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SEEPAGE STUDY OF A 15.3-MILE SECTION OF THE CENTRAL UTAH CANAL, PAHVANT VALLEY, MILLARD COUNTY, UTAH

by

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CONTENTS

	Page
Abstract	1
Introduction	1
Methods of investigation	2
Procedures used in computing losses and gains	2
Results	3
References cited	3
Publications of the Utah Department of Natural Resources, Division of Water Rights	13

ILLUSTRATIONS

Figure	1.	Map showing measuring sites on the Central Utah Canal	4
	2.	Graphs showing graphic averages of losses for reaches of the Central Utah Canal	5
	3.	Graphs showing gage heights at recorder sites during seepage runs along the Central Utah Canal	6

TABLES

Table	1.	Descriptions of measuring sites on the Central Utah Canal	9
	2.	Measurements of discharge, specific conductance, and water temperature at sites on the Central Utah Canal	10
	3.	Graphic averages of losses determined from seepage measurements for reaches of the Central Utah Canal	12

CONVERSION FACTORS

For readers who prefer to use metric units, conversion factors for inch-pound units used in this report are listed below:

Multiply	by	To obtain
cubic foot per second	0.02832	cubic meter per second
cubic foot per second per mile	0.01760	cubic meter per second per kilometer
mile	1.609	kilometer

Water temperature is given in degrees Celsius (°C), which can be converted to degrees Fahrenheit (°F) by the following equation:

$$°F = 1.8\ (°C) + 32.$$

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ABSTRACT

Three sets of seepage measurements were made at ten canal sites and at all turnouts along a 15.3-mile section of the Central Utah Canal during the summer of 1986. The total loss for the 15.3-mile section averaged about 36 cubic feet per second or 2.4 cubic feet per second per mile. The nine subsections were grouped into five reaches of one or more subsections with similar losses per mile. Average losses for these five reaches ranged from 0 to 4.1 cubic feet per second per mile. No average gains were detected.

INTRODUCTION

This report gives the results of seepage measurements of a 15.3-mile section of the Central Utah Canal in Pahvant Valley, Millard County, Utah (fig. 1). The study is the eighth in a series of seepage studies conducted by the U.S. Geological Survey in cooperation with the Utah Department of Natural Resources, Division of Water Rights. The Division of Water Rights needs information on gains and losses of canal discharge to refine water budget computations of recharge to and discharge from aquifers, and water managers need the information for allocating irrigation water. Seepage studies provide this kind of information.

The Central Utah Canal was constructed in the early 1900's, and first delivered water to Pahvant Valley in 1916 (Roger Walker, Sevier River Water Commissioner, oral commun., December 11, 1986). Water is diverted from the Sevier River to the Central Utah Canal at a point about 6 miles east of Leamington, which is about 25 miles northeast of McCornick, Utah. The canal has a capacity of about 100 cubic feet per second at the head of the section included in this study.

Prior to this study, two seepage studies were completed on other sections of the Central Utah Canal (Palmer B. Delong, U.S. Bureau of Reclamation, written commun., December 8, 1980 and Herbert and others, 1982).

METHODS OF INVESTIGATION

A reconnaissance was made of the Central Utah Canal during the spring of 1986, and the 15.3-mile section selected for the study was examined for: (1) location of pumps, turnouts, diversion structures, and bridges; (2) general condition of the canal (for example, whether it had recently been cleaned or repaired); and (3) location of areas of natural and irrigation return flow to the canal. Using information from the reconnaissance, 10 measurement sites were selected, dividing the canal into 9 subsections. Water-stage recorders were installed at the head, middle, and end of the 15.3-mile section. Discharge measurements were made at the 10 sites on the Central Utah Canal on June 26, July 18, and August 28, 1986. The three sets of discharge measurements were made by current meter, using standard methods of the U.S. Geological Survey (Buchanan and Somers, 1969). Each person participating in the study was assigned a number of measurements to be completed in 1 day. For each of the three dates, discharge at all 10 canal sites and all turnouts was measured or estimated. The measuring sites on the canal are listed in downstream order in table 1, including descriptions of location, identification of sites where water-stage recorders were operated, and whether measurements were made from a bridge or by wading. The time of measurement, discharge, specific conductance, and water temperature are summarized in table 2 for each set of measurements for the sites on the canal, and discharge only is given for the turnouts. Turnouts shown on figure 1 and listed in table 2 were in operation during at least one of the three seepage runs. There were no areas of natural or irrigation return flow to the 15.3-mile section during the three seepage runs.

