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SEEPAGE STUDY OF THE SOUTH BEND, RICHFIELD, AND VERMILLION CANALS, SEVIER COUNTY, UTAH

By

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Prepared by the
United States Geological Survey
in cooperation with the
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Division of Water Rights

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CONVERSION FACTORS

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

Multiply	By	To obtain
Cubic foot per second (ft^3/s)	0.02832	Cubic meter per second (m^3/s)
Cubic foot per second per mile (ft^3)/mi	0.01760	Cubic meter per second per kilometer (m^3/s)/km
Foot (ft)	0.3048	Meter (m)
Mile	1.609	Kilometer (m)

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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U.S. GEOLOGICAL SURVEY

ABSTRACT

A seepage investigation was made in 1987 on selected reaches of the South Bend, Richfield, and Vermillion Canals in Sevier County, Utah, to determine gains or losses in discharge. Fluctuations in discharge were adjusted using information from stage recorders operated at selected locations during each set of discharge measurements. The investigation showed a net gain of 0.2 cubic foot per second in the South Bend Canal: the upper reach gained 1.5 cubic feet per second, the two middle reaches together lost 2.5 cubic feet per second, and the lower reach gained 1.2 cubic feet per second. The Richfield Canal showed a net loss of 2.4 cubic feet per second: the two upper reaches together lost 4.4 cubic feet per second and the two lower reaches together gained 2.0 cubic feet per second. The Vermillion Canal showed a net loss of 0.2 cubic foot per second: the upper reach gained 2.3 cubic feet per second and the lower reach lost 2.5 cubic feet per second.

INTRODUCTION

This report gives the results of a seepage investigation for sections of the South Bend, Richfield, and the Vermillion Canals in Sevier County, Utah. This investigation (ninth of a series) is part of the statewide water-resources program conducted by the U.S. Geological Survey in cooperation with the Utah Department of Natural Resources, Division of Water Rights.

Information on discharge gains or losses for the canals is needed by water managers for reallocating irrigation water. Detailed investigation of a canal system can aid in locating the losing or gaining sections of the system.

This investigation included 10.6 miles of the South Bend Canal (fig. 1), 9.1 miles of the Richfield Canal (fig. 2), and 7.5 miles of the Vermillion Canal (fig. 3). Water is diverted to the canals from the Sevier River and is used primarily for irrigation.

METHODS OF INVESTIGATION

A reconnaissance was made of the canals in the spring of 1987. The sections of the canals selected for the investigation were examined for: (1) the locations of controls, turn outs, or other diversion structures, and for bridges; (2) the general condition of the canals (for example, whether they recently had been cleaned or other maintenance had been performed); and (3) the location of natural and irrigation-return flow to the canals.

Using the information from the reconnaissance, the sections of the canals were divided into reaches, and measuring sites were selected within each reach. Stage recorders were operated at selected sites, mainly at the start and end of each reach.

Four sets of seepage runs were made with discharge measured at eleven sites on the South Bend Canal. These seepage runs were made on May 19, June 23, July 16, and August 18, 1987. Four sets of seepage runs were made with discharge measured at eleven sites on the Richfield Canal. These seepage runs were made on May 20, June 23, July 15, and August 19, 1987. Three sets of seepage runs were made with discharge measured at nine sites and one set at eight sites on the Vermillion Canal. These seepage runs were made on May 21, June 22, July 17, and August 19, 1987. Sites where a discharge measurement (or estimate) was made at least once are shown in figures 1 to 3. Discharge measurements or estimates were made only at turnouts and return points which had discharge at the time of the study. Numbers (for example, T2 or R2) were assigned in downstream order to those turnouts and inflow points where flow occurred during at least one set of seepage runs. Continuous stage records were obtained for the upstream and downstream end of each reach and are shown in figures 4 to 6.

The discharge measurements were made with a current meter, using standard methods of the U.S. Geological Survey (Buchanan and Somers, 1969). Each person making discharge measurements was assigned a reach in which the required number of measurements could be completed in a day. In each reach, discharge measurements were made at all measuring sites, including both ends of the reach, all turnouts, and all return points. For each main channel discharge measurement, the date, time, discharge, temperature, and specific conductance are shown in tables 1 to 3. For turnout and return sites, the date and discharge are also shown in tables 1 to 3.

METHODS USED IN COMPUTING DISCHARGE GAINS AND LOSSES

The method used to compute the discharge gain or loss for South Bend, Richfield, and Vermillion Canals is described below. Information required to make this computation is the stage and discharge at both ends of the reach, the discharge for all turnouts and returns, the change in discharge with time at the head of the reach, the time when the discharge measurements were made at the head and end of the reach, and the time-of-travel through the reach.

The following data are collected in the field and used in the discharge gain or loss computations: The discharge at the head and end of the reach; stage of the canal within the study section; and the discharge for all turnout and return points within the reach.

Once the above information has been collected, the discharge gain or loss within a selected reach can be computed using the following computation steps:

1. Determine the measured discharge at the head of the reach, Q_{mh}.
2. Determine the measured discharge at the end of the reach, Q_{me}.

3. Determine the time-of-travel in the reach.

4. Compute the rate-of-change in discharge at the head of the reach.

5. Subtract the time-of-travel from the time of the measurement at the end of the reach.

6. Determine the comparable discharge at the head of the reach, Q_{ch} using the time determined in no. 5.

7. Adjust Q_{ch} for all turnout and return discharge which will yield an adjusted discharge at the end of the reach Q_{ce}.

8. Subtract adjusted discharge, Q_{ce}, from the measured discharge, Q_{me}, at the end of the reach. If this value is positive, the reach has a gain; if it is negative, the reach has a loss.

The quantity of gain or loss in discharge was plotted as a function of distance downstream from the head of the reach. This was done for each set of seepage runs on the main canals as shown in figures 7 to 9.

In some instances, depending on the rate of gain, loss, or the scatter of plotted points, the canals were segmented into shorter reaches. The data for each of the newly defined reaches were plotted in figures 7 to 9 with the gain or loss in discharge at each main canal measuring site plotted as a function of distance from the head of the reach. A straight line was fitted through the plotted points for each reach, and the quantity and rate of gain or loss from the reach was determined from this line. The results are shown in table 4.

For a given reach, the quantity of gain or loss varied within each set of discharge measurements and among the several sets of measurements. This variation is shown by the scatter of the plotted points in figures 7 to 9. The scatter is attributed to one or more of the following: (1) Poor measuring conditions; (2) changes in the rate of seepage loss from the canal; (3) changes in the rate of seepage return to the canal from ground water and unconsumed irrigation water; (4) the inability to adjust completely for fluctuations in discharge within a given reach; and (5) the possibility that a water user changed the discharge in the turnouts or returns during the time of the discharge measurements. An application of this method is included below.

The discharge measurement at the downstream end of the reach, Q_{me}, was 205 cubic feet per second at 1000 hours and the time travel between sites is 1 hour; therefore, the comparable time for flow at the head of the reach is 0900 hours. If the discharge at the head of the reach, Q_{mh} was measured as 200 cubic feet per second at 0800 hours and was determined to be decreasing at 5.0 cubic feet per second per hour, the discharge at 0900 hours would be Q_{ch} = 195 cubic feet per second. This value of Q_{ch} is then routed downstream through the reach, adjusting for each turnout and return discharge. This adjusted discharge, Q_{ce}, is the expected discharge at the end of the reach. The adjusted discharge Q_{ce} is subtracted from the measured discharge, Q_{me}, at the end of the reach, giving a gain of 10 cubic feet per second.

EVALUATION OF THE CANAL SYSTEMS

South Bend Canal

Four sets of seepage runs were made on the South Bend Canal near the diversion from the Sevier River near Monroe (fig. 1). For each seepage run, discharge measurements were made at eleven sites on the canal. The first and last reaches of the canal indicated gains of 1.5 and 1.2 cubic feet per second, respectively. The middle two reaches lost 2.5 cubic feet per second. The section of the canal investigated indicated a net gain of 0.2 cubic feet per second. Following is a brief description of each reach studied and the calculated changes in discharge (fig. 4 and table 1).

Reach SB1-SB4.--Site SB1 is a temporary gage where a stage recorder was operated to monitor changes in the canal, and is 0.4 mile downstream of the diversion from the Sevier River. Site SB4 is at the intersection of the canal and State Route 118 near Joseph. The discharge measurements in this reach had little scatter and they indicated a net gain of 1.5 cubic feet per second or about 0.5 cubic foot per second per mile.

Reach SB4-SB6.--Site SB6 is a temporary gage where a stage recorder was operated to monitor changes in the canal and is 0.9 mile upstream from State Route 118 near Monroe. The discharge measurements in this reach had considerable scatter and they indicated a net loss of 2.5 cubic feet per second or about 1.2 cubic feet per second per mile.

Reach SB6-SB8.—Site SB8 is 1.1 miles downstream from State Route 118 near Monroe. The discharge measurements in this reach had some scatter and they indicated no gain or loss in discharge.

Reach SB8-SB11.--Site SB11 is a temporary gage where a stage recorder was operated to monitor changes in the canal and is about 2 miles south of Monroe. The discharge measurements in this reach had little scatter and they indicated a net gain of 1.2 cubic feet per second or 0.4 cubic foot per second per mile.

Richfield Canal

Four sets of seepage runs with discharge measurements at eleven sites were made on the Richfield Canal (fig. 2). Losses were indicated in the two reaches at the head of the canal, whereas the other two reaches indicated no loss and a gain of 2.0 cubic feet per second in the last reach. The maximum loss was 3.4 cubic feet per second and occurred in the first reach. The canal had a net loss of 2.4 cubic feet per second. The following is a brief description of each reach studied and the calculated changes in discharge (see fig. 5 and table 2).

Reach RC1-RC3.--Site RC1 is the Richfield Canal gage near the diversion point from the Sevier River. A stage recorder operated by the water users was used to monitor changes in the canal. Site RC3 is just southwest of Elsinore. The discharge measurements had considerable scatter and indicated a net loss in discharge of 3.4 cubic feet per second or 1.9 cubic feet per second per mile.

Reach RC3-RC6.--Site RC6 is a temporary gage where a stage recorder was operated to monitor changes in the canal and is about 0.7 mile southwest of Central. The discharge measurements in this reach had some scatter and indicated a net loss of 1.0 cubic foot per second or 0.3 cubic foot per second per mile.

Reach RC6-RC9.—Site RC9 is about 2.0 miles south of Richfield. The discharge measurements in this reach had some scatter and indicated no gain or loss in discharge.

Reach RC9-RC11.--Site RC11 is a temporary gage where a stage recorder was operated to monitor changes in the canal and is about 0.4 mile southwest of Richfield. The discharge measurements in this reach had some scatter and indicated a net gain of 2.0 cubic feet per second or 1.2 cubic feet per second per mile.

Vermillion Canal

Three sets of seepage runs with discharge measurements at nine sites and one set with discharge measurements at eight sites were made on the Vermillion Canal from Sigurd to about a mile north of Aurora (fig. 3). The upper reach indicated a gain while the lower reach indicated a loss. The net loss for the canal is 0.2 cubic foot per second. The following is a brief description of each reach studied and the calculated changes in discharge (fig. 9 and table 3).

Reach VM1-VM6.—Site VM1 is a temporary gage near Sigurd where a stage recorder was operated to monitor changes in the canal. Site VM6 is a temporary gage and is about 1.7 miles south of Aurora where a stage recorder was operated to monitor changes in the canal. The discharge measurements in this reach had some scatter and indicated a net gain in discharge of 2.3 cubic feet per second or 0.5 cubic foot per second per mile.

Reach VM6-VM9.—Site VM9 is a temporary gage on a parshall flume. This site is about one mile north of Aurora where a stage recorder was operated to monitor changes in the canal. The discharge measurements in this reach had some scatter and indicated a net loss of 2.5 cubic feet per second or 0.9 cubic foot per second per mile.

SUMMARY

The upper reach of the South Bend Canal indicated a gain in discharge, the middle reaches indicated a loss of discharge, and the lower reach indicated a gain in discharge. The South Bend Canal had a net gain of 0.2 cubic foot per second.

