WATER

HYDROLOGICAL DATA

NO. 8

TEST-DRILLING RESULTS

IN

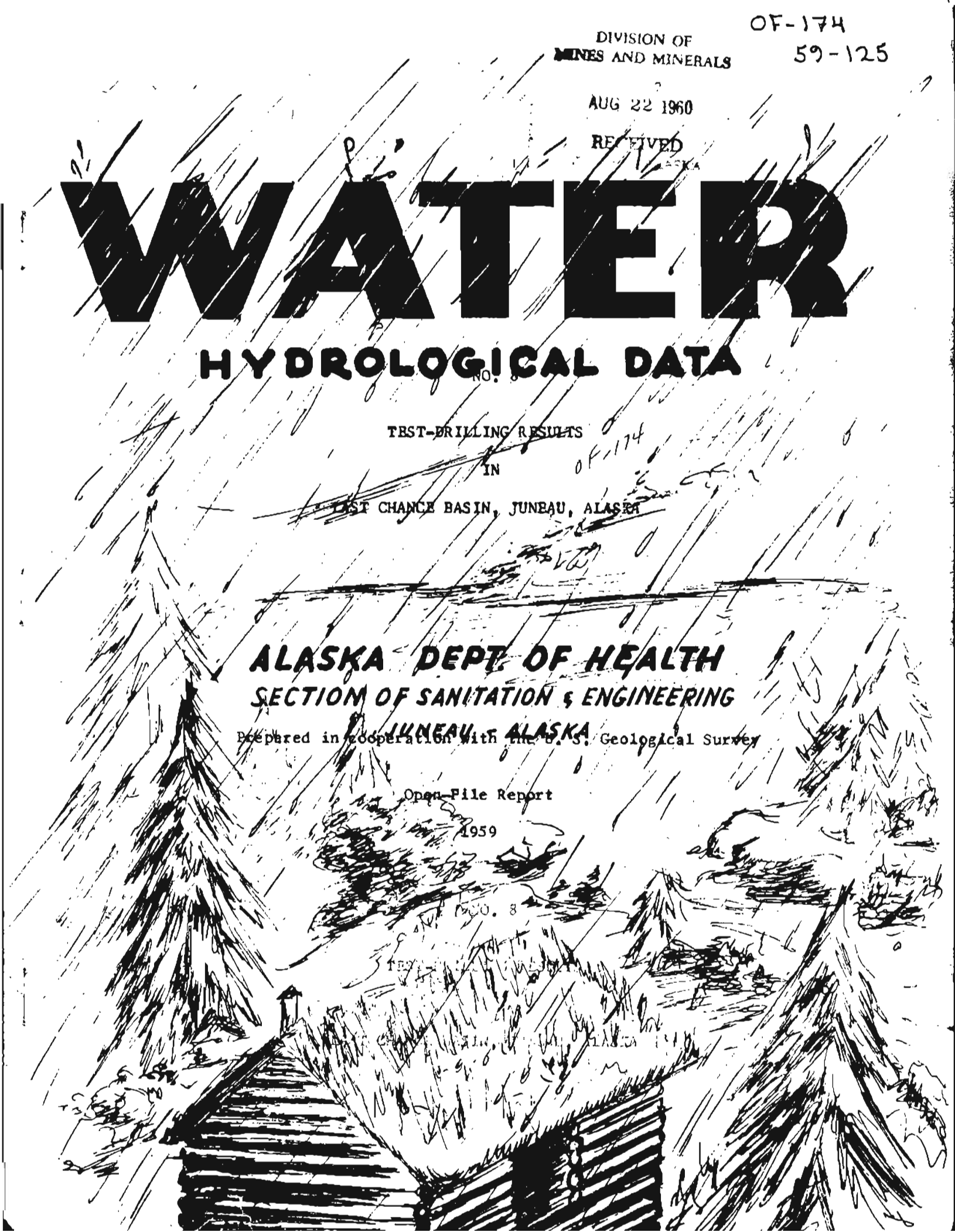
LAST CHANCE BASIN, JUNEAU, ALASKA

ALASKA DEPT. OF HEALTH
SECTION OF SANITATION & ENGINEERING
JUNEAU, ALASKA

Prepared in cooperation with the U. S. Geological Survey

Open-File Report

1959



SUMMARY

OF

TEST-DRILLING RESULTS

IN

LAST CHANCE BASIN, JUNEAU, ALASKA

By

Roger M. Waller

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SUMMARY OF TEST-DRILLING RESULTS IN LAST CHANCE BASIN, JUNEAU, ALASKA

By Roger M. Waller

Introduction

Purpose and Scope

This report is a summary of the results of a test-drilling project conducted by the city of Juneau in Last Chance Basin. The U. S. Geological Survey, by a cooperative agreement with the city, supervised the drilling project and collected supplemental hydrologic data as part of its overall program of evaluating the water resources of Alaska. The project presented an opportunity to observe the first concerted effort to determine ground-water resources in a part of southeastern Alaska.