PROCEDURES USED IN COMPUTING LOSSES AND GAINS

The losses and gains determined from results of the measurements listed in table 2 were used to develop the data plotted in figure 2. Average losses for reaches of the 15.3-mile section of the canal are summarized in table 3. The procedures used to obtain these results are described below.

The general procedure for computing losses and gains for canal seepage studies is to compute the discharge that would be expected at each canal measuring site, assuming no loss or gain. Beginning with the discharge at the head of the section of canal studied and proceeding in a downstream direction, all turnout discharges are subtracted and all inflows are added, and this corrected discharge is subtracted from the discharge measured at each downstream site to obtain the loss or gain. This computation is complete if the discharge remains steady or does not fluctuate during the time between measurements at the upstream and downstream sites. Fluctuations in discharge with time are determined from computations at sites equipped with recorders.

The tabulation for determining losses or gains for the three seepage runs for this study of a 15.3-mile section of the Central Utah Canal was less complex than for some seepage studies. Discharge did not fluctuate enough during the time (0800 to 1400 hours on a given day) of measurement at the 10 canal sites for any of the three seepage runs to require corrections. (See figure 3 and table 2.) In addition, no areas of natural or irrigation return discharge to the section of canal studied were detected during the three seepage runs. Thus, computations were simplified.

A preliminary analysis usually results in grouping one or more subsections, with similar losses or gains per unit length, into reaches. Thus, for this study, the nine subsections, CU1-CU2 through CU9-CU10, were grouped into reaches CU1-CU2, CU2-CU4, CU4-CU5, CU5-CU7, and CU7-CU10, and the results are shown in figure 2 and are summarized in table 3.

RESULTS

A summary of measurements made on all three seepage runs appears in table 2. The June 26, 1986 measurement at CU1 is not listed in table 2 because it was in error due to poor measuring conditions. Within a given reach, the amount of loss varied between seepage runs. This variation is shown by the scatter of the plotted points in figure 2. The scatter is attributed to one or more of the following factors: (1) Nonideal measuring conditions, (2) changes in the rate of seepage loss from the canal, and (3) the possibility that a water user changed the discharge in his turnouts during the time of the seepage measurements.

Results from measurements in reach CU1-CU2 show an average loss of about 6.5 cubic feet per second, which represents 4.1 cubic feet per second per mile. Results for CU2-CU4 show some scatter and an average loss of 8.5 cubic feet per second, which represents 2.7 cubic feet per second per mile. Results for CU4-CU5 show some scatter and indicate no average loss or gain. Results for CU5-CU7 show substantial scatter, indicating an average loss of 3.5 cubic feet per second, which represents 1.1 cubic feet per second per mile. Results for CU7-CU10 show substantial scatter, indicating an average loss of 17.0 cubic feet per second, which represents 3.3 cubic feet per second per mile. The total loss for the entire 15.3-mile section of the canal averaged about 36 cubic feet per second (table 3) or 2.4 cubic feet per second per mile.