The two upper reaches on the Richfield Canal indicated a loss of discharge and the lower two reaches indicated a gain in discharge. The canal had a net loss of 2.4 cubic feet per second.

The upper reach of the Vermillion Canal indicated a gain in discharge and the lower reach indicated a loss of discharge. The canal had a net loss of 0.2 cubic foot per second.

REFERENCES

Buchanan, T.J., and Somers, W.P., 1969, Discharge measurements at gaging stations: U.S. Geological Survey Techniques of Water-Resources Investigations, Book 3, Chapter A8, 66 p.

Figure 1.

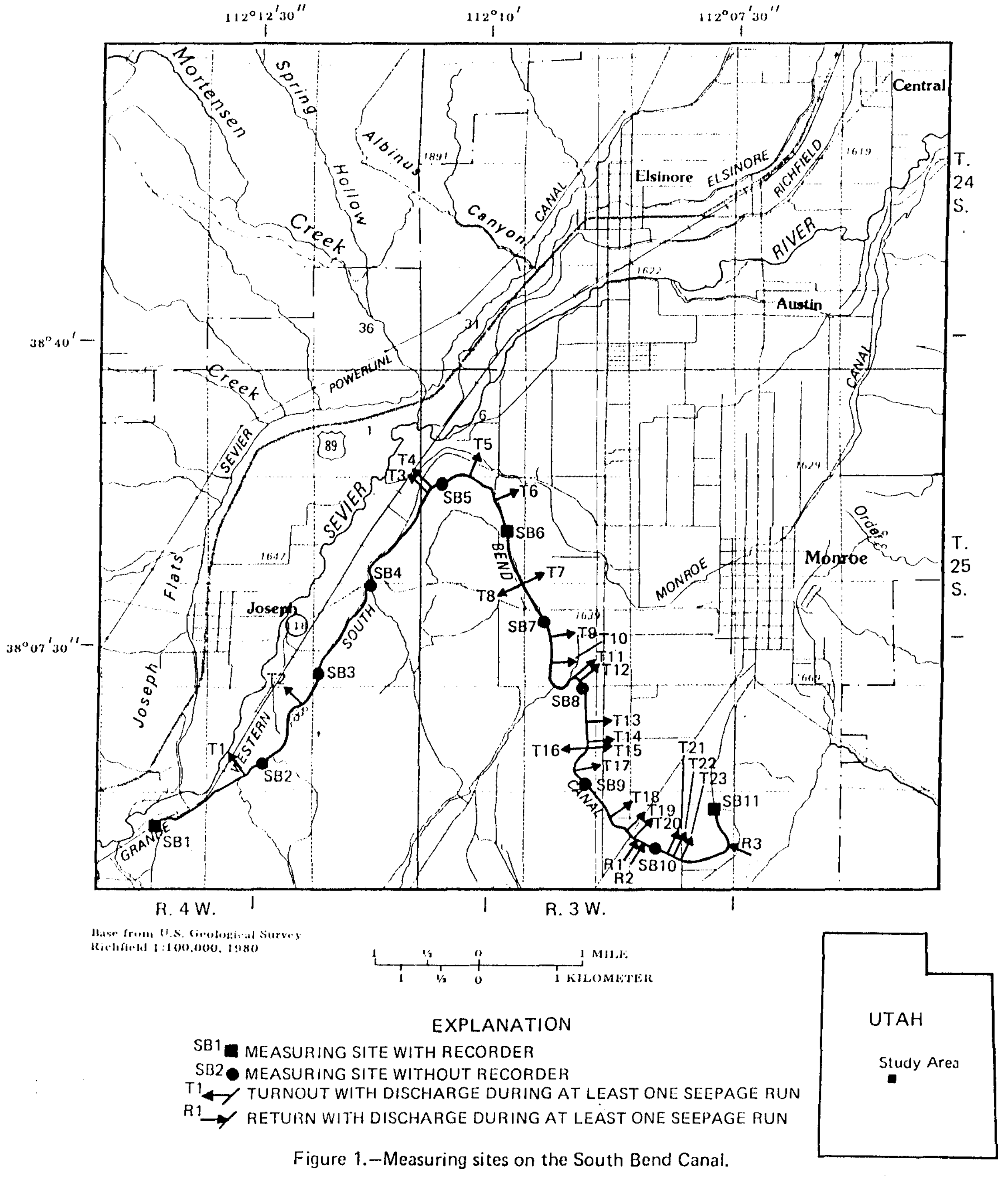


Figure 1.—Measuring sites on the South Bend Canal.

Figure 2.

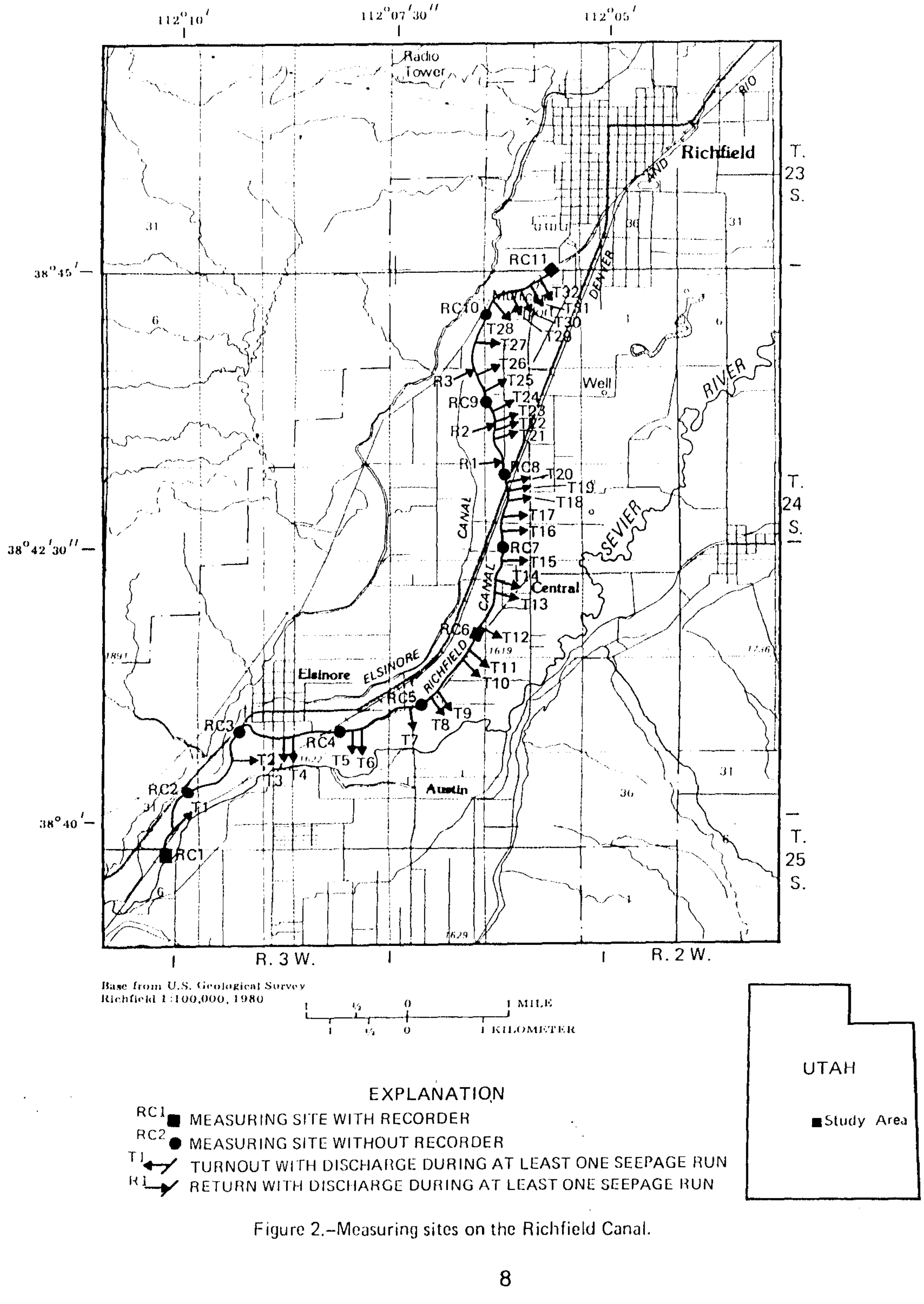
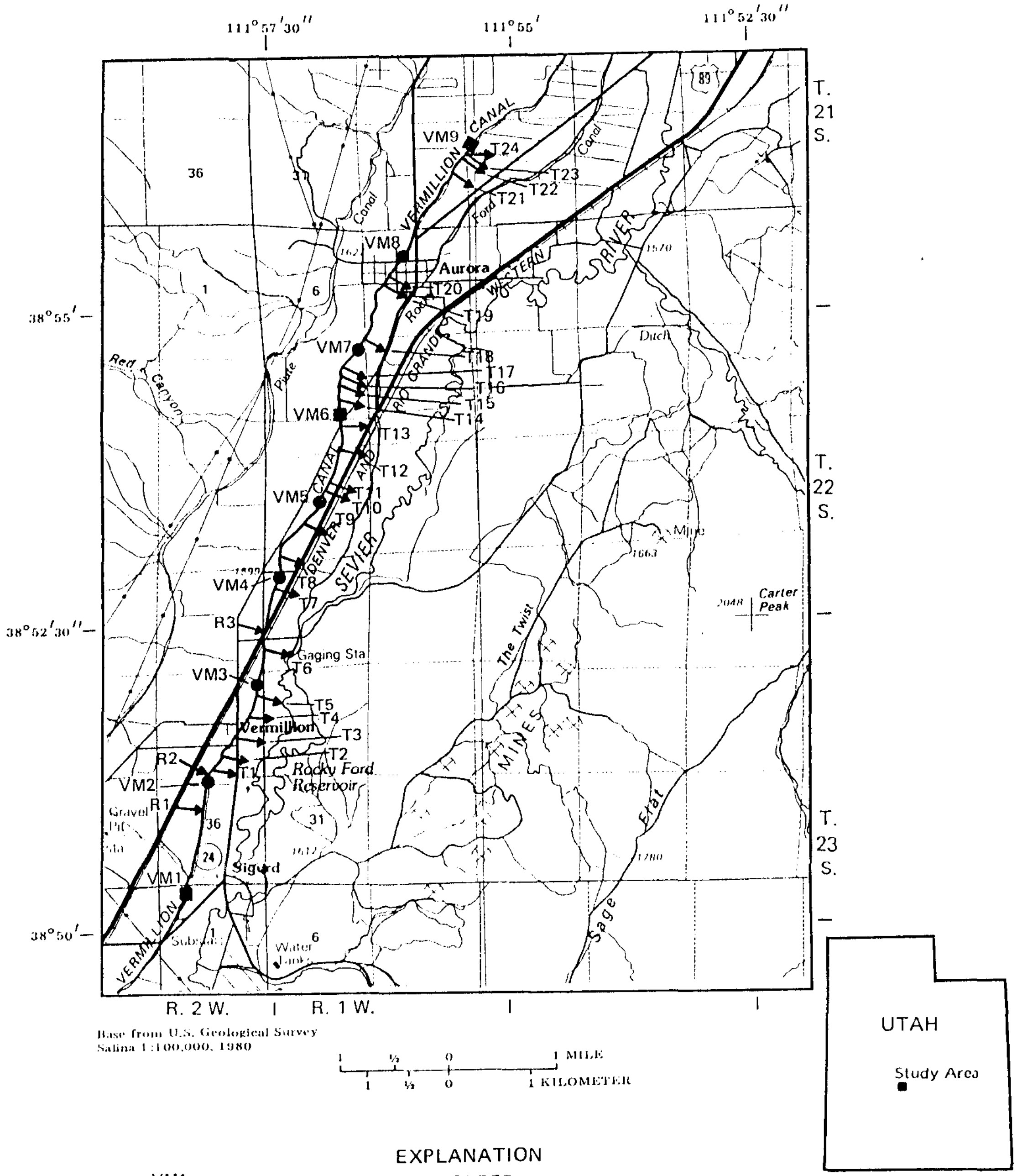


Figure 2.–Measuring sites on the Richfield Canal.

