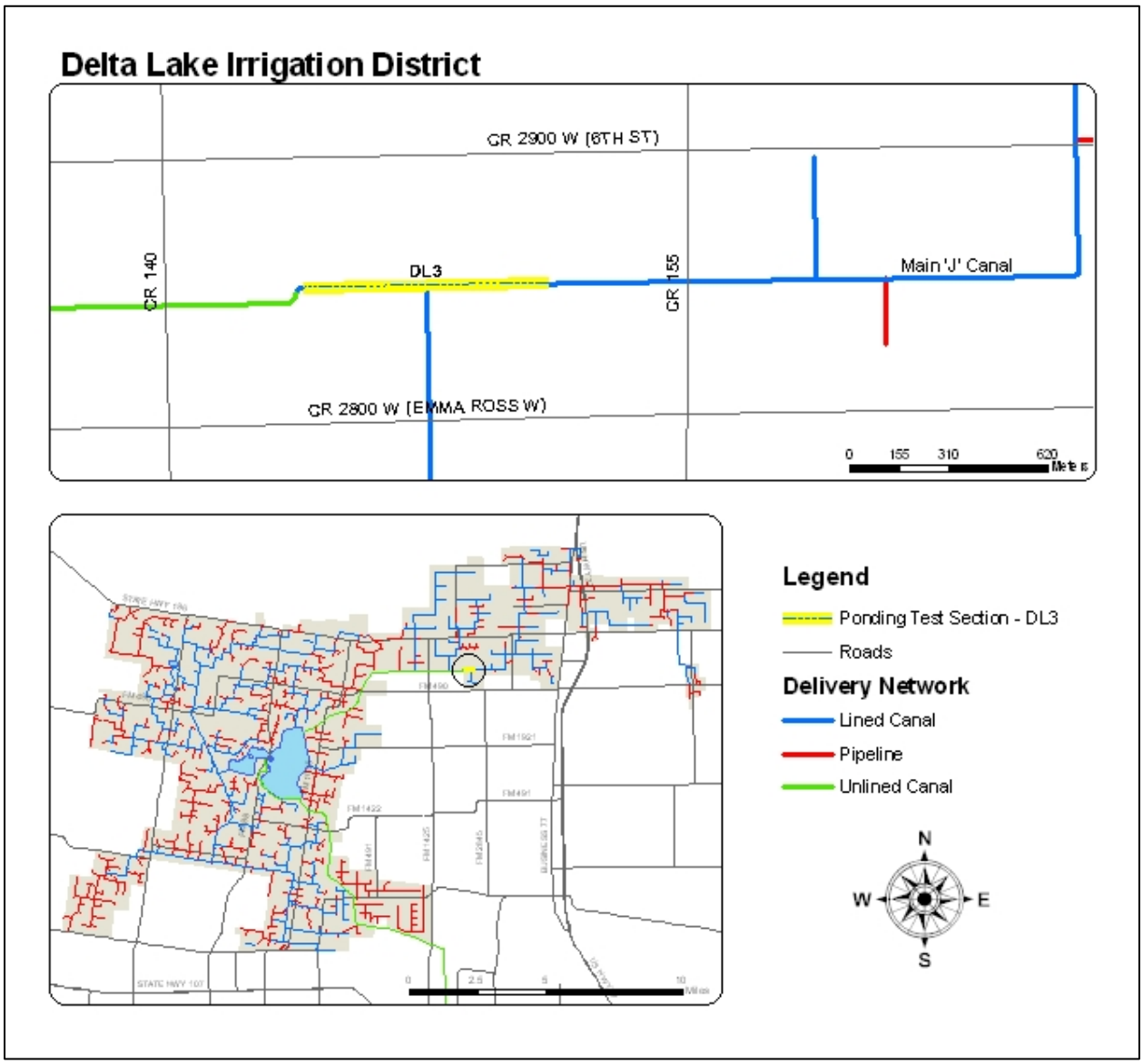

Figure 2. District map and location of the ponding test 'DL3' on the Main 'J' Canal.

Testing Program and Discussion

Water loss rates are measured using the ponding method. In this method, the two ends of a canal segment are closed or sealed with earthen dams. Once sealed, water elevations are taken for approximately 48 hours. Four staff gages were placed in the test segment and water stage levels were recorded manually. During the test, staff gage stand elevations and canal dimensions, including cross-sections, depth and side slopes are surveyed and measured using a GPS survey-grade instrument (Figure 3). This information is used in combination with water level changes to

calculate the water loss rates. It's important to note that there are two different types of tests that can be conduct using the ponding method.