The test-drilling project was undertaken to determine the geologic and hydrologic conditions in the basin. A series of exploratory test holes were drilled and then one test well was converted into a production well to make possible a pumping test to evaluate the water-bearing potential of the deposits penetrated. The information obtained in drilling and in making observations of streamflow and of ground-water-level fluctuations is presented herein, with a generalized summary of conclusions as to the geohydrology of Last Chance Basin. Mechanical (particle-size) analyses of sand and gravel samples of various water-bearing formations and data on water-level fluctuations observed during a 22 hour pumping test have not yet been compiled and are not included in this summary. This data when compiled will be incorporated with a general report on the ground-water resources of the entire Juneau area.

Location and Extent of Area

Last Chance Basin is just northeast of the city of Juneau (fig. 1) at an altitude ranging from about 260 feet to about 330 feet. The basin floor extends in an east-west direction for about 4,000 feet and is a maximum of 700 feet wide. Gold Creek traverses the basin from east to west and reaches tidewater at the city of Juneau about a mile from the lower end of the basin.

Geologic Features

Last Chance Basin lies in a narrow, steep-walled, glaciated valley. The basin is the lowest of several basins along the 5 miles of Gold Creek. The basin floor is underlain by unconsolidated deposits of Gold Creek, talus and slide rock from the adjacent mountain slope, and possibly marine deposits.

It has been presumed (Spencer, 1906, p. 79) that, after extensive glaciation, Last Chance Basin "was formed*** by a great landslide from the steep northern wall of the valley. The avalanche character of the dam is still easily recognized and the scar upon the mountain side is quite distinct, though the slide is certainly ancient. Its age is at least several hundred years***." It was believed that the dam thus created trapped sediments until it was breached, thus filling the bedrock valley to a level surface up to the toe of the slide. Spencer (p. 83) further reasoned that the bedrock floor was not much more than 90 feet below the basin floor "since rock is exposed in the stream bed at an elevation about 30 feet below the tunnel level." Presumably, this exposure is just below and on the south side of the present flume. Spencer stated (1906, p. 84) that "the slope (bedrock) from the present head of the flat (Last Chance Basin) to the head of the delta near Juneau may be supposed to have been practically uniform." and he based his assumption of the thickness of gravels in the basin on this reasoning.

Results of the test-hole drilling indicate that the unconsolidated sediments are at least 236 feet thick - - much thicker than had been postulated.

Test-Drilling Data

Test Holes

Eleven test holes were drilled in the basin (see fig. 2) to determine the character and thickness of the unconsolidated sediments. It was planned to drill each hole to bedrock, but difficulties were encountered which prevented all but one hole from reaching bedrock.

Drilling of the test holes, particularly tests 2B and 4 (table 1) indicated that the depth to bedrock was very great in part of the basin. Well 4 penetrated 236 feet of unconsolidated gravel, sand, silt, and clay, and had not reached bedrock. Test 3A is believed to have encountered bedrock at about 60 feet. The occurrence of numerous boulders at depth presented much drilling difficulty, so it was decided that too much time would be consumed in trying to determine depth to bedrock. It is assumed that the holes located along the south side of the basin were drilled essentially to bedrock because of the proximity of the "toe of the bedrock slope."