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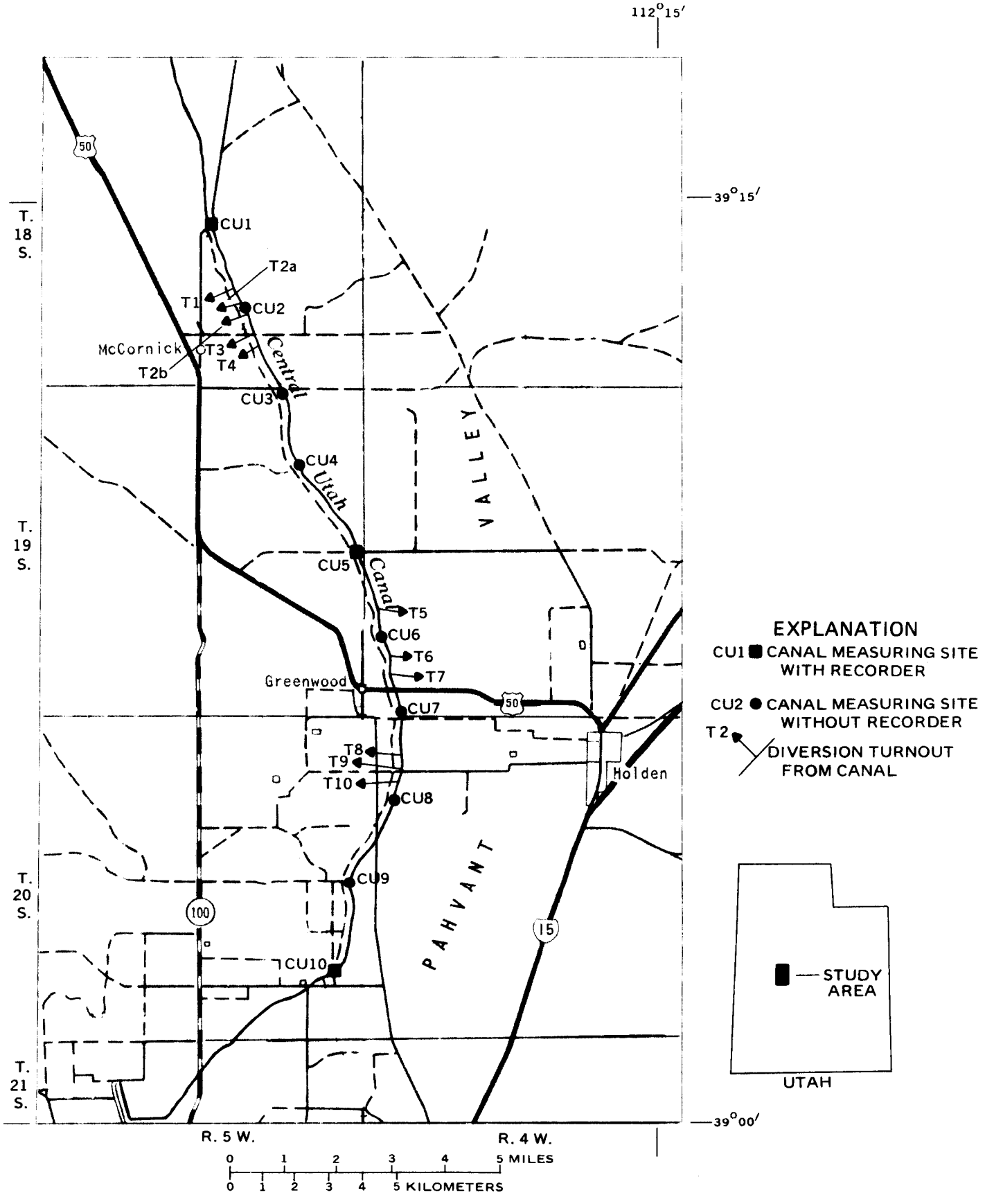

Figure 1.—Measuring sites on the Central Utah Canal.

