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OFFICE OF THE STATE ENGINEER

GROUND WATER IN THE AUSTIN AREA, LANDER COUNTY, NEVADA

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INTRODUCTION

The U. S. Geological Survey, in cooperation with the Office of the State Engineer of Nevada, made a preliminary survey of ground-water conditions in the Austin area, Nev., during the period July 25 to 28, 1949. The purpose was to evaluate ground-water conditions with special reference to the quantity of ground water that might be available in the area—an adequate water supply has been a constant problem throughout the history of the Austin area. The investigation was made by the writer under the supervision of Thomas W. Robinson, district engineer, Ground Water Branch, U. S. Geological Survey. Material assistance was given in the field by local residents. Frank Bertrand, water commissioner, Thomas Peacock, county assessor, and George McGinnis, county commissioner, guided the writer to springs now utilized by the town of Austin and rendered other valuable field assistance.

Location

The Austin area, in Lander County, Nevada, is on the west flank of the Toyabe Range between the latitudes 39°28'30" N. and 39°30' N. Austin, the county seat, is in the lower part of Pony Canyon north of Marshall Canyon. U. S. Highway 50, carrying considerable east-west traffic across the State, passes through town. There are numerous small business establishments in Austin, as well as the high school and county administration buildings. These activities, as well as ranching and mining in adjacent areas, are sufficient to maintain a population of about 600.

History

The early history of the area is described by Ross, _/ and it

_/Ross, C. P., The geology and ore deposits of the Reese River mining district, Lander County, Nevada. U. S. Geol. Survey, unpublished manuscript and maps on file at Mackay School of Mines, Univ. of Nevada, Reno, Nev.

is largely from his report on the geology and ore deposits of the Reese River mining district that the following account has been taken.

In 1851, Col. John Reese undertook the exploration of a now route of travel from Salt Lake City to the westernmost outpost of trading activity in the then Utah Territory at Genoa. The route chosen by Col. Reese carried him almost due west across what is now the State of Nevada from Deep Spring on the east to Genoa on the west, and, although the trail was routed across high passes in many of the ranges in the interior of the Great Basin, it soon became a popular route to the rich mining camp of Virginia City, the gold fields of California, and later to the State capital at Carson City. In 1860, the route was adopted by the Pony Express and later, in 1861, by the Overland stage. It is not then surprising that the ranges in the interior of the Great Basin should be prospected for their mineral wealth by the early miners and prospectors.

In May 1862, William M. Talcott, a former Pony Express rider, found a silver-bearing quartz vein in the Toyabe Range about 2 miles south of this early trail. He called the gulch in which he found the ore Pony Canyon. As a result, in May 1862 the Reese River mining district was organized. In December 1862, John Frost made the first location on ground that proved to be the center of the mining activity for the district. The first ore was taken from Pony Canyon to Virginia City and started a rush from there to the new strike. According to some accounts, as many as 10,000 people came to the new district in 1863, although many soon passed on to other camps.

Austin remained an active mining camp until about 1887. Up to that time the total ore produced was valued at about $20,000,000. From 1887 to 1949, however, the camp has been relatively inactive. Ore valued at about $1,000,000 is reported to have been produced in the early part of this period, but since about 1913 the camp has been worked only in sporadic fashion. When visited by the writer during this investigation the mines of Pony Canyon had been abandoned for many years, and only two small mines in Marshall Canyon were being worked.

In the early days of mining, water must have been almost as valuable as the ore extracted from the underground workings. Reportedly it was so scarce that the owner of a cart distributing it in Austin netted $1,000 to $2,000 a week. When the mines were deepened, additional water was encountered but the needs of the community were never completely satisfied. Throughout the history of the district the supply has been insufficient to furnish the needs of the town and ore-dressing mills.

Climate

Precipitation has been recorded at Austin nearly continuously since 1890. Prior to that time partial records were kept in the late 1870's for which the years 1878 and 1879 were complete. The annual precipitation and monthly average, which are taken from Weather Bureau reports, are shown in tables 1 and 2.