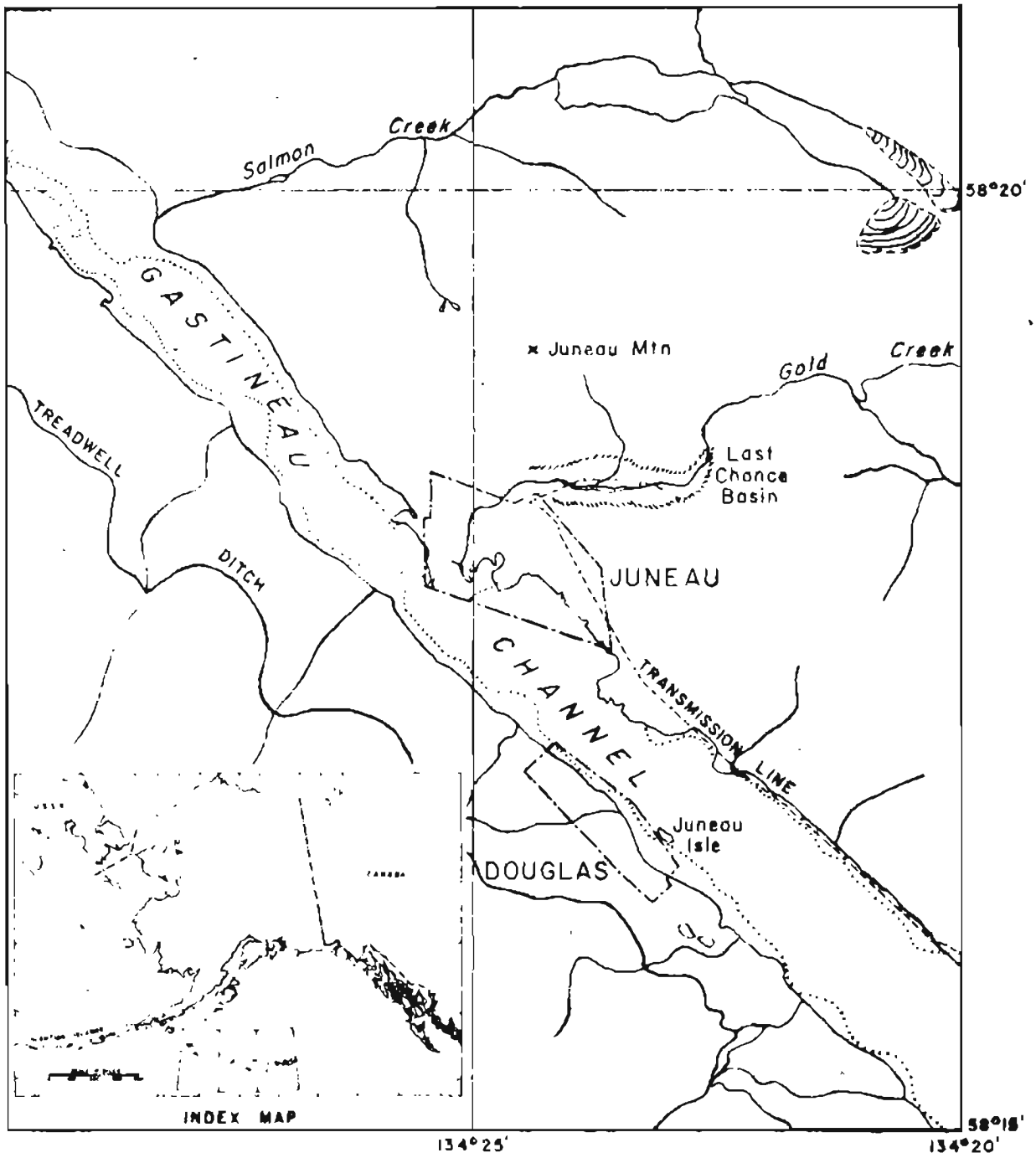

Figure 1. Index map of southeastern Alaska showing area of report.

The drill-hole data indicate that the axis, or deepest part of the bedrock valley (not the basin floor) probably lies near the north edge of the present basin floor. The lower reaches of the entire north slope of the valley are mantled with talus and slide rock, as compared to the essentially "mantle-free" slope on the south side of the valley. Hence, the present configuration of the valley does not indicate the shape of the bedrock floor.

The altitude of the bottom of the deep test hole is approximately 40 feet. Bedrock outcrops in Evergreen Bowl in Juneau (half a mile down Gold Creek from Last Chance Basin) indicate a very narrow (about 100 feet), steep-walled gorge at a creek altitude of about 60 feet. Hence, it appears that Gold Creek had an ancient, deeply cut canyon (?) extending from tidewater to a point at least halfway up Last Chance Basin. At the head of Last Chance Basin, bedrock occurs along the steeper gradient of Gold Creek.

The logs of the test holes indicate that the major water-bearing sand and gravel bodies are present within the upper 100 feet of sediments. Below this depth clay and silt predominate. The sand and gravel appear to occur in two distinct zones separated by a layer of clayey silt. (See table 1) The clayey-silt layer acts as a confining layer and creates an artesian head in the lower aquifer as much as 8 feet (test 2) above the land surface. The upper aquifer is confined in at least 2 wells (2 and 2B) but appears to be in direct contact with the creek in most places. It might be that this upper confining layer is a deposit of a lake formed by Spencer's postulated landslide dam referred to earlier.