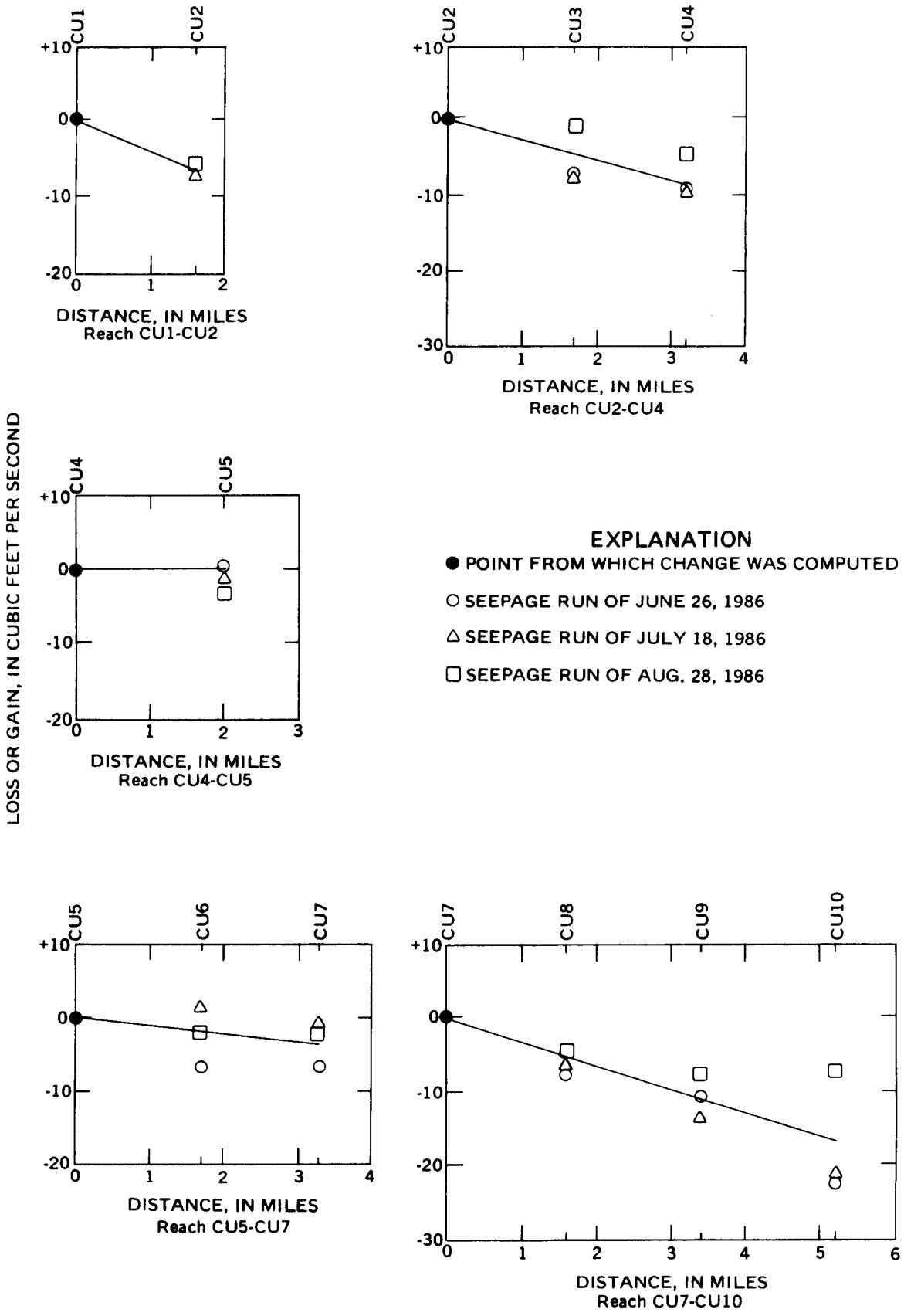

Figure 2.—Graphic averages of losses for reaches of the Central Utah Canal.