Figure 3.



EXPLANATION

VM1 ■ MEASURING SITE WITH RECORDER

VM2 ● MEASURING SITE WITHOUT RECORDER

T1 TURNOUT WITH DISCHARGE DURING AT LEAST ONE SEEPAGE RUN

R1 RETURN WITH DISCHARGE DURING AT LEAST ONE SEEPAGE RUN

Figure 3.—Measuring sites on the Vermillion Canal.

Figure 4.

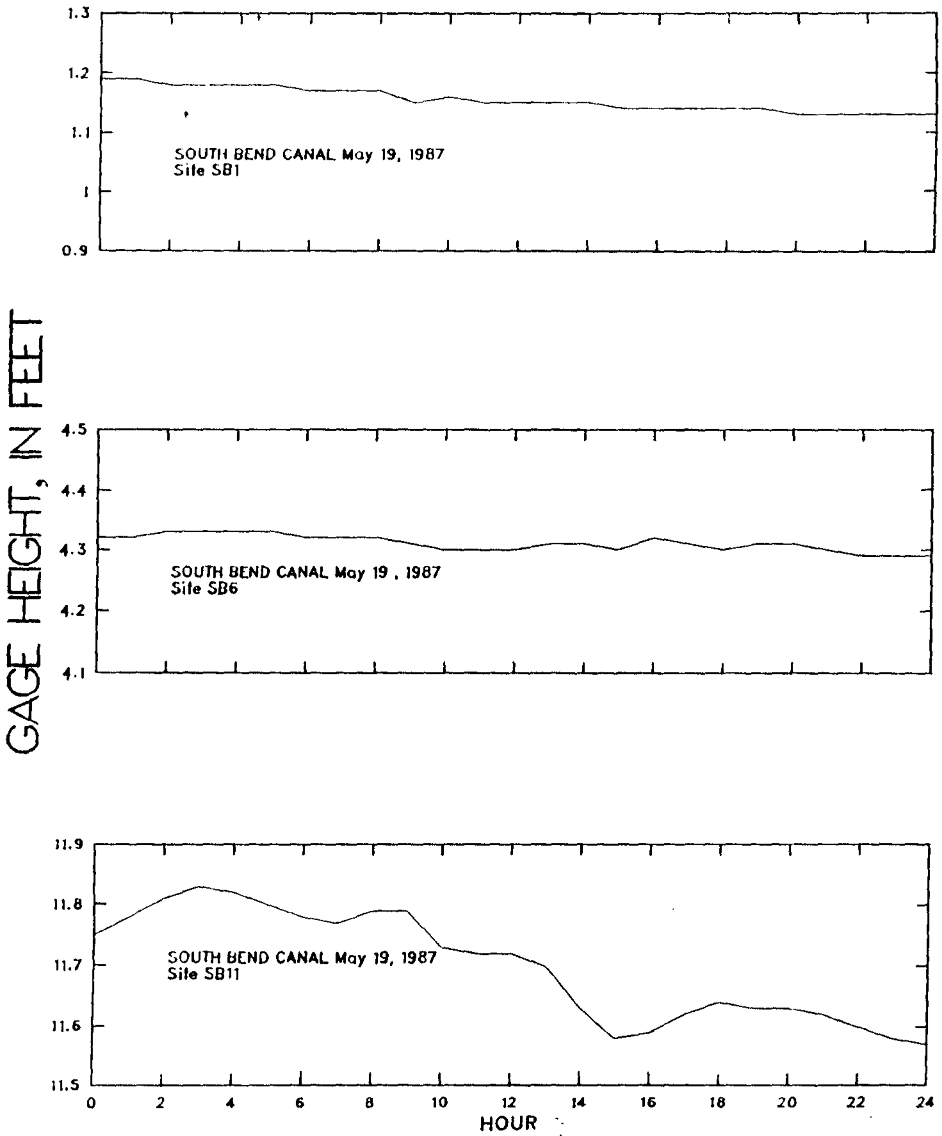


Figure 4.--Gage heights from recorder sites during discharge measurements on the South Bend Canal, 1987

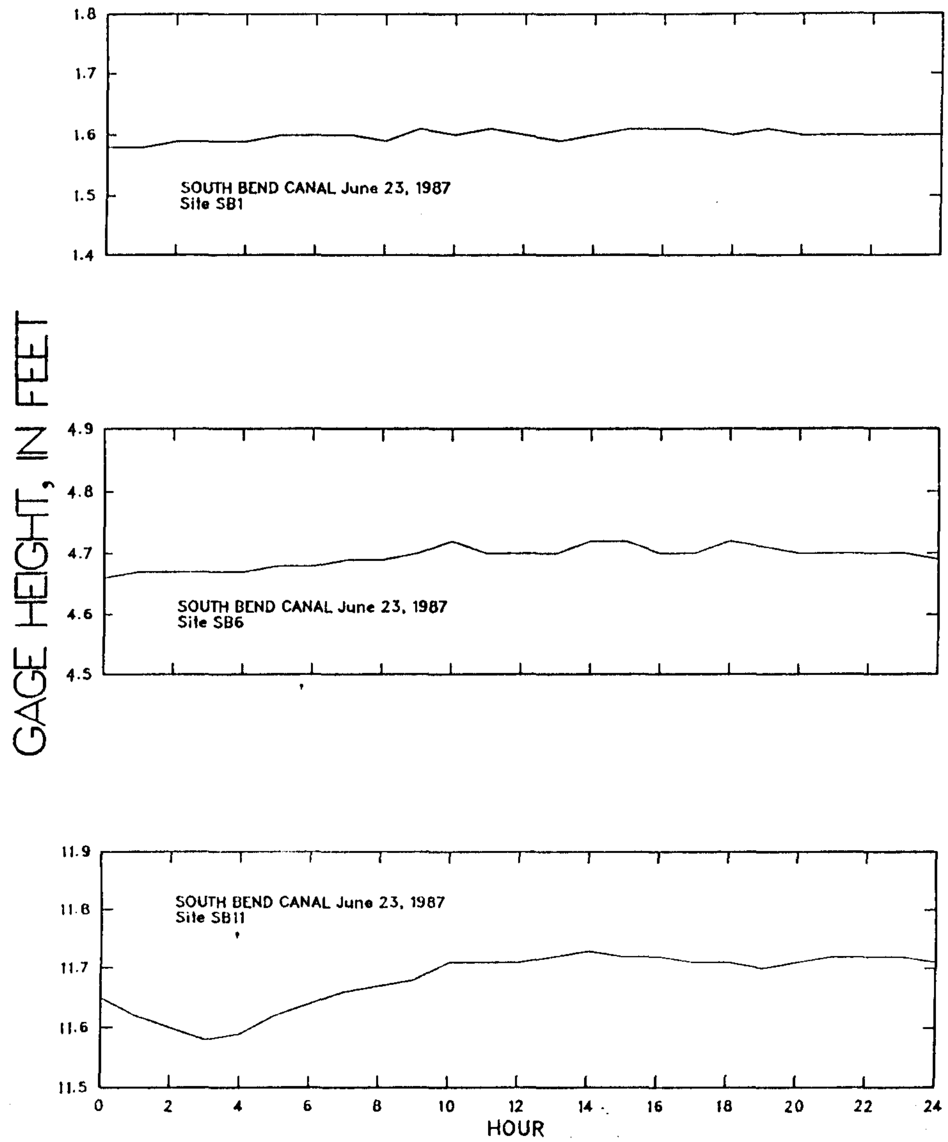


Figure 4.--Gage heights from recorder sites during discharge measurements on the South Bend Canal, 1987--Continued

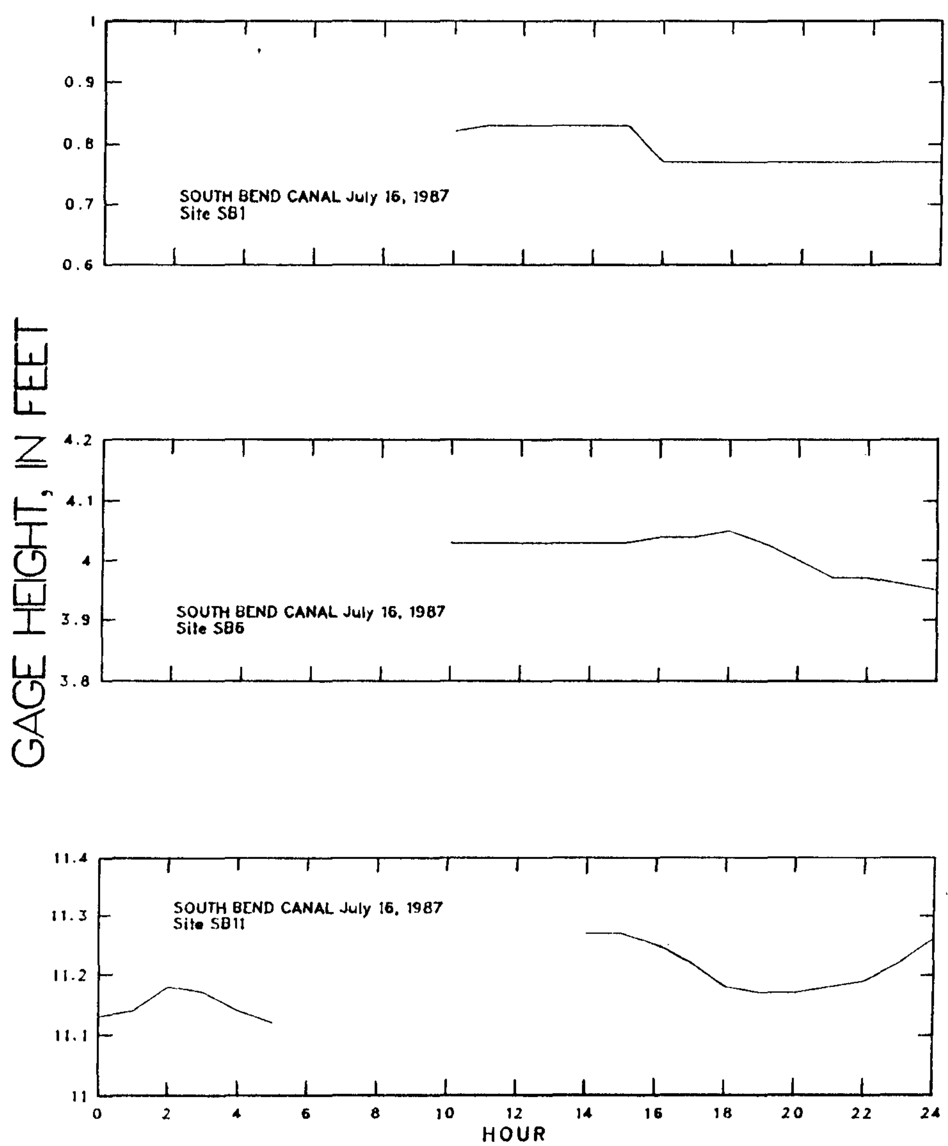


Figure 4.--Gage heights from recorder sites during discharge measurements on the South Bend Canal, 1987--Continued