As is to be expected, the coarseness of the sand and gravel particles in the water-bearing formations increases in the upstream direction. Test holes 3 and 3A appear to have better water-yielding capabilities than test holes further downstream.

Test Well

The site for the 8-inch test well (fig. 2) was selected to permit having several observation wells nearby and to test the lower aquifer at a site relatively close to the Jualpa tunnel. It is thought that the tunnel might be used to transmit water to the city. Its lower end terminates in the Evergreen Bowl within the city limits. The test well was completed and tested for about 22 hours at the rate of about 100 gpm, —- about 40 feet of drawdown. Extensive data were collected during the test and will be incorporated in a later report.

Water-Level Data

Daily water-level measurements were began in each test hole after completion of drilling. See table 2 for all daily measurements.

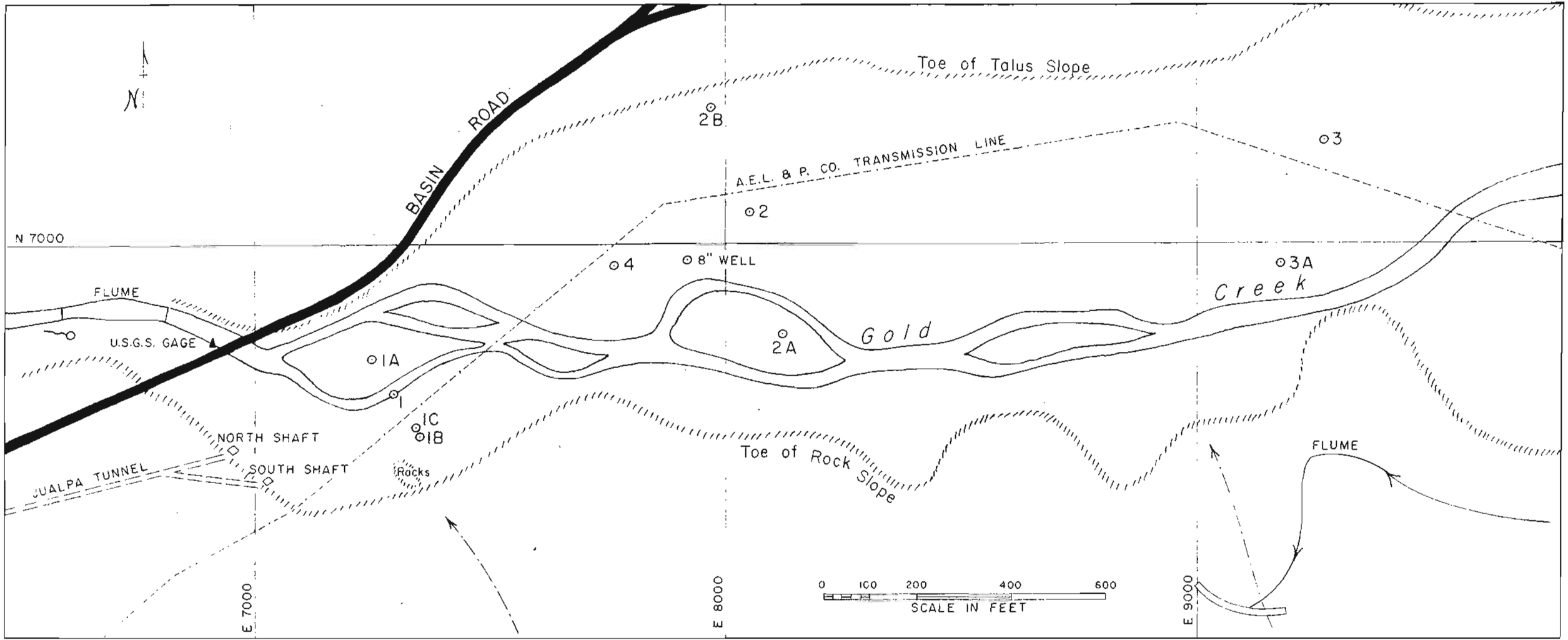

Figure 2. Map of Last Chance Basin showing location of test holes.

The measurements were usually made about 11:00 a.m. each day that the author was in Juneau and are recorded as depth to water below the measuring point. During the pumping test on the 8-inch well, recording gages were installed on four adjacent test holes to observe the effects of pumping.

The changes recorded in the water levels of each well correlate very well with the amount of flow in Gold Creek. (See table 3 for the daily discharge of Gold Creek.) As the amount of flow in Gold Creek increased, the water level in each well rose. Conversely, as the flow of Gold Creek decreased the water levels fell. The discharge of the creek at this time of the year is at its lowest (Wells and Love, 1958a, p.23) so it is probable that the water levels in the wells also were at a low point.