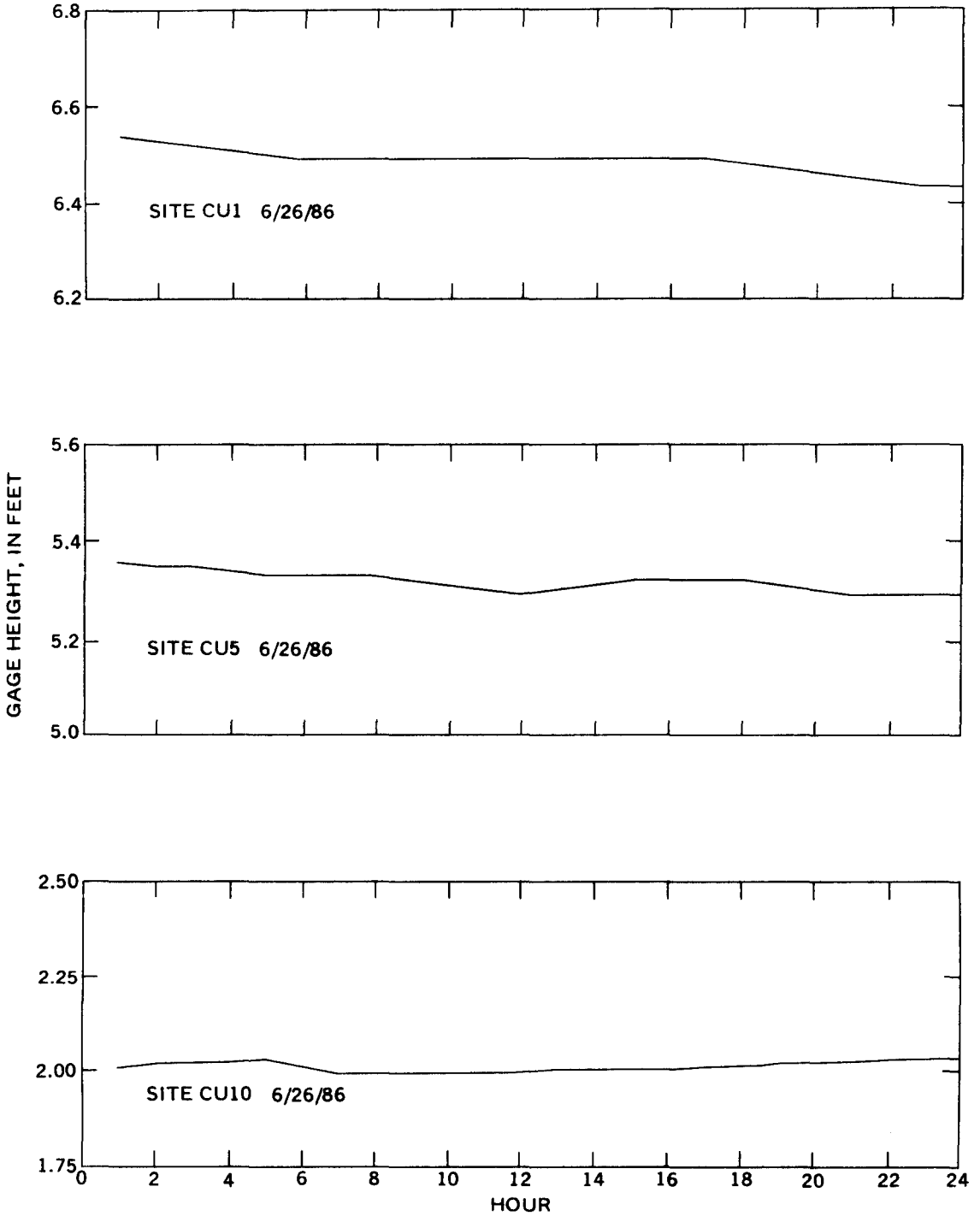

Figure 3.—Gage heights at recorder sites during seepage runs along the Central Utah Canal.