FIGURE 4—PAGE 4

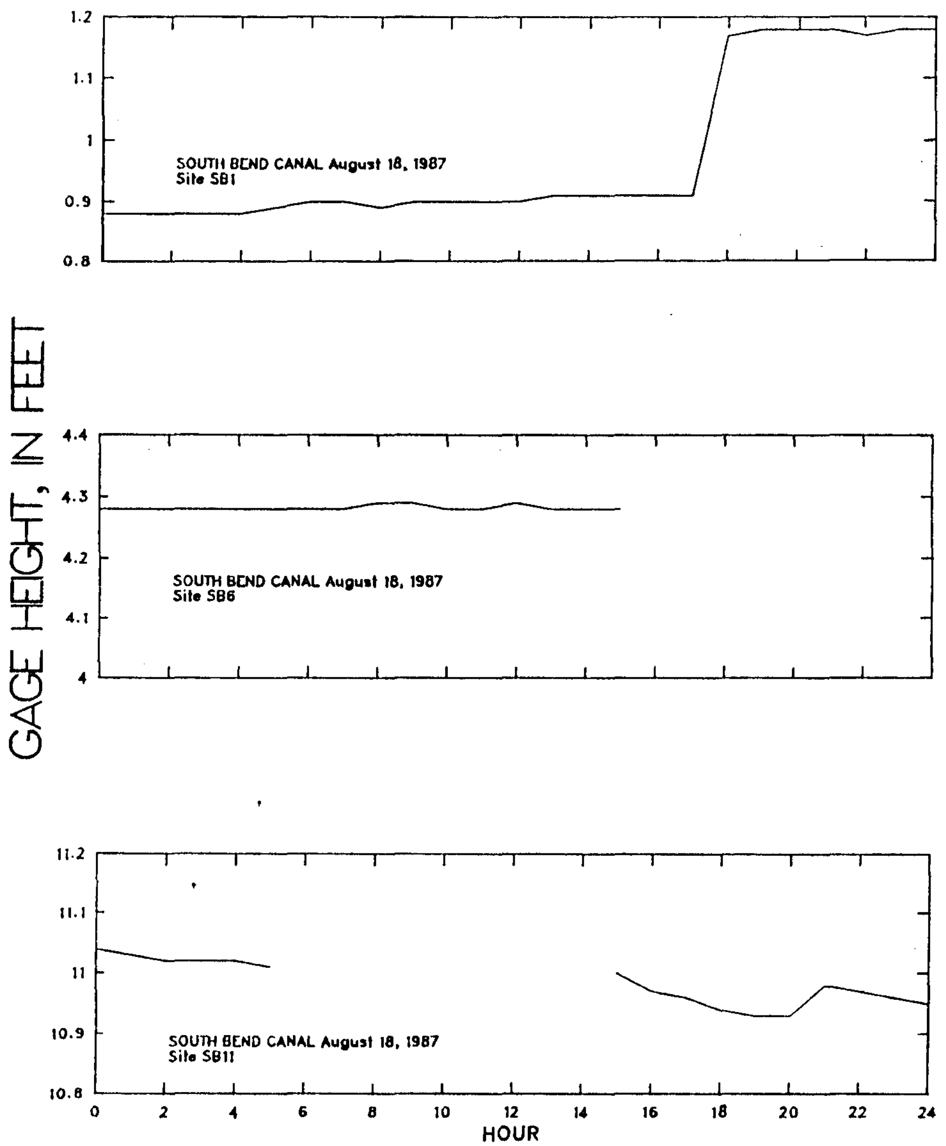


Figure 4.——Gage heights from recorder sites during discharge measurements on the South Bend Canal, 1987——Continued

Figure 5.

PAGE 1

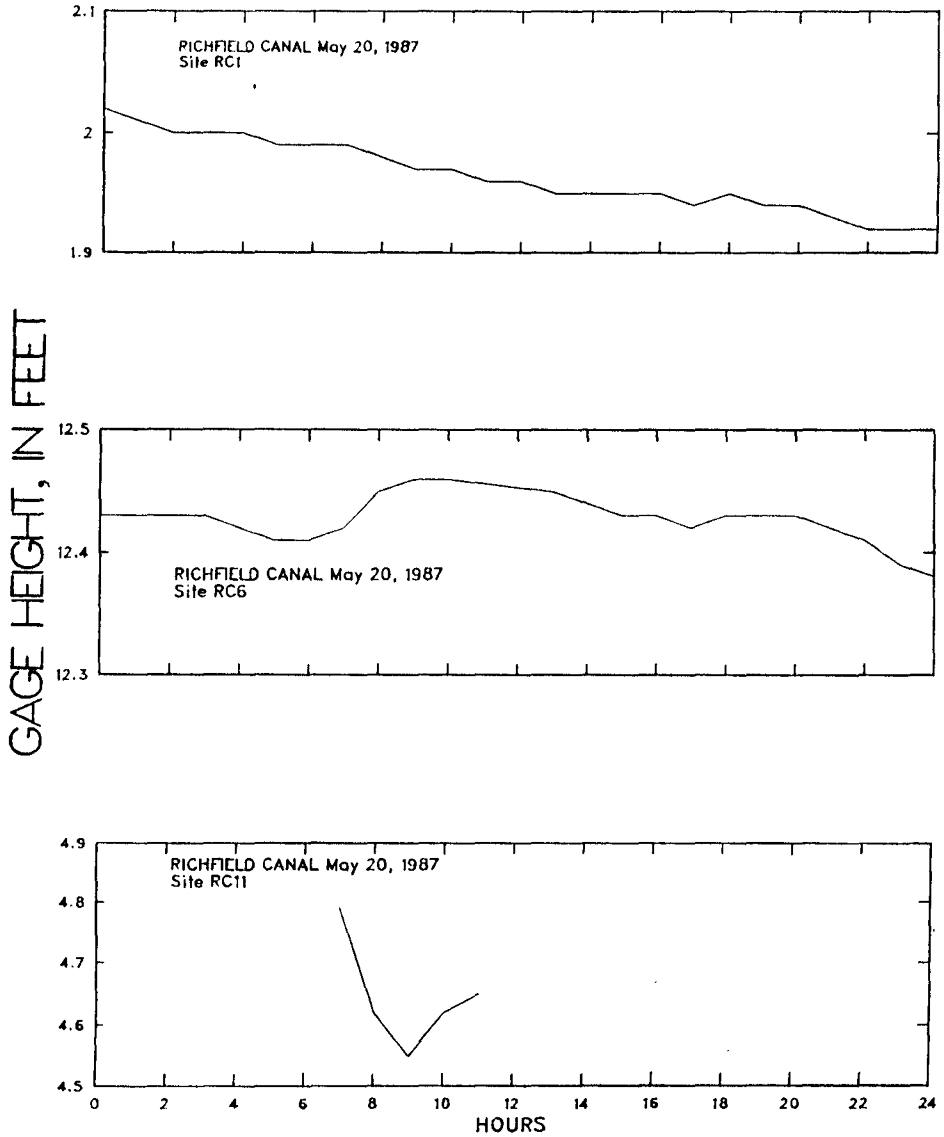


Figure 5.—Gage heights from recorder sites during discharge measurements on the Richfield Canal, 1987

FIGURE 5.--PAGE 2

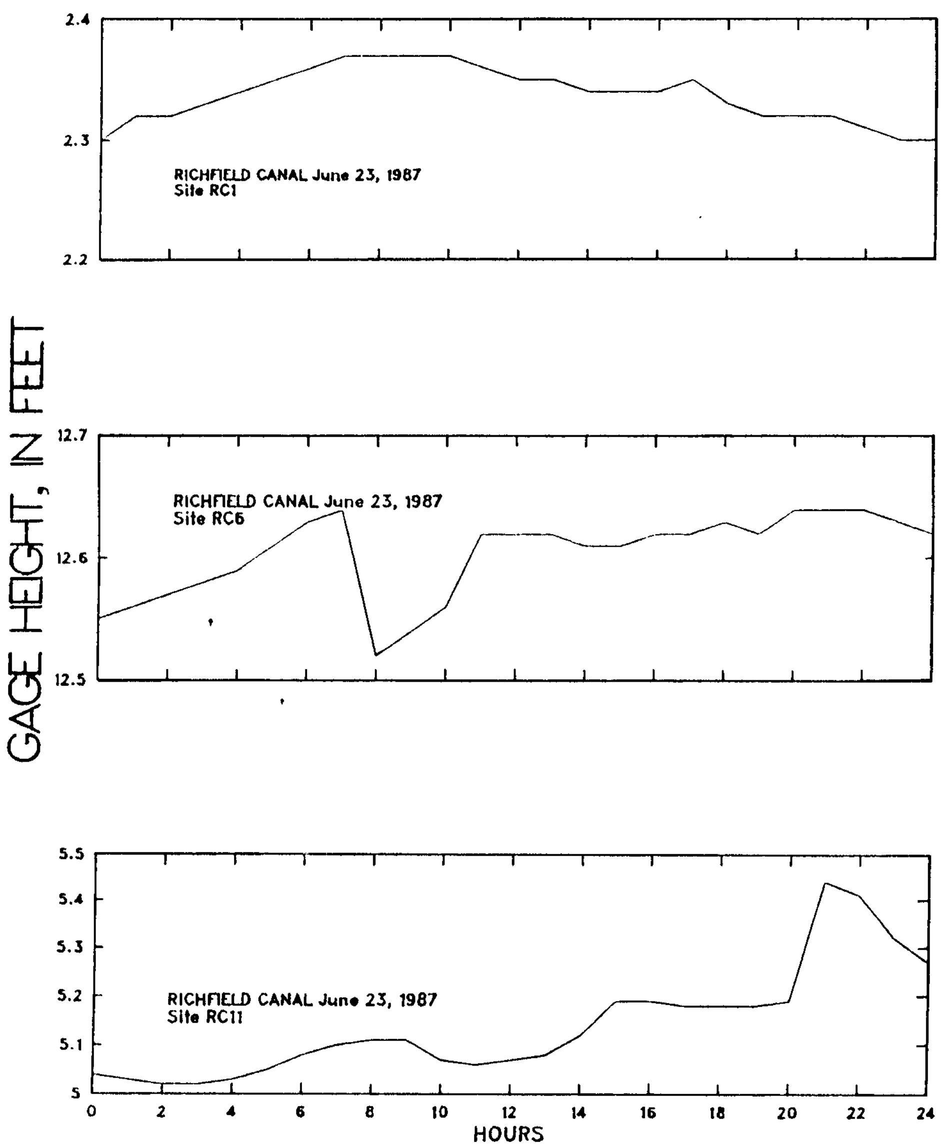


Figure 5.--Gage heights from recorder sites during discharge measurements on the Richfield Canal, 1987--Continued

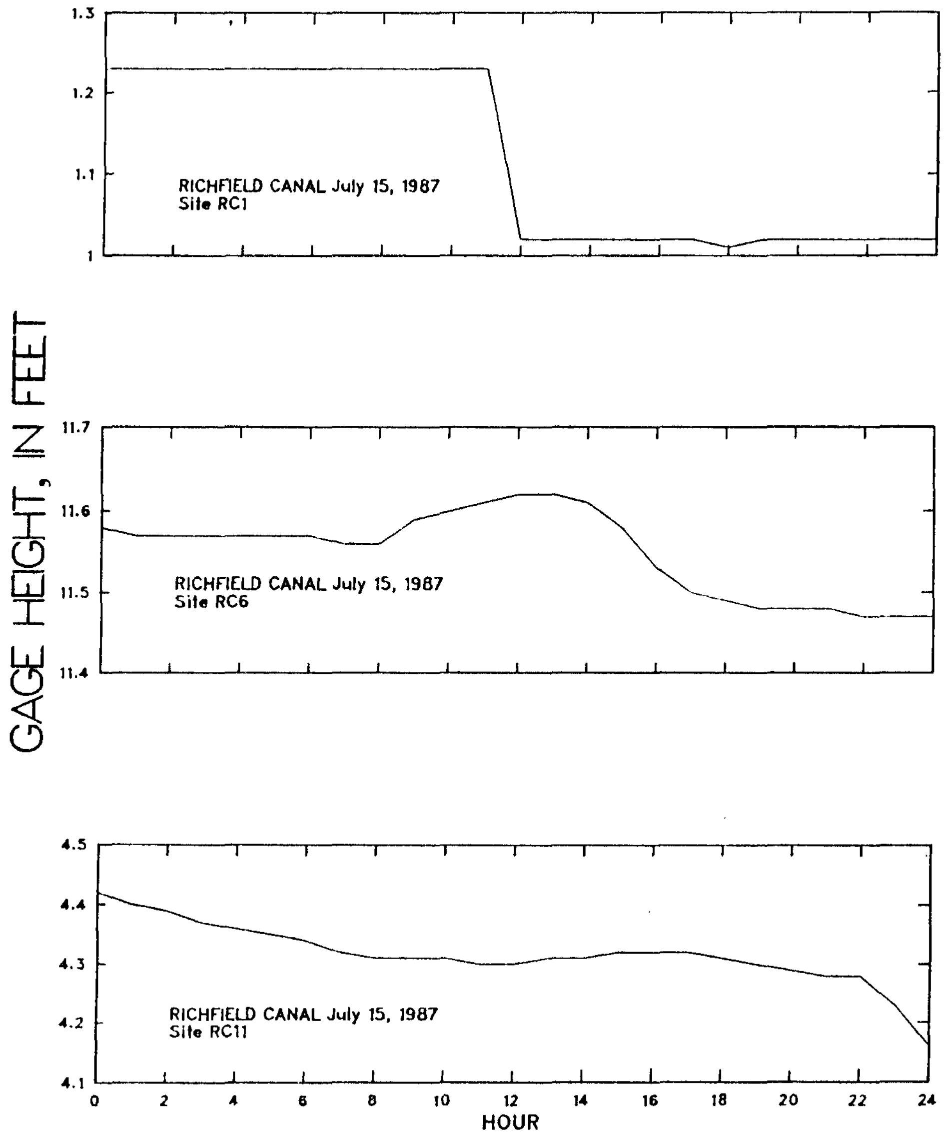


Figure 5.--Gage heights from recorder sites during discharge measurements on the Richfield Canal, 1987--Continued

FIGURE 5.--PAGE 4.