The records indicate a range in annual precipitation from 6.34 inches (1926) to 21.07 inches (1891). For the 57 years of record, it will be noted that precipitation was below the normal in 31 years and above normal in 26 years. More than two-thirds of the normal annual precipitation occurs in the 6-month period December through May. Most of the winter precipitation occurs as snow. Through the spring and summer, rainfall is very erratic and occurs in a wide range of intensity. Frequently the entire precipitation for any one month may occur during a single storm.

The mean annual temperature is about 47° F., although there is a considerable range both daily and seasonally. Summer temperatures are high through the day but generally are moderate at night.

TABLE 1

Annual precipitation, in inches, Austin, Lander County, Nev., altitude 6,630 feet

Year	Inches	Year	Inches	Year	Inches
1878	12.77	1908	10.72	1929	10.65
79	9.80	09	---	30	16.67
		10	---	31	11.84
1890	14.95	11	8.47	32	12.43
91	21.07	12	12.77	33	10.16
92	10.43	13	17.60	34	14.63
93	11.22	14	14.33	35	16.26
94	14.89	15	12.39	36	14.91
95	9.22	16	11.99	37	9.63
96	8.45	17	12.12	38	16.51
97	12.89	18	15.23	39	12.16
98	13.21	19	9.15	40	14.69
99	---	20	11.64	41	19.36
1900	8.05	21	9.20	42	12.01
01	13.73	22	17.86	43	11.89
02	8.30	23	10.24	44	---
03	9.24	24	9.14	45	16.31
04	13.88	25	17.01	46	16.93
05	10.63	26	6.34	47	6.40
06	15.19	27	10.64	48	11.45
07	10.46	28	10.44		

TABLE 2

Normal monthly and yearly precipitation, in inches, Austin, Lander County, Nev.

Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Year
1.22	1.22	1.47	1.72	1.52	0.75	0.54	0.57	0.52	0.83	0.79	1.13	12.33

Topography

The Austin area is on the west flank of the northern part of the Toyabe Range. In this vicinity, the crest of the Toyabe Range is from 7,500 to about 8,400 feet above sea level. Austin Summit, over which U. S. Highway 50 is routed, is at an altitude of 7,484 feet.

The floor of Reese River Valley, immediately west of the town of Austin, is 5,900 feet above sea level. Thus, the maximum relief of the Toyabe Range in this area is about 2,500 feet. The topography is mature above 6,500 feet and slopes generally have gradients not exceeding a 1,000 feet per mile. Between the 6,500-foot and the 6,100-foot levels is a moderately dissected pediment--the greatest dissection occurring along Pony and Marshall Canyons.

The floor of Reese River Valley west of the Austin area is relatively smooth, only shallow drainageways connecting the principal tributary canyons with the poorly defined channel system of Reese River.

GEOLOGY

Most of the Austin area is underlain by bedrock generally classed as a quartz monzonite of Jurassic (?) age. This was intruded into Paleozoic sediments--quartzite, slate, shale, and some limestone--which now have been removed almost entirely from the area. Tertiary volcanic rocks and associated sediments, which probably once covered the area, now occur locally southeast of Austin near the crest of the Toyabe Range.

The character of the quartz monzonite together with existing climatic conditions are such that soil and hill wash cover most of the ground surface.

Joint or fracture systems that might contain ground water generally have been filled with vein minerals or have been masked by the mantle of weathered quartz monzonite. Joint openings probably decrease with depth but should transmit some water, as is suggested by reports of the depth and yield of the well a short distance east of Austin.

Some dikes or veins are resistant to erosion and may form local barriers to the movement of ground water, particularly in the weathered parts of the quartz monzonite.

GROUND WATER

In the Austin area, most of the available ground water is believed to occur in the weathered bedrock and the alluvium in the bottoms of the canyons. Replenishment occurs seasonally or during prolonged and heavy periods of rainfall. Ground water is discharged into small temporary streams from springs in areas of transpiration, and as underflow from the area.

Because of the steep water-table gradients, the water temporarily stored in the weathered bedrock and alluvium is discharged relatively fast and maintains a limited flow only in the principal canyons or from the more favorable spring areas.