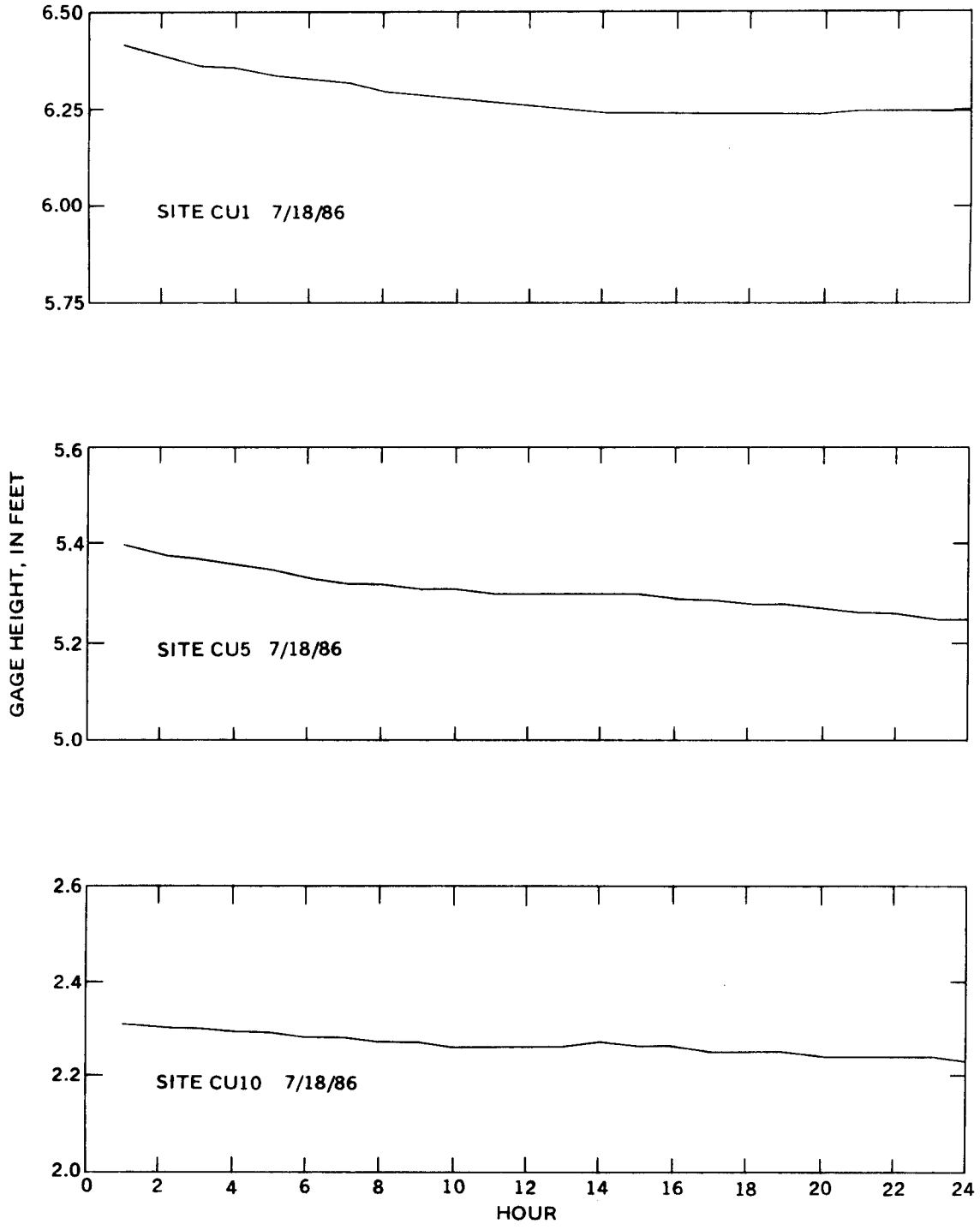

Figure 3.—Gage heights at recorder sites during seepage runs along the Central Utah Canal—Continued.