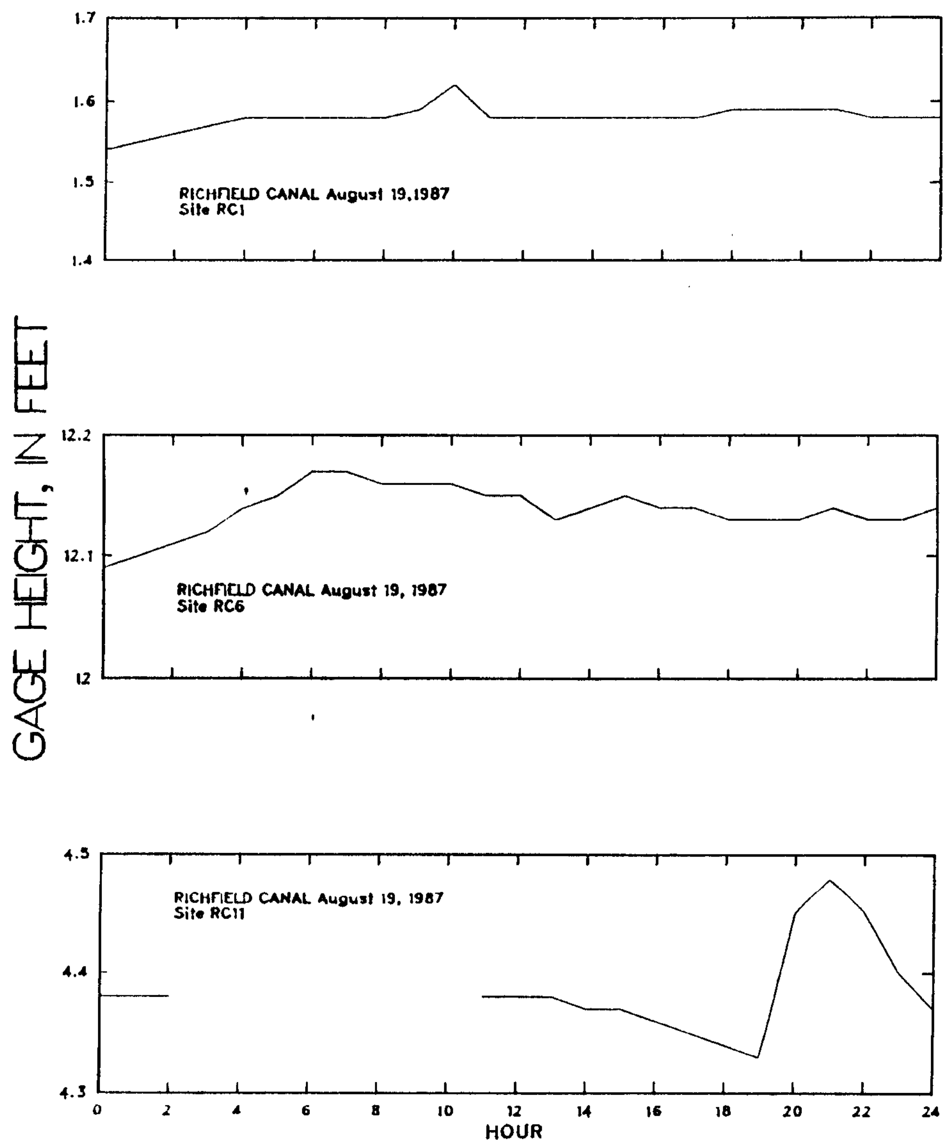


Figure 5.--Gage heights from recorder sites during discharge measurements on the Richfield Canal, 1987--Continued

Figure 6.

PAGE 1

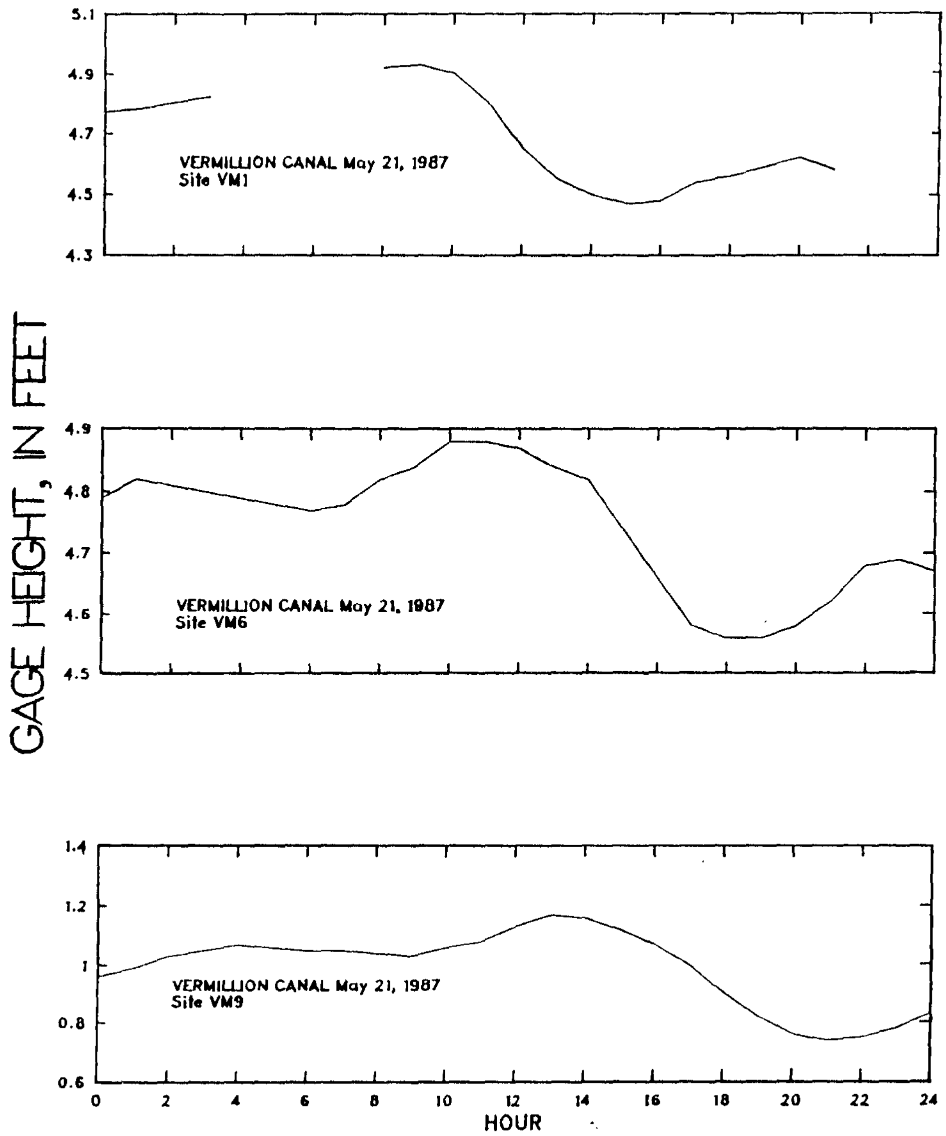


Figure 6.--Gage heights from recorder sites during discharge measurements on the Vermillion Canal, 1987

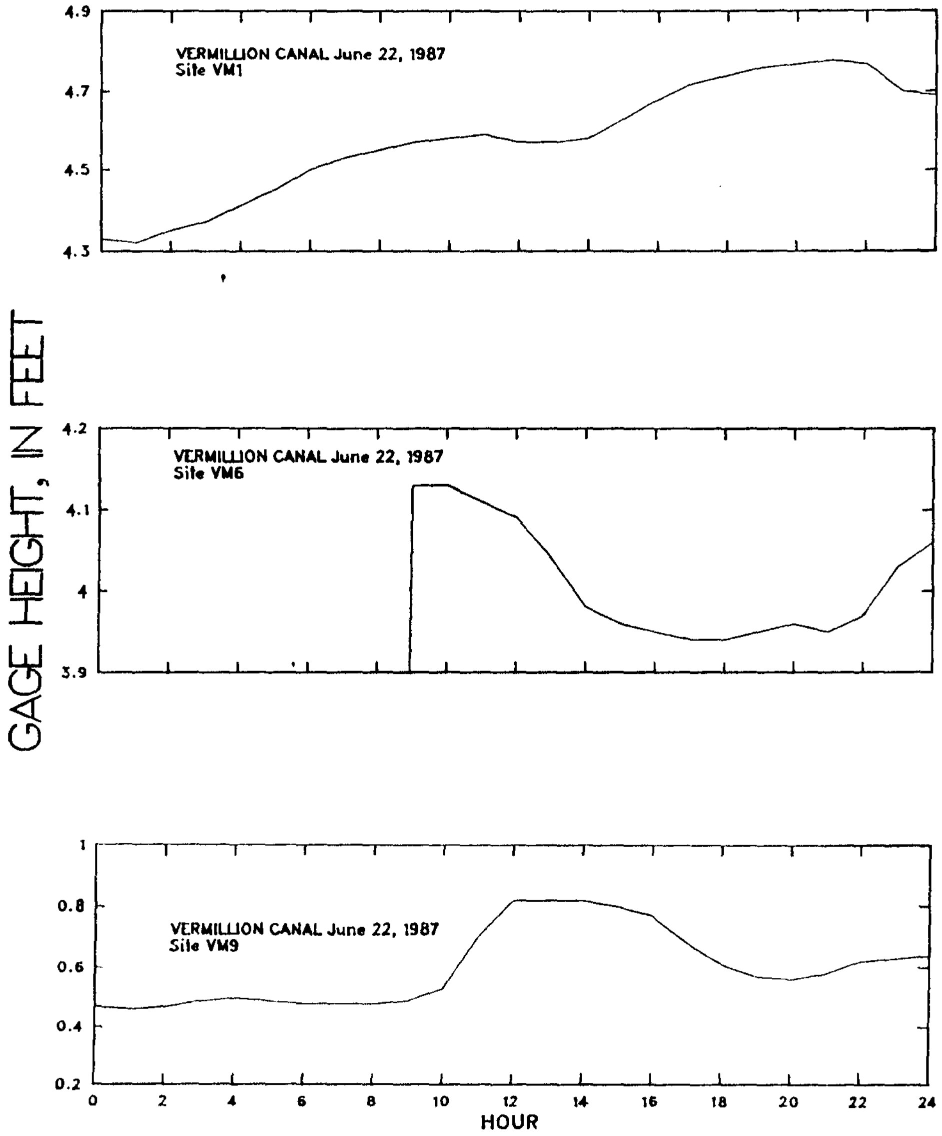


Figure 6.--Gage heights from recorder sites during discharge measurements on the Vermillion Canal, 1987--Continued