Groves of aspen prominently indicate some spring areas, and these in the Austin area generally are high on the slopes of the Toyabe Range. These spring areas are favorably located for the accumulation of deep snowdrifts during the winter. The additional water that results probably has permitted deeper-than-average weathering of the quartz monzonite, and this in turn is favorable for development of localized ground-water storage. At present much of the water discharged from these spring areas is utilized by the dense growth of aspen and, to a lesser extent, by other vegetation. However, two springs of this type are developed for municipal use. Most of the underflow in Pony and Marshall Canyons, the principal drainage systems, is believed to move out of the area into Reese River Valley, although a part of the underflow is diverted for municipal supply.

Present water supply

Marshall Canyon supply.--Three tunnels adjacent to each other, designated 1, 2, and 3, at the head of Marshall Canyon, were producing a combined flow of 17.6 gallons per minute on July 26, 1949.

Tunnels 1 and 2 are about three-fourths of a mile south of Austin. They are at about the same altitude, and tunnel 1 is about 300 yards south of 2. Both tunnels are about 40 feet long and 4 by 5½ feet in cross section. They penetrate directly into the hillside at the lower edges of small groves of aspen. These tunnels collect water originating from the downward percolation of snow melt into decomposed quartz monzonite. Both tunnels are heavily timbered and shored throughout their length. Ground water is reported to drip from the backs, walls, and faces of the tunnels. It is then ponded on the floor behind low wooden barriers, whence it is diverted into a pipe line leading to sediment traps below the tunnel portals. On July 26, 1949, the measured flow from tunnel 1 was 3.8 gallons per minute, and from tunnel 2 it was 4.4 gallons per minute. This supply is reportedly constant throughout the season.

Tunnel 3 is in a gully tributary to Marshall Canyon and about 300 yards down the canyon from tunnel 2. It is driven at right angles to and below the floor of this gully. The floor of the tunnel is reportedly on unaltered quartz monzonite, whereas its back and sides are in alluvium and decomposed quartz monzonite. It is heavily timbered and shored. The structure collects underflow moving down the gully and ponds it on the floor of the tunnel. A pipe line then carries it out to a sediment trap, and thence to the main water line. On July 26, 1949, the measured flow from this tunnel was 9.4 gallons per minute, but later in the summer its flow reportedly diminishes.

<u>Pony Canyon supply</u>.--On July 27, 1949, the total amount of water from all sources in Pony Canyon was measured as 29.5 gallons per minute. This water supply originates as seepage from a tunnel and as spring discharge to form a small stream flowing in the bed of Pony Canyon. A 6-inch drilled well in the canyon has occasionally furnished water to Austin, although this source of supply is reported to be unreliable and has not been used for several years.

The tunnel, about the same size as those in Marshall Canyon, penetrates into the south side of the canyon about 1 mile southeast of town. At the time the area was visited it was possible to walk about 150 feet in from the portal of the tunnel to a point where the back had caved and blocked the passageway with decomposed monzonite. Several small fault zones were exposed in the tunnel but none of them were yielding water. The supply here is believed to originate from the downward percolation of snow melt along zones of alteration in the monzonite. Water is withdrawn from behind the cave-in by a pipe line and is then led to a sediment trap where, on July 27, 1949, the measured flow was 16.2 gallons per minute.

The second source of supply in Pony Canyon is stream flow in the bottom of the canyon. This flow originates in a large marshy spring area about 1½ miles southeast of town, and about half a mile up the canyon from the tunnel. No attempt has been made to develop this spring and it is open to livestock. Surface water from it collects in the bottom of the canyon, trickles for about 200 yards through a growth of willow and wild rose, and is then trapped in a catchment composed of coarse rocks where it is diverted into a pipe line. On July 27, 1949, the flow from this source was 13.3 gallons per minute, measured at the same sediment trap used for water diverted from the tunnel. Reportedly this supply fluctuates throughout the year and is only used during periods when the water shortage is acute.