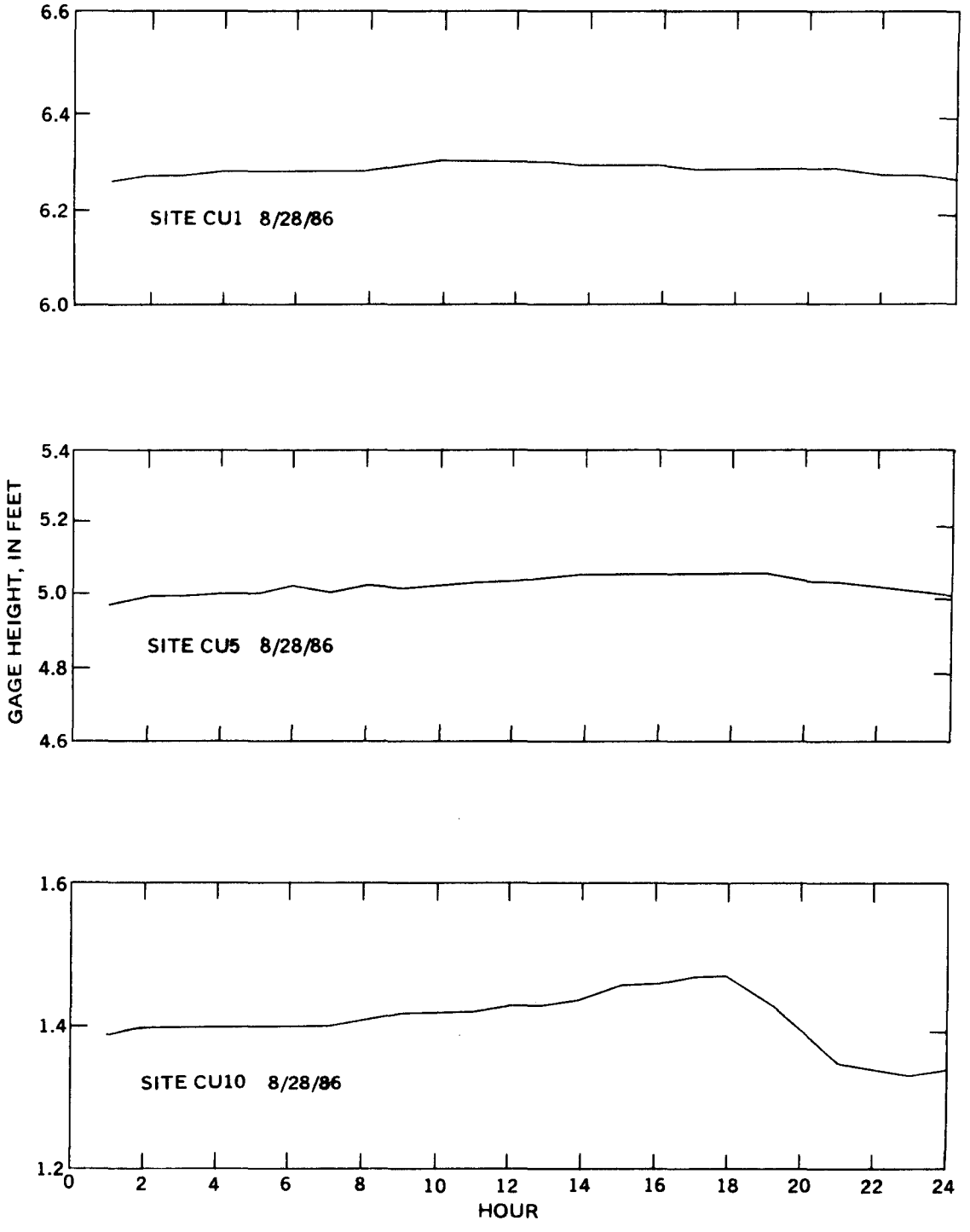

Figure 3.—Gage heights at recorder sites during seepage runs along the Central Utah Canal—Continued.

Table 1.--Descriptions of measuring sites on the Central Utah Canal

Site number	Location	Remarks
CU1	NE¼NW¼NW¼ sec.22, T.18 S., R.5 W.	Water-stage recorder operated at this site, and measurements were made from bridge and by wading.
CU2	NW¼SE¼NE¼ sec.27, T.18 S., R.5 W.	Measurements were made by wading.
CU3	SE¼SE¼NE¼ sec.35, T.18 S., R.5 W.	Measurements were made by wading.
CU4	SW¼SE¼NE¼ sec.11, T.19 S., R.5 W.	Measurements were made by wading.
CU5	SE¼SE¼SE¼ sec.13, T.19 S., R.5 W.	Water-stage recorder operated at this site, and measurements were made by wading.
CU6	SW¼SE¼NW¼ sec.30, T.19 S., R.4 W.	Measurements were made by wading.
CU7	SE¼SW¼SW¼ sec.31, T.19 S., R.4 W.	Measurements were made by wading.
CU8	SW¼SW¼SE¼ sec. 7, T.20 S., R.4 W.	Measurements were made by wading.
CU9	SE¼SW¼SE¼ sec.13, T.20 S., R.5 W.	Measurements were made by wading.
CU10	NE¼SE¼SW¼ sec.25, T.20 S., R.5 W.	Water-stage recorder operated at this site, and measurements were made by wading.