Contrary to expectations, the downstream wells showed a rise in water level prior to those upstream when the creek discharge was increasing. The rising effect seemed to be progressively reflected up the basin. Conversely, the downstream wells showed the drop in water level first and the effect was progressively noticed up the valley. It is thought that the creek has immediate access to recharge the lower aquifer in the downstream part of the basin; hence, the recharge takes effect promptly and the increase in water pressure is transmitted back up the confined aquifer.

Stream-Discharge Data

The U. S. Geological Survey operates a continuous recorder at the Gold Creek Bridge at the lower end of Last Chance Basin. Records of discharge in prior years are recorded in three water supply papers. (See selected references.) The daily discharge of Gold Creek during the test-drilling project is tabulated in table 3.

Three series of gaging measurements were made on Gold Creek to try to determine the loss or gain in the creek discharge from the head of the basin. The following discharge measurements, in cubic feet per second (cfs), were recorded:

Date 1959	Head of Last Chance Basin	USGS Gage	Calhoun St. flume	Powerhouse tailrace
January 29	7.7 cfs.	4.8 cfs.	5.7 cfs.	*
February 17	8.3	4.9	4.5	3.8 cfs.
March 31	8.0	5.0	8.2	0

*Not measured.

The Calhoun Street flume is below the Evergreen Bowl, at the rock gorge mentioned previously. The powerhouse tailrace is at tidewater. The Calhoun plus tailrace discharge is the total yeild of Last Chance Basin except for an unknown minor diversion through the abandoned Alaska-Juneau gold mill (upstream from area shown on fig. 2) and the unknown diversion to the Juneau water supply. The city collects water from the spring (see fig 2) below the end of Last Chance Basin.

Water temperatures of the creeks and spring are shown on table 2. For comparison, ground-water temperatures of well 2 (allowed to flow a couple of hours) were 35°F, 39°F, and 40°F on March 17, 19, and April 8, respectively. The temperature of the test-well water was 39½°F during the 2-day test, April 10 and 11.

Chemical Analysis

Table 4 gives the chemical analysis of water samples from the lower aquifer of well 2 and the 8-inch well.

Selected References

Spencer, A. C., 1906, The Juneau gold belt: U. S. Geological Survey Bull. 287

Wells, J. V. B., and Love, S. K., 1957, Compilation of records of quantity of surface waters of Alaska through September 1950: U. S. Geological Survey Water-Supply Paper 1372.

_____, 1958, Quantity and quality of surface waters of Alaska, October 1950 to September 1953: U. S. Geological Survey Water Supply Paper 1466.

_____, 1958, Quantity and quality of surface waters of Alaska, October 1953 to September 1956: U. S. Geological Survey Water Supply Paper 1486.

Table 1. Logs of test holes, Last Chance Basin, Juneau, Alaska

	Thickness (feet)	Depth (feet)
Test Hole 1. Altitude 272 feet		
Sand and gravel	17	17
Sand, fine, water-bearing	9	26
Clay, blue, gravel and sand	13	39
Gravel and sand, fine, water-bearing	3	42
Sand and gravel, medium, water-bearing	8	50
Cased to 45 feet.		
Test Hole 1A . Altitude 271 feet		
Gravel and sand, fine, water-bearing	24	24
Clay, sand, and gravel, with wood	25	49
Gravel and boulders, water-bearing	2	51
Gravel and sand, water-bearing	10	61
Gravel, sand, and clay, water-bearing	6	67
Boulder (?)	1	68
Cased to 67 feet.		
Test Hole 1B . Altitude 274 feet		
Gravel, very coarse	5	5
Gravel, coarse	5	10
Gravel and clay	5	15
Gravel, water-bearing	10	25
Gravel, fine, and clay, brown	10	35
Gravel and sand, fine, water-bearing	5	40
Casing pulled.		

Table 1. Logs of test holes, Last Chance Basin, Juneau, Alaska - Continued

	Thickness	Depth
Test Hole 2 , Altitude 290.9 feet		
Gravel, sandy	9	9
Sand and gravel, water-bearing	9	18
Sand, fine, silt and clay	19	37
Gravel, fine, water-bearing	5	42
Sand, fine, water-bearing	3	45
Boulder	3	48
Gravel, fine, and sand, water-bearing	3	51
Sand, fine, and gravel, coarse, water-bearing	6	57
Sand, medium, water-bearing	3	60
Gravel, very coarse, water-bearing	5	65
Cased to 61 feet. Casing perforated at 50, 54, and 58 feet.		
Test Hole 2A , Altitude 286.1 feet		
Gravel, coarse to very coarse	10	10
Gravel, coarse, with wood, water-bearing	5	15
Gravel, fine, water-bearing	10	25
Clay, gray	22	47
Boulder	1	48
Gravel, very coarse, water-bearing	4	52
Cased to 52 feet.		