Figure 3. Shows the GPS survey and a staff gage

Tests are classified as follows:

- Seepage loss tests – canal segments that do not contain valves and/or gates; thus, all water loss is due to seepage through the canal sidewalls and floor.
- Total loss tests – canal segments which contain valves and/or gates. Frequently, these gates and valves have undetectable leaks or leaks that are difficult to measure, and therefore may contribute to the measured losses.

The test segment DL3 did contain two farm turnout valves and one small head-gate for a southbound lateral canal; thus, the *total loss rate* was measured. Upon the start of the test, measures were taken to limit water losses through the mentioned control structures. Pretest inspections of the farm turnout valves and the lateral head-gate were performed to check for visible signs of leakage. A small earthen dam was also constructed of just downstream of the lateral head-gate in attempt to rule out losses due to the lateral canal (Figure 4).

Figure 4. Lateral gate & earthen dam downstream

Additional data is given in Table 2 including estimated evaporation rates and total loss rates in terms of change in water level. Evaporation rates were calculated from local weather station data. The weather data can be found at http://texaset.tamu.edu.

Table 2. Additional Test Result Information for the Main 'J' Canal.

Evaporation Rates		**Δ Water Level without Evaporation**	
in/hr	**ft/day**	**in/hr**	**ft/day**
0.001	0.002	0.03	0.06

Appendix

Detailed Test Results

Table 3 provides details on test DL3 including data collected and recorded changes in water depths during the test. The canal cross sections at the four staff gages are illustrated in Figures 5 – 8. Also shown on these charts are the water depths at the beginning of the test.

Table 3. Raw Test Data for DL3

District:	Delta Lake	**Test ID:**	DL3
Canal:	Raymondville	**Lining Type:**	Concrete lined
Avg. Top Width:	17 feet	**Date:**	Dec 6-9, 2005
Test Length:	2500 feet	**Start Time:**	4:02 pm
Total Depth:	6 feet	**Finish Time:**	1:00 pm

Location: 4 miles west of US Hwy 77 and a mile north of FM 490

Staff Gage Readings

	SG1		**SG2**		**SG3**		**SG4**	
DATE	**Time**	**Meas.**	**Time**	**Meas.**	**Time**	**Meas.**	**Time**	**Meas.**
6-Dec	16:02	2.06	16:05	2.11	16:09	5.35	16:13	5.61
	16:32	2.10	16:35	2.09	16:39	5.34	16:44	5.60
	17:02	2.08	17:05	2.08	17:09	5.33	17:13	5.60
	17:32	2.08	17:35	2.07	17:39	5.33	17:43	5.60
7-Dec	10:02	2.02	10:05	2.04	10:09	5.30	10:13	5.57
	13:02	2.02	13:05	2.04	13:09	5.28	13:13	5.56
	16:20	2	16:45	2.02	16:49	5.27	16:53	5.54
8-Dec	10:02	1.94	10:05	1.96	10:09	5.21	10:13	5.49
	13:02	1.94	13:05	1.96	13:09	5.20	13:13	5.49
9-Dec	13:02	1.90	13:05	1.92	13:09	5.16	13:13	5.44
True depth adjustment factor (ft)		2.10		2.43		-0.83		-0.93