Table 2.—Measurements of discharge, specific conductance, and water temperature at sites on the Central Utah Canal

Site: CU, canal; T, diversion. Discharge: e, estimated.

Site number (fig. 1)	Date	Time	Discharge (cubic feet per second)	Specific conductance (microsiemens per centimeter at 25 degrees Celsius)	Water temperature (degrees Celsius)
CU1	June 26, 1986	0830	--	1,300	19.0
T1		0855	0.27	-	-
CU2		1100	79.1	1,390	19.5
T2b		1015	1.02	-	-
T3		-	4.27	-	-
CU3		1135	66.7	1,420	20.5
CU4		1305	64.6	1,360	22.0
CU5		1430	65.0	1,370	-
CU5		0830	64.4	1,460	20.0
T5		1230	.90	-	-
CU6		1010	57.0	1,400	20.5
T7		-	e 2.0	-	-
CU7		1105	55.2	1,380	21.0
T8		1300	e 2.0	-	-
T9		1305	.12	-	-
CU8		1120	45.3	1,400	21.5
CU9		1220	42.5	1,420	22.0
CU10		1310	30.2	1,420	23.0
CU1	July 18, 1986	0820	87.4	1,320	19.0
T1		0815	.13	-	-
T2a		0845	1.1	-	-
CU2		0935	78.8	1,320	19.0
T3		0905	3.8	-	-
T4		-	e 2.0	-	-
CU3		-	65.7	1,310	20.0

Table 2.—Measurements of discharge, specific conductance, and water temperature at sites on the Central Utah Canal--Continued

Site number (fig. 1)	Date	Time	Discharge (cubic feet per second)	Specific conductance (microsiemens per centimeter at 25 degrees Celsius)	Water temperature (degrees Celsius)
CU4		1120	63.3	1,300	21.0
CU5		1200	62.2	1,340	21.0
CU5		0900	63.0	1,380	20.0
T5		-	e 1.8	-	-
CU6		-	62.4	1,390	21.0
T6		1010	e 2.0	-	-
CU7		1000	58.5	1,360	21.0
T8		-	e 2.0	-	-
T10		-	.25	-	-
CU8		1110	50.0	1,420	21.0
CU9		1240	42.4	1,350	22.0
CU10		1315	34.6	1,330	22.0
CU1	AUG. 28, 1986	0830	73.7	1,280	20.5
T1		0830	e .20	-	-
CU2		1015	67.6	1,270	21.0
T2		0845	.24	-	-
T3		0915	3.74	-	-
T4		0935	e 2.0	-	-
CU3		1130	61.5	1,300	21.5
CU4		1150	57.1	1,290	22.0
CU5		1230	54.0	1,280	23.0
CU5		0830	50.6	1,300	21.0
CU6		0940	49.2	1,320	21.0
T6		-	e 2.0	-	-
CU7		1100	46.8	1,320	22.0
T8		1030	e 2.0	-	-
CU8		1215	40.6	1,320	23.0
CU9		1350	37.6	1,350	23.0
CU10		1345	37.6	1,280	23.0

Table 3.--Graphic averages of losses determined from seepage measurements for reaches of the Central Utah Canal

Reach	Length (miles)	Graphic averages of losses (from fig. 2)	
		Cubic feet per second	Cubic feet per second per mile
CU1–CU2	1.6	6.5	4.1
CU2–CU4	3.2	8.5	2.7
CU4–CU5	2.0	0	0
CU5–CU7	3.3	3.5	1.1
CU7–CU10	5.2	17.0	3.3
Total	15.3	35.5	

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