Table 1. Logs of test holes, Last Chance Basin, Juneau, Alaska - Continued

	Thickness (feet)	Depth (feet)
Test Hole 2B . Altitude 238.8 feet		
Fill	5	5
Clay, gray and humus	5	10
Gravel, water-bearing	5	15
Clay and gravel with wood, water-bearing	10	25
Clay, brown and gravel	5	30
Gravel, fine	5	35
Gravel, coarse, water-bearing	5	40
Gravel, fine	10	50
Gravel, coarse, water-bearing	20	70
Gravel, fine, water-bearing	25	95
Clay and silt	25	120
Clay, gray	15	135
Clay, dark-gray with pebbles and shells starting at 139 feet	20	155
Gravel and clay	4	159
Clay, gray	8	167
Cased to 165 feet. Casing perforated at 54, 58, 62, and 66 feet.		
Test Hole 3 . Altitude 300 feet		
Gravel, coarse	5	5
Gravel, fine, water at 8 feet	5	10
Gravel, coarse, with clay, water-bearing	25	35
Clay, gray	10	45
Gravel, fine and boulders	7	52
Sand, fine to medium, hard packed, water-bearing	8	60
Gravel, very coarse, water-bearing	5	65
Sand, medium, water-bearing	5	70
Gravel, course, occasional clay and pebbles, water-bearing	35	105
Gravel, coarse, and sand, fine, water-bearing	5	110
Gravel, coarse, water-bearing	2	112
Cased to 112 feet.		

Table 1. Logs of test holes, Last Chance Basin, Juneau, Alaska - Continued

	Thickness (feet)	Depth (feet)
Test Hole 3A . Altitude 298 feet		
Gravel, very coarse	5	5
Gravel, coarse, water-bearing	35	40
Gravel, coarse	5	45
Clay, black, and gravel	5	50
Clay, black, and sand, fine	5	55
Sand, fine, black, water-bearing	5	60
Slate, black	10	70
Cased to 58 feet.		
Test Hole 4 . Altitude 280.6 feet		
Silt and humus	5	5
Gravel, very coarse	5	10
Clay, gray, and silt	10	20
Clay, gray and gravel	10	30
Clay, gray	5	35
Gravel, fine to medium, wood chips at 40-45 feet, water-bearing	27	62
Gravel, sand, fine, and some silt, water-bearing	2	64
Sand and silt, brown	9	73
Sand and silt, gray	2	75
Silt, gray; wood chips 80-90 feet	25	100
Silt and clay; shells	10	110
Silt and gravel; shells	2	112
Silt with clay	15	127
Silt and gravel, water-bearing	3	130
Clay, blue	45	175
Clay, blue and gravel	5	180
Clay, blue	25	205
Sand, fine	5	210
Gravel, fine	10	220
Boulder	3	223
Gravel, fine, water-bearing	3	226
Sand, fine	4	230
Gravel, cemented and clay, green	6	236
Cased to 236. Casing perforated at 40, 43, 49, 52, and 55 feet.		

Table 1. Logs of test holes, Last Chance Basin, Juneau, Alaska - Continued

	Thickness (feet)	Depth (feet)

6-inch Test Well . Altitude 282.45 feet

Clay and humus	5	5
Gravel, fine to medium, water-bearing	11	16
Silt and clay	9	25
Silt, clay, and rocks	5	30
Clay and occasional rocks	5	35
Gravel, fine to medium, water-bearing	15	50
Sand, fine, and rocks, small, some water	6	56
Gravel, medium, water-bearing	4	60
Gravel, coarse, water-bearing	8	68
Sand, fine, water-bearing	2	70

Cased with 8-inch to 58 feet. 6-inch from 53 to 70 feet, perforated at 50 to 66 feet.

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Table 2. Measurements of the water levels in wells in Last Chance Basin.
(In feet below measuring point.