FIGURE 6.--PAGE 3

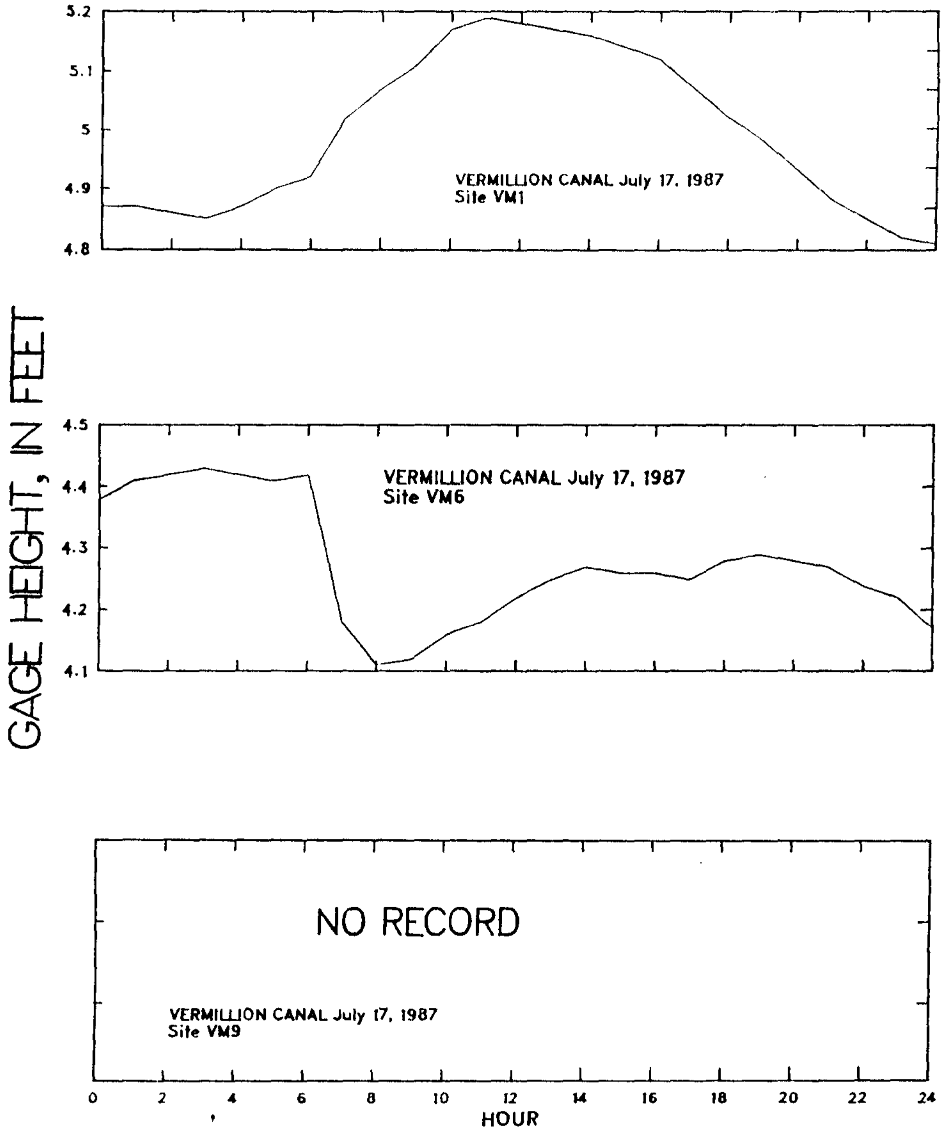


Figure 6.--Gage heights from recorder sites during discharge measurements on the Vermillion Canal, 1987--Continued

FIGURE 6.--PAGE 4

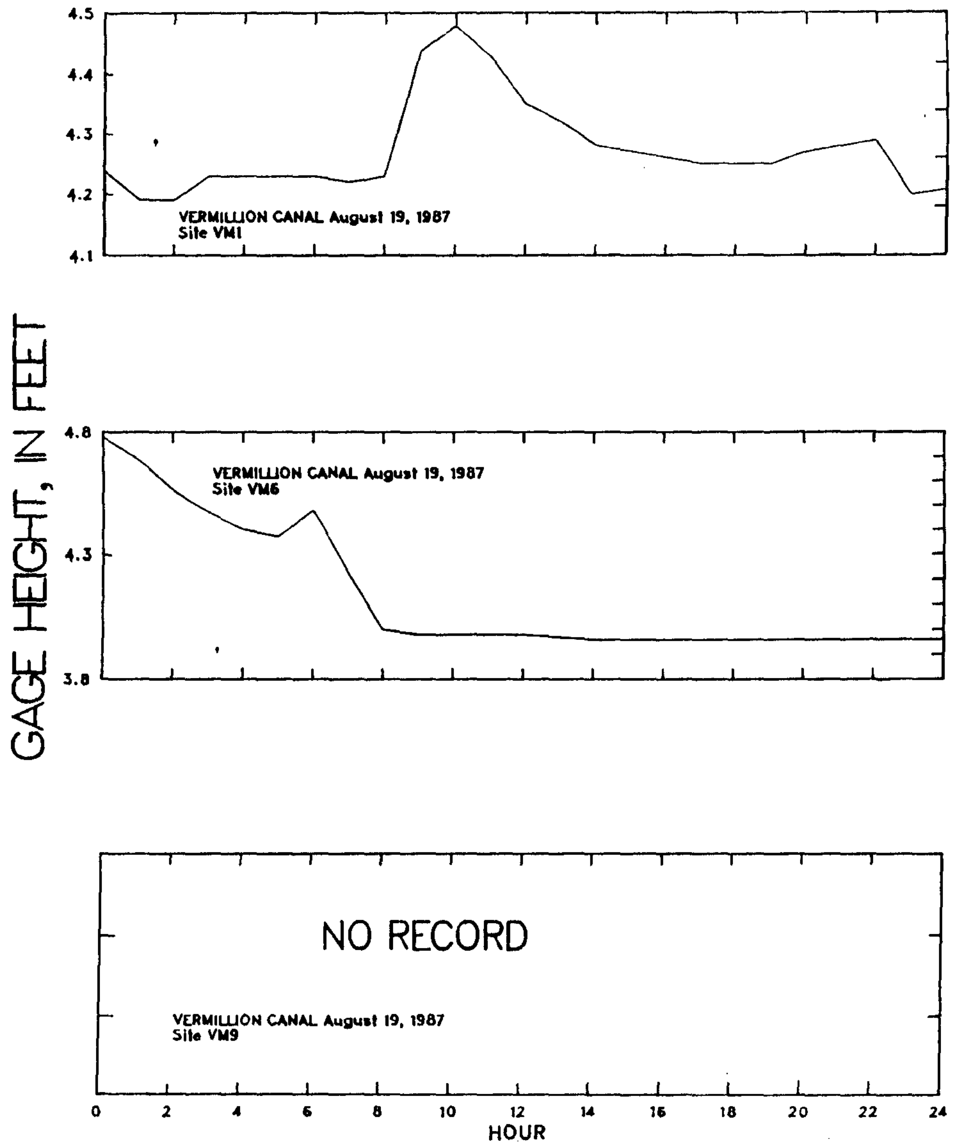


Figure 6.--Gage heights from recorder sites during discharge measurements on the Vermillion Canal, 1987--Continued

Figure 7.

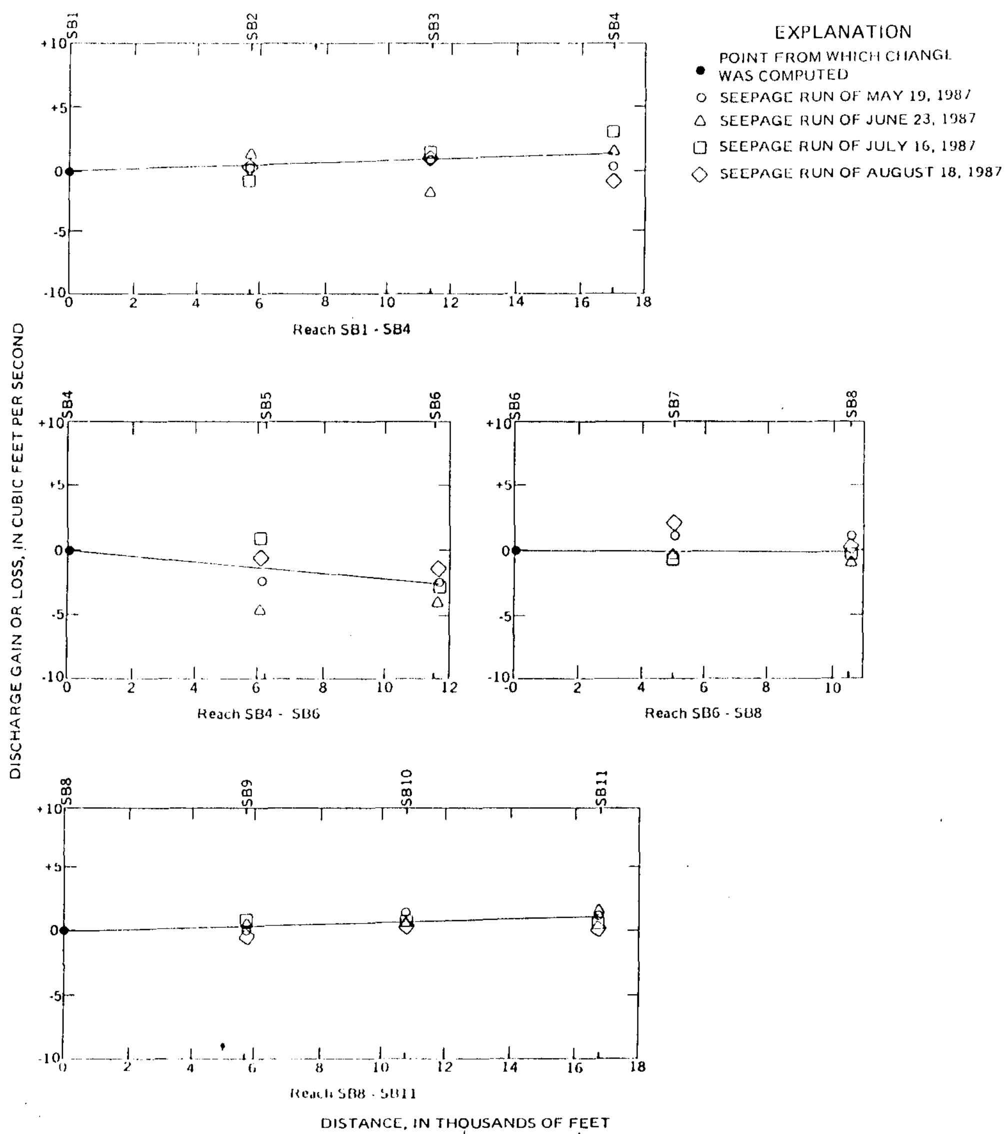


Figure 7.—Discharge gain or loss for reaches of the South Bend Canal, 1987.