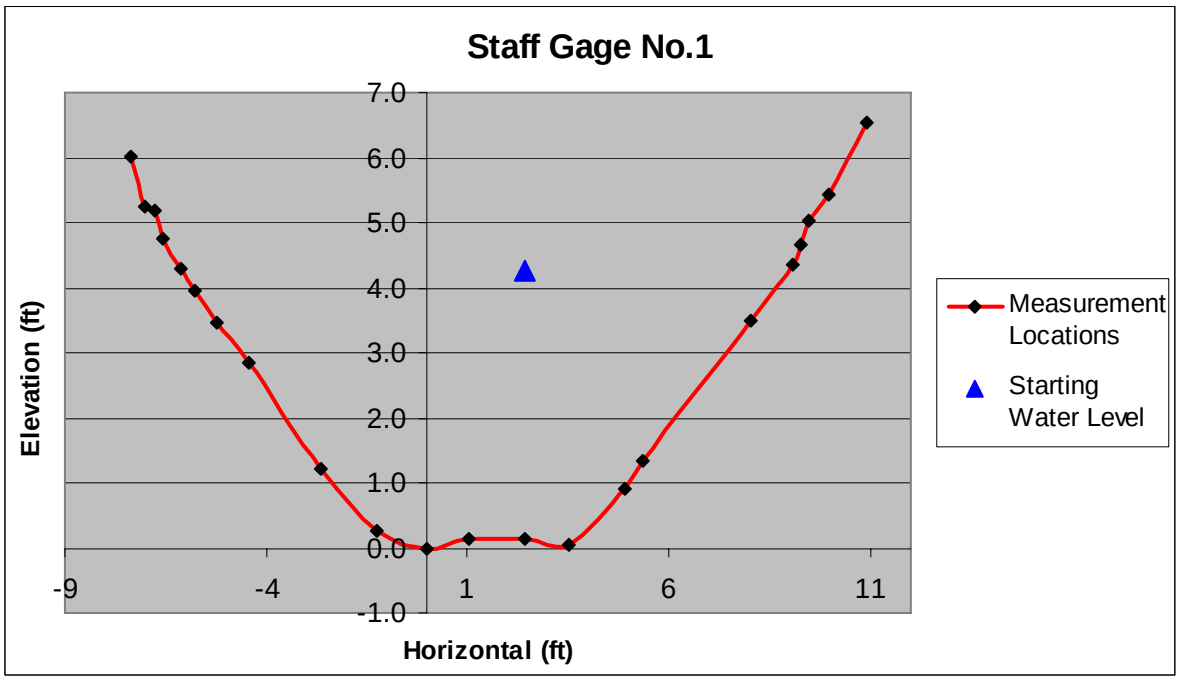

Figure 5. Cross Section at Staff Gage No.1

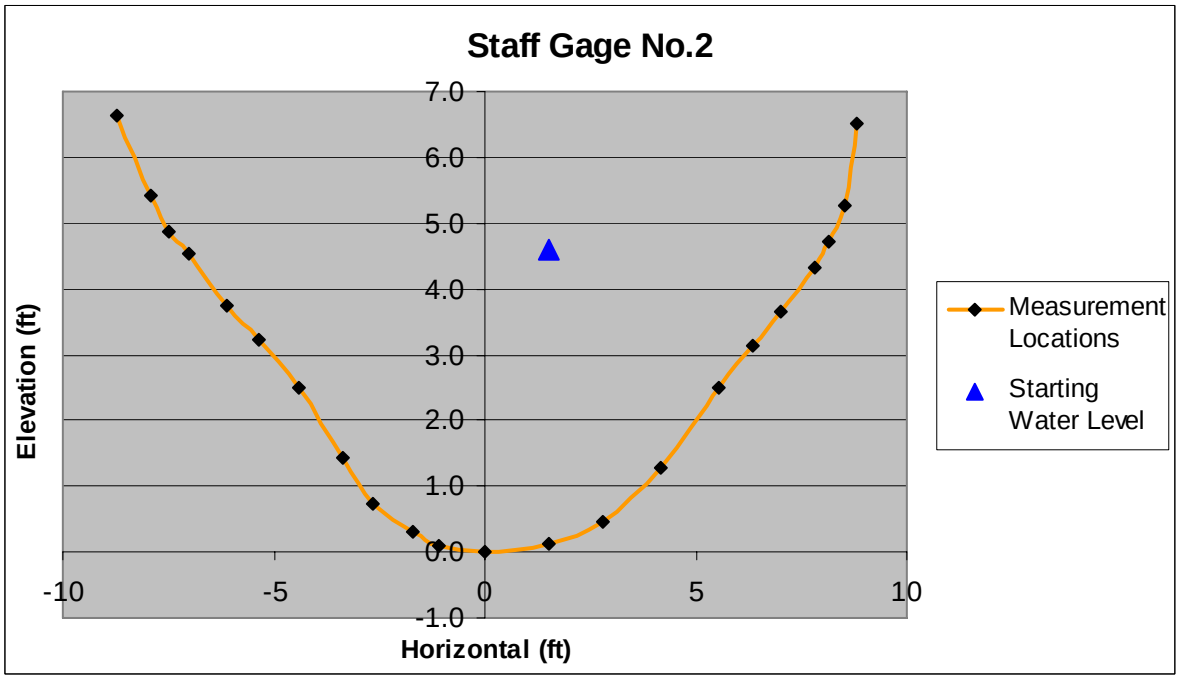

Figure 6. Cross Section at Staff Gage No.2

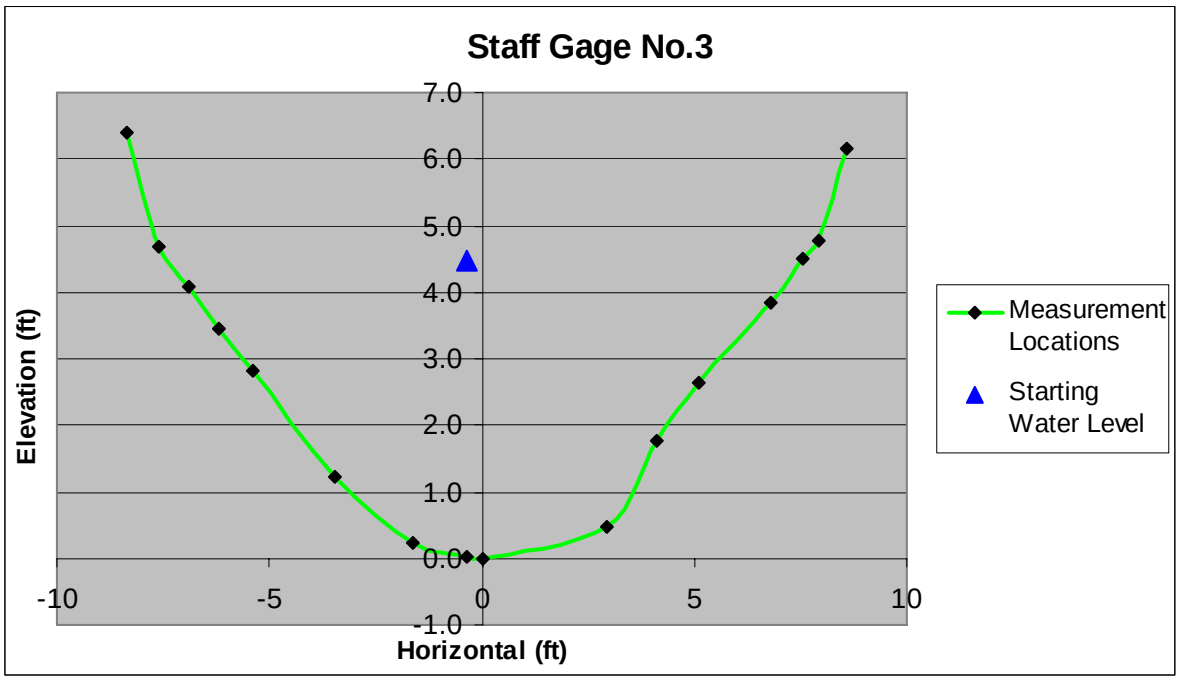

Figure 7. Cross Section at Staff Gage No.3

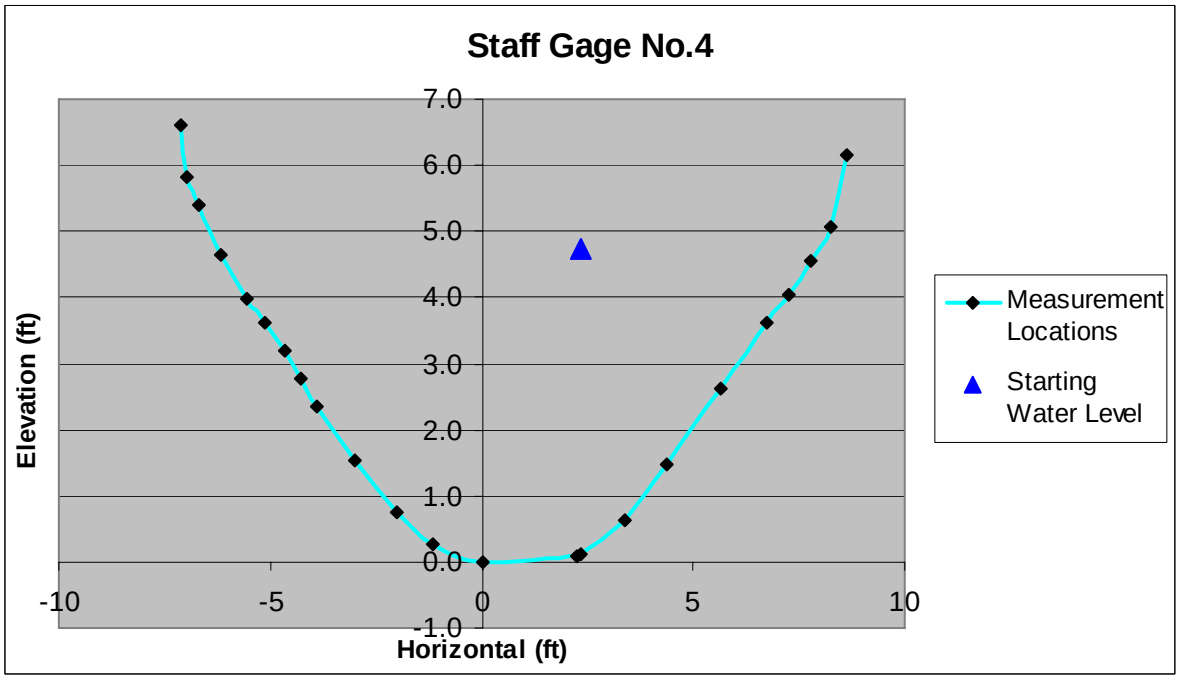

Figure 8. Cross Section at Staff Gage No.4

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 5 – 7. Table 8 gives seepage rates versus lining type as reported in the scientific literature.

Table 5. 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 6. 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 7. 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 8. 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.

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