Date 1959	Temperature °F Gold Creek	City Spring	Well 1	Well 1A	Well 2							
2/16	34	-	7.42 [1]	-	-							
2/17	34	-	6.96	-	-							
2/18	32½	-	7.01	-	-							
2/19	32½	-	7.06	-	-							
2/20	34	-	7.04	-	-							
2/21	34	-	7.04	-	-							
2/23	35	-	6.87	-	-							
2/24	35	-	6.80	Start [2]	-							
2/25	35	-	6.77	7.70	-							
2/26	35	-	6.42	7.71	-							
2/27	35	-	6.27	7.24	-							
2/28	35	-	5.80	7.77	-							
3/1	36	-	5.79	7.00	-							
3/2	35	-	6.05	7.06	-							
3/3	34½	-	5.62	6.81	-							
3/4	35	-	6.10	7.04	-							
3/9	-	-	6.00	7.30	-							
3/13	34	-	6.03	7.58	-							
3/14	36	-	6.33	7.71	-							
3/15	35½	-	6.51	7.68	-							
3/16	35	-	5.74	6.72	Start [3]							
3/17	34	-	6.16	7.26	0.69							
3/18	33½	-	6.45	7.57	0.71							
3/19	34½	37½	6.57	7.65	0.76							
3/20	33½	37½	6.68	7.78	0.79							
3/21	34	-	6.82	7.85	0.85							
3/22	35	-	6.90	7.95	-							
3/23	35½	-	6.96	8.03	1.07							
3/24	36	-	7.03	8.04	1.13							
3/25	36½	-	7.07	8.06	1.17							
3/26	35½	-	7.11	8.12	1.19							
3/27	-	-	-	8.09	-							

1/ MP is top of casing, altitude 273.8 feet.
2/ MP is top of casing, altitude 273.3 feet.
3/ MP is top of plate on casing, altitude 291.0 feet.

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Table 2. Measurements of the water level in wells in Last Chance Basin. (In feet below measuring point.) - Continued

Date	Temperature °F		Well	Well	Well	Well	Jualpa	Tunnel	Well	Well	Well	Well
	Gold Creek	City Spring	1	1A	2	2A	South Shaft	North Shaft	2B	3	3A	4
3/30	-	-	-	8.04	-	Start[1]	Start[2]			Start[3]	Start[4]	
4/7	37	38	6.31[5]	7.39[6]	0.83	1.48	1.98	Start[7]		4.51	7.58	
4/8	38	-	6.37	7.41	0.88	1.50	2.32	10.14		4.53	7.64	
4/9	36	-	6.37	7.39	0.83	1.50	2.24	10.16		4.56	7.66	
4/10	37½	-	6.25	7.14	0.55	1.44	1.86	9.88		4.56	7.61	
4/11	38	38	5.93	6.86	0.13	1.30	1.77	9.71		4.25	7.44	
4/12	37½	-	5.93	6.89	2.68	1.18	1.83	9.61		4.03	7.24	
4/13	38	-	5.91	6.88	2.71	1.18	1.85	9.71		3.97	7.12	
4/14	37½	-	5.91	6.92	2.78	1.18	1.89	9.76		3.97	7.05	
4/15	38	-	5.99	7.00	2.91	1.22	1.98	9.83		3.97	7.07	
4/16	38	-	6.03	7.04	3.01	1.26	2.01	9.88		3.94	7.07	
4/17	37½	-	6.03	7.02	3.01	1.30	1.89	9.83		3.94	7.10	
4/20	38	-	5.03	5.90	2.52	1.09	0.59	8.93		3.23	-	
4/21	39	-	4.91	5.97	2.21	0.95	1.30	8.37		2.72	6.41	
4/22	40	-	5.00	6.14	2.04	0.84	1.58	8.98		2.61	6.24	
4/23	39	38½	5.19	6.27	2.07	0.87	1.71	9.13		2.62	6.17	
4/24	38½	-	5.31	6.39	2.23	0.90	1.65	9.23		2.65	6.16	
4/25	39	-	5.41	6.47	2.32	0.96	1.69	9.33		2.64	6.17	
4/26	39½	-	5.46	6.47	2.38	1.02	1.62	9.36		2.64	6.22	
4/27	37½	-	5.32	7.22	2.35	1.00	0.79	9.04		2.57	6.17	
4/28	40	-	5.28	7.22	2.36	1.01	1.19	9.15		2.57	2.19	
4/29	39½	38½	5.38	6.46	2.37	1.03	1.38	9.28	Start[8]	2.59	6.21	
4/30	38½	-	5.49	6.53	2.35	1.03	1.58	9.37	1.08	2.62	6.24	Start[9]
5/1	37	-	5.58	6.64	10/	1.08	1.74	9.45	1.20	2.64	6.28	2.73
5/4	41	-	5.75	6.74	3.12	1.09	1.91	9.54	1.21	2.72	6.44	2.72

1/ MP is top of plate on casing, altitude 286.1 feet.
2/ MP is top of board cover, altitude 267.8 feet.
3/ MP is top of plate on casing, altitude 301.6 feet.
4/ MP is top of plate on casing, altitude 301.8 feet.
5/ MP is top of plate on casing, altitude 273.8 feet.
6/ MP is top of plate on casing, altitude 273.3 feet.
7/ MP is top of board cover, altitude 273.4 feet.
8/ MP is top of plate on casing, altitude 288.8 feet.
9/ MP is top of casing, altitude 280.8 feet.
10/ MP is top of plate on casing, altitude 290.9 feet.