Figure 8.
PAGE 1

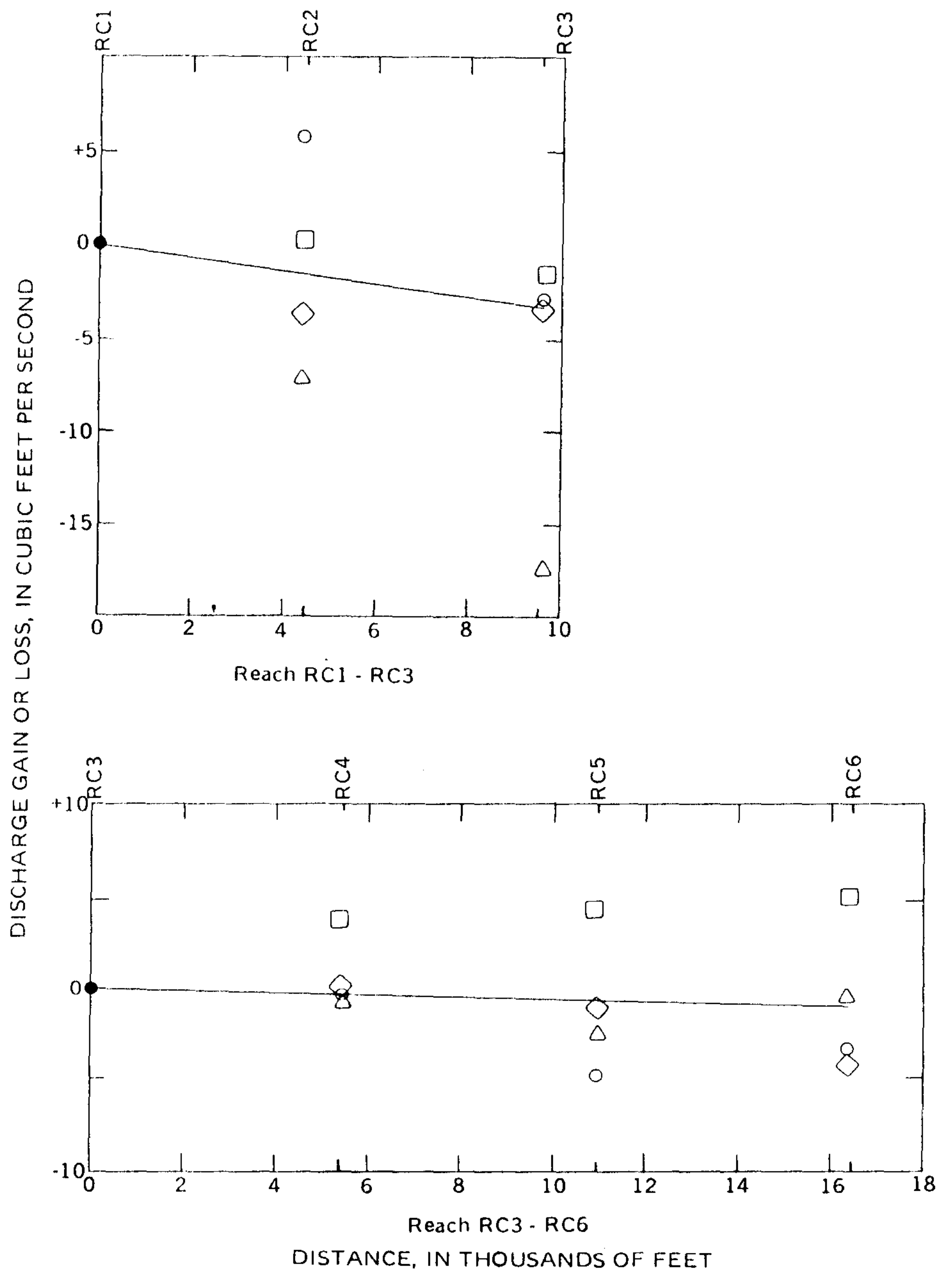


Figure 8.—Discharge gain or loss for reaches of the Richfield Canal, 1987.

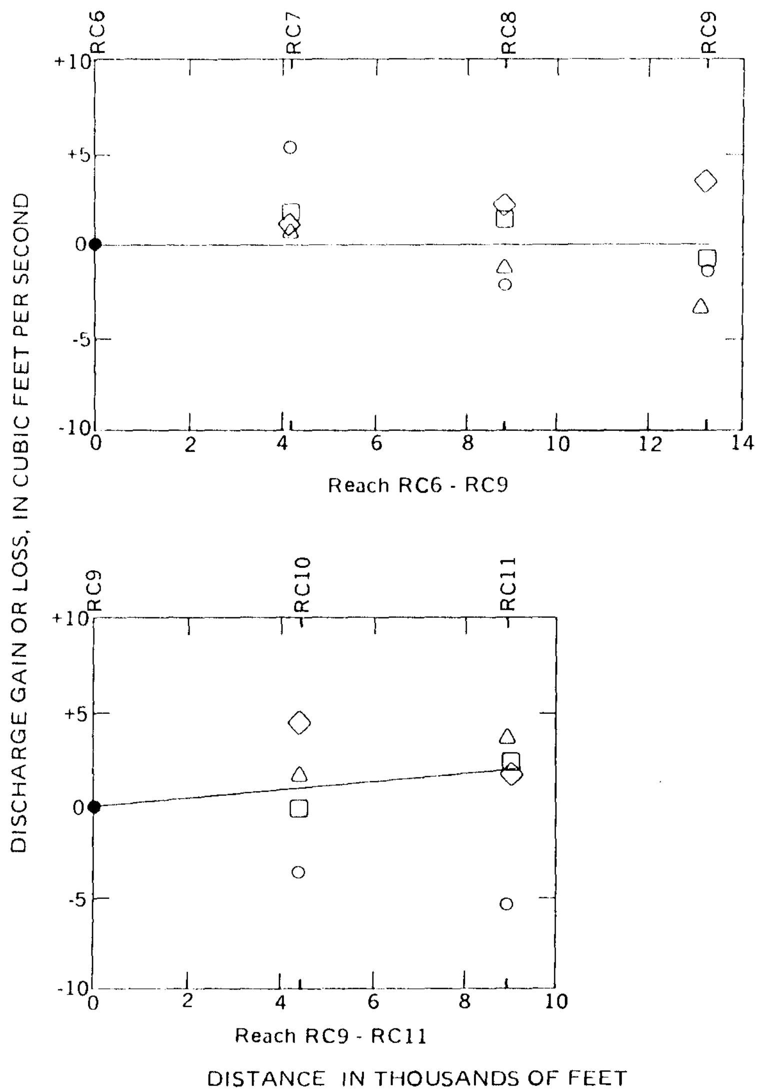


Figure 8.—Discharge gain or loss for reaches of the Richfield Canal, 1987—Continued.

Figure 9.

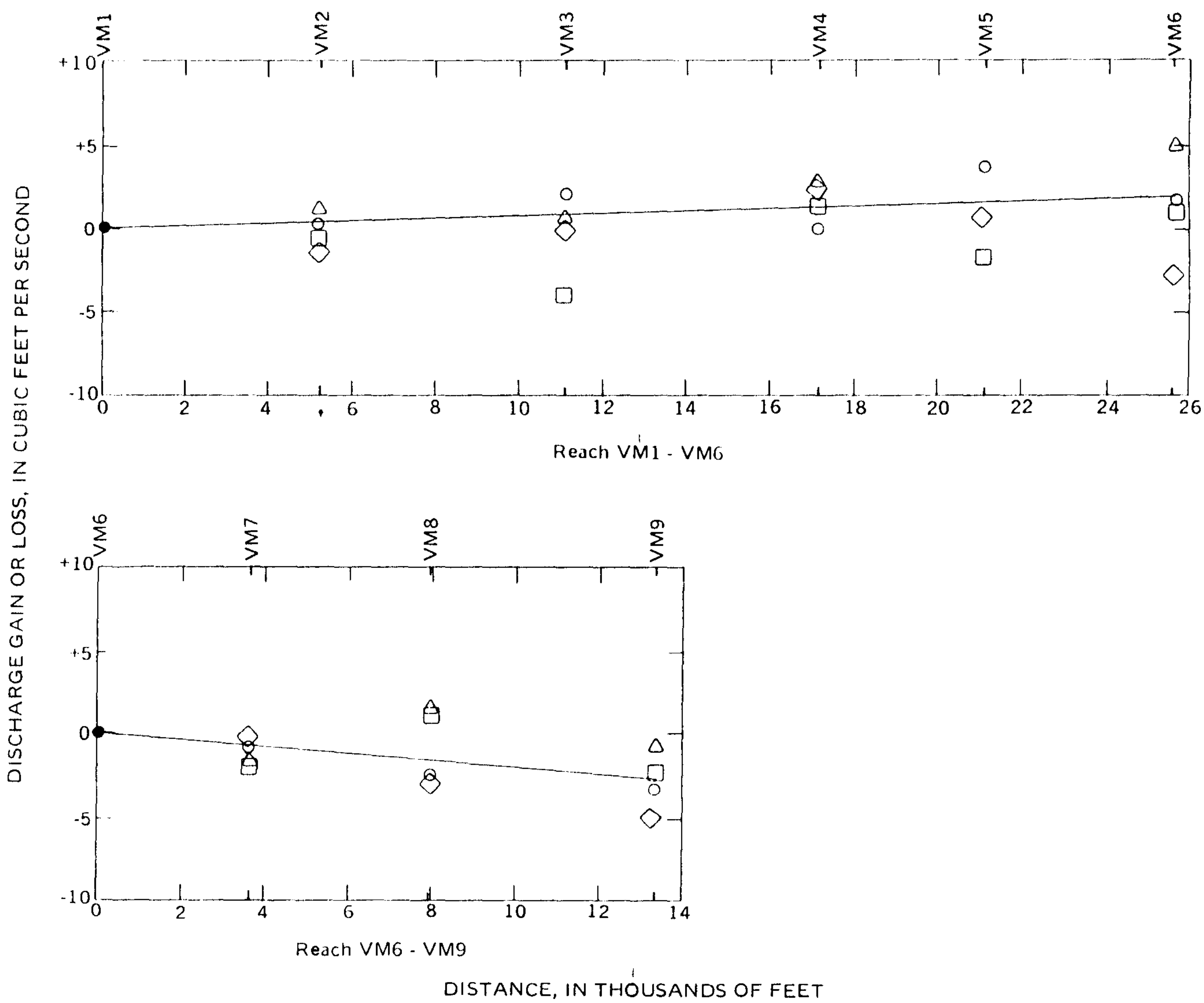


Figure 9.—Discharge gain or loss for reaches of the Vermillion Canal, 1987.

Table 1.—Measurements made on the South Bend Canal

Site: R, return; T, turnout. Discharge: E, estimated. Dashes (--), not measured

Site no. (fig. 1)	Time	Discharge (cubic feet per second)	Specific conductance (microsiemens per centimeter)	Water temperature (degrees Celsius)
		Measurements made on May 19, 1987		
SB1	0745	46.4	305	11.0
SB2	0855	46.3	310	11.0
T2	--	0.2E	--	--
SB3	1000	47.1	305	12.0
SB4	1050	46.5	310	12.0
T3	--	2.9	--	--
SB5	1140	41.2	320	12.5
T5	--	0.1E	--	--
T6	--	3.0E	--	--
SB6	1315	38.1	320	13.5
SB6	0745	47.5	305	10.5
T8	--	2.7	--	--
SB7	0835	37.5	335	10.5
T9	--	1.8	--	--
T10	--	6.5E	--	--
T12	--	2.0E	--	--
SB8	0920	27.3	340	11.0
T13	--	1.0E	--	--
T14	--	0.5E	--	--
T15	--	2.0E	--	--
T17	--	1.5E	--	--
SB9	1000	24.2	345	11.5
T19	--	1.9	--	--
T20	--	2.5	--	--
R1	--	0.2	--	--
R2	--	0.2	--	--
SB10	1045	19.9	340	12.0
T22	--	0.5E	--	--
R3	--	1.1	--	--
SB11	1130	20.3	340	12.5

Table 1.—Measurements made on the South Bend Canal—Continued

Site no. (fig. 1)	Time	Discharge (cubic feet per second)	Specific conductance (microsiemens per centimeter)	Water temperature (degrees Celsius)
		Measurements made on June 23, 1987		
SB1	1335	64.4	425	18.0
SB2	1420	65.5	425	19.0
T2	—	0.1	—	—
SB3	1500	62.7	430	18.5
SB4	1545	66.0	420	20.0
T4	—	4.0E	—	—
SB5	1615	57.7	420	20.0
T5	—	2.0E	—	—
T6	—	3.0E	—	—
SB6	1740	52.8	410	20.5
SB6	1345	54.5	—	—
T7	—	1.0E	—	—
T8	—	5.1	—	—
SB7	1440	48.3	—	20.0
T9	—	6.0E	—	—
T10	—	7.0E	—	—
T12	—	6.0E	—	—
SB8	1520	28.7	450	21.0
T13	—	1.0E	—	—
T14	—	2.0E	—	—
T15	—	3.0E	—	—
T17	—	2.0E	—	—
SB9	1750	20.8	450	21.0
T18	—	1.0E	—	—
T19	—	1.5E	—	—
MSB10	1835	20.0	420	21.5
T21	—	3.0E	—	—
T22	—	0.5E	—	—
T23	—	1.0E	—	—
SB11	1825	15.3	415	22.0

Table 1.—Measurements made on the South Bend Canal—Continued

Site no. (fig. 1)	Time	Discharge (cubic feet per second)	Specific conductance (microsiemens per centimeter)	Water temperature (degrees Celsius)
		Measurements made on July 16, 1987		
SB1	0950	32.1	490	18.5
T1	—	0.1E	—	—
SB2	1035	31.1	490	19.5
SB3	1110	33.2	485	20.0
SB4	1150	35.1	490	20.0
T3	—	1.0	—	—
SB5	1230	35.1	485	20.5
T5	—	1.0E	—	—
T6	—	4.0E	—	—
SB6	1315	26.2	485	21.0
SB6	1010	29.4	455	19.0
T7	—	2.5E	—	—
T8	—	3.5	—	—
SB7	1145	23.0	455	20.0
T9	—	2.6	—	—
T10	—	4.0E	—	—
T11	—	0.1E	—	—
T12	—	4.0E	—	—
SB8	1235	12.7	455	20.0
T13	—	1.0E	—	—
T15	—	1.0E	—	—
T17	—	1.0E	—	—
SB9	1315	10.5	450	20.5
T18	—	1.8E	—	—
T19	—	0.1E	—	—
T21	—	0.4E	—	—
T22	—	0.3E	—	—
SB10	1400	7.9	450	20.5
SB11	1450	7.9	445	20.5

Table 1.—Measurements made on the South Bend Canal—Continued

Site no. (fig. 1)	Time	Discharge (cubic feet per second)	Specific conductance (microsiemens per centimeter)	Water temperature (degrees Celsius)
		Measurements made on August 18, 1987		
SB1	1115	35.4	455	19.5
SB2	1210	35.8	455	20.0
SB3	1300	36.4	440	20.5
SB4	1340	33.6	435	21.0
T3	—	0.3E	—	—
SB5	1425	32.4	435	22.0
T5	—	0.3	—	—
T6	—	4.0E	—	—
SB6	1510	27.6	420	22.0
SB6	1115	28.5	400	19.0
T7	—	0.5	—	—
T8	—	1.1	—	—
SB7	1225	29.1	385	20.0
T9	—	1.1	—	—
T1	—	6.0E	—	—
T12	—	4.0E	—	—
SB8	1315	16.9	340	21.0
T13	—	1.2E	—	—
T15	—	0.5E	—	—
T16	—	0.3E	—	—
T17	—	3.0E	—	—
SB9	1400	11.9	390	24.0
T19	—	1.0E	—	—
T20	—	2.5E	—	—
SB10	1555	8.9	308	25.0
T23	—	2.9	—	—
SB11	1525	6.8	345	26.0

Table 2.—Measurements made on the Richfield Canal

Site: R, return; T, turnout. Discharge: E, estimated. Dashes (—), not measured.

Site no. (fig. 1)	Time	Discharge (cubic feet per second)	Specific conductance (microsiemens per centimeter)	Water temperature (degrees Celsius)
		Measurements made on May 20, 1987		
RC1	0820	91.3	390	13.0
T1	—	4.1	—	—
RC2	1000	92.8	385	13.0
RC3	1050	84.2	380	13.5
T4	—	0.1E	—	—
RC4	1215	83.8	380	13.5
RC5	1340	79.4	375	13.5
T9	—	5.7	—	—
RC6	1455	75.1	380	14.5
RC6	0730	79.7	410	11.0
RC7	0830	88.0	410	11.0
T17	—	5.0E	—	—
T18	—	2.7	—	—
RC8	0935	69.6	410	11.5
R2	—	1.0E	—	—
RC9	1020	71.6	415	12.0
T26	—	3.6	—	—
R3	—	0.5E	—	—
RC10	1115	65.1	410	12.5
T28	—	3.4	—	—
T29	—	7.0E	—	—
T30	—	3.8	—	—
T32	—	2.1	—	—
RC11	1150	48.7	410	13.0
		Measurements made on June 23, 1987		
RC1	0655	124.9	440	15.5
RC2	0745	118.1	440	16.0
RC3	0825	107.4	445	16.0
T4	—	3.0E	—	—
RC4	0910	104.0	450	16.0
T6	—	6.5	—	—

Table 2.—Measurements made on the Richfield Canal—Continued

Site no. (fig. 1)	Time	Discharge (cubic feet per second)	Specific conductance (microsiemens per centimeter)	Water temperature (degrees Celsius)
		Measurements made on June 23, 1987—Continued		
RC5	1010	95.4	445	17.0
T8	—	1.3E	—	—
T9	—	2.5	—	—
T10	—	5.5	—	—
T11	—	0.1E	—	—
RC6	1050	88.2	450	16.5
RC6	0705	88.0	460	16.0
T12	—	3.4	—	—
RC7	0825	85.2	480	16.0
T15	—	3.0	—	—
T16	—	4.9	—	—
T18	—	3.4	—	—
T19	—	3.5	—	—
T20	—	4.4	—	—
RC8	0915	64.1	490	16.0
R1	—	3.3	—	—
T21	—	0	—	—
T22	—	4.7	—	—
T24	—	3.7	—	—
RC9	1015	55.6	490	16.0
T27	—	1.2	—	—
RC10	1105	56.0	490	17.0
R4	—	1.3	—	—
T31	—	1.4E	—	—
RC11	1150	58.2	480	18.0
		Measurements made on July 15, 1987		
RC1	1310	24.4	500	21.5
RC2	1325	27.2	510	21.0
RC3	1400	25.4	520	21.0
T4	—	0.8	—	—
RC4	1445	28.3	530	21.0
T7	—	2.0E	—	—

Table 2.—Measurements made on the Richfield Canal—Continued

Site no. (fig. 1)	Time	Discharge (cubic feet per second)	Specific conductance (microsiemens per centimeter)	Water temperature (degrees Celsius)
		Measurements made on July 15, 1987—Continued		
RC5	1530	26.8	560	20.5
RC6	1615	26.9	570	20.5
RC6	1240	33.4	520	19.5
RC7	1340	35.2	515	19.5
RC8	1430	34.8	550	19.5
T23	—	0.4	—	—
RC9	1510	31.9	515	20.5
T27	—	1.4	—	—
RC10	1550	30.5	525	20.5
RC11	1635	32.9	520	21.0
		Measurements made on August 19, 1987		
RC1	0715	71.9	510	16.0
RC2	0800	68.6	510	16.0
T2	—	0.4	—	—
RC3	0840	68.3	505	16.5
T3	—	0.2	—	—
RC4	0920	67.8	505	16.5
T5	—	0.1E	—	—
T7	—	4.6	—	—
RC5	1000	62.4	505	17.0
T9	—	7.1	—	—
RC6	1035	52.2	505	17.0
RC6	0720	53.4	530	20.0
T12	—	0.2	—	—
T13	—	0.1	—	—
T14	—	1.2	—	—
T15	—	1.9	—	—
RC7	0840	51.7	490	18.0
T20	—	3.3	—	—
RC8	0945	48.7	495	17.0
T22	—	3.3	—	—

Table 2.—Measurements made on the Richfield Canal—Continued

Site no. (fig. 1)	Time	Discharge (cubic feet per second)	Specific conductance (microsiemens per centimeter)	Water temperature (degrees Celsius)
		Measurements made on August 19, 1987--Continued		
RC9	1035	46.9	490	18.5
T25	—	3.8	—	--
T26	—	4.5	—	--
T27	—	1.3	—	--
RC10	1130	41.8	530	21.5
R4	—	0.4	—	--
R5	—	0.2E	—	--
RC11	1210	39.1	—	--

Table 3.—Measurements made on the Vermillion Canal

Site: R, return; T, turnout. Discharge: E, estimated. Dashes (--), not measured.

Site no. (fig. 1)	Time	Discharge (cubic feet per second)	Specific conductance (microsiemens per centimeter)	Water temperature (degrees Celsius)
		Measurements made on May 21, 1987		
VM1	0755	50.5	640	12.5
R1		1.0E		
VM2	0910	51.6	640	12.5
T2		5.0		
T5		0.5		
VM3	1015	47.5	630	13.0
T7		0.1		
VM4	1010	43.9	650	13.5
VM5	1235	43.6	650	14.5
VM5	0745	47.3	660	11.5
VM6	0830	47.7	680	11.5
VM7	0910	46.9	680	11.5
VM8	0945	45.3	680	12.0
T21		0.2		
VM9	1030	44.5	700	12.5
		Measurements made on June 22, 1987		
VM1	1040	36.0	--	--
R1		1.0E		
VM2	1200	40.4	670	20.0
T1		8.5		
R2		0.1		
T4		8.0		
VM3	1320	19.4	680	21.5
T6		4.9		
VM4	1420	16.9		
VM6	1310	21.9	750	21.5

Table 3.—Measurements made on the Vermillion Canal—Continued

Site no. (fig. 1)	Time	Discharge (cubic feet per second)	Specific conductance (microsiemens per centimeter)	Water temperature (degrees Celsius)
		Measurements made on June 22, 1987—Continued		
VM6	1025	24.0	690	19.5
VM7	1105	23.0	695	20.0
VM8	1145	25.6	730	20.0
VM9	1210	23.4	740	21.0
		Measurements made on July 17, 1987		
VM1	0905	54.0	690	18.0
VM2	0955	53.5	690	18.0
T3	—	0.6	—	—
VM3	1050	49.4	690	20.0
VM4	0850	55.0	—	—
T9	—	4.1	—	—
VM5	1005	47.9	—	—
T10	—	5.2	—	—
T11	—	2.4	—	—
T12	—	5.8	—	—
T13	—	4.7	—	—
VM6	1050	32.4	680	19.5
T15	—	3.3	—	—
T17	—	2.6	—	—
VM7	1135	24.8	680	20.0
T19	—	4.7	—	—
T20	—	0.9	—	—
VM8	1210	22.2	—	—
T22	—	8.6	—	—
T23	—	3.0	—	—
T24	—	5.6	—	—
VM9	1225	1.6	680	20.5
		Measurements made on August 19, 1987		
VM1	1310	32.0	760	21.0
R1	—	2.8	—	—
VM2	1350	33.3	765	21.5
VM3	1420	35.8	770	21.5

Table 3.—Measurements made on the Vermillion Canal—Continued

Site no. (fig. 1)	Time	Discharge (cubic feet per second)	Specific conductance (microsiemens per centimeter)	Water temperature (degrees Celsius)
		Measurements made on August 19, 1987--Continued		
R3	—	0.4E	—	—
VM4	1450	37.1	770	21.5
T8	—	0.1E	—	—
VM5	1535	35.1	755	22.0
T11	—	6.3	—	—
T13		6.8	—	—
VM6	1610	17.7	775	20.0
VM6	1310	21.9	705	21.0
T14		7.9	—	—
T15		3.9	—	—
T16		3.2	—	—
VM7	1410	6.6	740	23.0
T18		1.8	—	—
VM8	1450	2.7	620	26.5
VM9	1520	0.0	—	—

Table 4.—Gains or losses determined from discharge measurements for reaches of the canals

Reach	Length (ft)	Graphic averages (from figures 7-9) Gain (+) or Loss (-) Cubic feet per second	Graphic averages (from figures 7-9) Gain (+) or Loss (-) Cubic feet per second per mile
South Bend Canal			
SB1-SB4	16,980	+1.5	+0.5
SB4-SB6	11,450	-2.5	-1.2
SB6-SB8	10,490	0	0
SB8-SB11	16,790	+1.2	+0.4
TOTAL	55,710	+0.2	
Richfield Canal			
RC1-RC3	9,550	-3.4	-1.9
RC3-RC6	16,400	-1.0	-0.3
RC6-RC9	13,100	0	0
RC9-RC11	8,870	+2.0	+1.2
TOTAL	47,920	-2.4	
Vermillion Canal			
VM1-VM6	25,550	+2.3	+0.5
VM6-VM9	14,300	-2.5	-0.9
TOTAL	39,850	-0.2	

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