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Table 2. Measurements of the water level in wells in Last Chance Basin.
(In feet below measuring point.) - Continued

Date	Temperature °F		Well	Well	Well	Well	Jualpa	Tunnel	Well	Well	Well	Well	8-inch
1959	Gold Creek	City Spring	1	1A	2	2A	South Shaft	North Shaft	2B	3	3A	4	Well
5/5	42	-	5.77	6.71	3.19	1.10	1.94	9.53	1.18	2.76	6.44	2.71	-
5/6	41	-	5.65	6.51	3.34	1.37	1.73	9.40	1.09	2.73	6.42	2.71	-
5/7	39½	-	5.42	6.33	3.11	1.01	1.46	9.21	0.89	2.71	6.29	2.61	-
5/8	38	-	5.14	6.17	4.23	0.96	-	8.84	0.77	2.62	6.12	2.49	-
5/9	38	39	4.72	5.88	4.37	0.94	-	8.66	0.76	2.55	6.00	2.56	-
5/10	37½	-	4.84	5.91	4.29	0.96	-	8.70	0.81	2.51	5.94	2.57	-
5/10	Pumping test starts on 8-inch well - additional measurements available.												-
5/10	-	-	4.86	5.93	-	-	-	-	-	2.50	5.94	-	-
5/11	Pumping test ends.												
5/11	-	-	4.96	6.04	4.16	0.15	-	8.81	0.87	2.50	5.96	2.80	3.34 1/
5/12	51	39	5.14	6.21	4.24	1.12	1.37	8.96	0.94	2.51	5.98	2.81	3.30

1/ LP is lower edge of coupling in plate in casing, altitude 289.58 feet.

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Table 3. Daily discharge, in second-feet, of Gold Creek at Juneau, February 11, to May 12, 1959.

Day	Oct.	Nov.	Dec.	Jan.	Feb.	March	Apr.	May	June	July	Aug.	Sept.
1							6.5	26				
2						11	11	25				
3							9.1	24				
4							7.6	25				
5						18	6.5	27				
6						26	6.0	40				
7						16	6.0	50				
8						12	6.0	66				
9						9.7	7.6	64				
10						8.5	11	60				
11					6.5	8.8	13	53				
12					6.2	7.6	12	49				
13					5.8	7.6	11					
14					5.5	6.5	11					
15					5.2	7.9	10					
16					5.0	17	10					
17					4.8	12	11					
18					4.3	8.8	12					
19					4.3	7.6	21					
20					4.1	6.8	35					
21					3.9	8.8	47					
22						5.5	42					
23						5.2	32					
24						5.0	26					
25					5.4	5.0	25					
26						4.5	28					
27						4.5	32					
28						4.3	29					
29						4.5	27					
30						4.8	27					
31						5.0						

Table 4. Chemical analyses of well water, Last Chance Basin.

Analyses by Geological Survey, United States Department of the Interior
(parts per million)

9-26E q 16828

	Test 2 Well	8-inch Well
Date of collection	4/8/59	5/11/59
Silica (SiO_2)	3.9	3.9
Iron (Fe)	.03	.02
Manganese (Mn)	.01	.00
Calcium (Ca)	24	26
Magnesium (Mg)	2.1	3.6
Sodium (Na)	1.3	1.3
Potassium (K)	1.0	1.3
Bicarbonate (HCO_3)	45	52
Carbonate (CO_3)	37	
Sulfate (SO_4)	34	37
Chloride (Cl)	.0	1.0
Fluoride (F)	.0	.1
Nitrate (NO_3)	1.4	1.5
Dissolved solids		
Calculated	90	102
Residue on evaporation at 180°C	68	80
Hardness as $CaCO_3$	32	38
Noncarbonate hardness as $CaCO_3$		
Alkalinity as $CaCO_3$		
Specific conductance (micromhos at 25°C)	159	171
pH	7.1	7.6
Color	0	0
Temperature (°F)	40	40