The 6-inch well mentioned earlier is midway between the tunnel and the east edge of Austin. Little is known about the well. It is reported to be 270 feet deep and is believed to penetrate quartz monzonite to penetrate quartz monzonite for its entire depth. At the time of the investigation it was sealed with a lift pump and it was not possible to measure either its depth or the depth to water. According to Mr. Peacock, however, several attempts have been made to pump water from it but the small discharge could be maintained for only 15 to 20 minutes. Presumably the well draws water from joints in the monzonite, which undoubtedly have very low storage capacities and are not sufficiently numerous to form adequate aquifers.

Possibilities for additional ground water

Additional ground water may be obtained by improving the structures now used to collect water from both Marshall and Pony Canyons, by developing other spring areas, by reducing transpiration losses, by using drainage water from the Clifton tunnel, and by pumping from wells in the Austin area or the adjacent part of Reese River Valley.

Marshall Canyon.--The three tunnels in Marshall Canyon were constructed in the late 1930's by the Public Works Administration. All three, although heavily timbered and shored, cave badly and require frequent cleaning and retimbering, which entails the expenditure of considerable sums of money. Tile drains laid in a shallow ditch on the floor of the tunnel and covered with 1 or 2 feet of gravel or broken rock of uniform size, one-fourth to one-half inch in diameter, would permit ground-water flow even though the back of the tunnel caved in. Further protection may be given the drains by covering the gravel or rock with clean sand to prevent the infiltration of clay and silt from caving materials. With such construction, the tunnel may be allowed to cave, as water will continue to infiltrate to the drain system from where it can be discharged to a pipe line.

Additional water may be developed in Marshall Canyon from other unused spring areas by tapping the ground water at the lower edge of one or more groves of aspen in a manner similar to that used to tap the ground water by tunnels 1 and 2. The writer, together with Mr. Bertrand, visited one of these spring areas about 1,500 feet southeast of and about 100 feet higher than the sediment trap at tunnel 3. The spring discharges at the rate of about 3 gallons per minute from alluvium at the base of a large grove of aspen. The supply may be further increased by intercepting the unmeasured ground water percolating through the alluvial and weathered material.

In connection with the development of water from the spring areas, there is the possibility of salvaging at least a part of the water transpired by water-loving plants in the vicinity of the spring areas. During the growing season these plants transpire considerable quantities of water. By cutting down or otherwise destroying the aspen groves of the spring areas, a part of this water could be salvaged. Ground water that would otherwise be transpired in the process of supporting plant growth would then be available for other use.

Ground water may also be obtained in favorable locations in the floor of the canyon at lower altitudes than the spring supplies now utilized. The quantity of water that may be developed is limited to the amount of underflow at the place of development, and also by efficiency of the development.

Pony Canyon.--The spring area in Pony Canyon is utilized only during the summer months when the water supply for Austin from all sources is at its lowest. As mentioned earlier, water rises in an unfenced spring area which is open to pollution by livestock. Additional ground water may be obtained by a suitable collecting structure at the lower edge of the spring area.

Additional ground water can be obtained from the alluvium in the floor of Pony Canyon. For example, at a point about 600 feet upstream from where U. S. Highway 50 leaves the floor of Pony Canyon east of Austin, surface features indicate that the total thickness of alluvium and weathered monzonite in the axis of the canyon may be about 50 feet, and the depth to water probably is not more than 15 feet below land surface. Under such conditions, a dug or drilled well penetrating the full thickness of the alluvium and the weathered monzonite would intercept much of the underflow. An accurate log of the material penetrated by such a well would furnish information needed to complete a successful well, and would be a useful record in the sinking of additional wells in the area. Additional ground water probably could be obtained in Pony Canyon within the limits of Austin town site. However, water so obtained would be strongly susceptible to pollution and proper preventive measures would be necessary.

Clifton tunnel.--The Clifton drainage tunnel, _/ which had

_/Op cit.

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been begun by Allan Curtis early in the operation of the Manhattan Silver

Mining Co., and extended somewhat by Hanchett near the close of the company's life, was reopened by the Austin Mining Co. in 1893. This tunnel, when completed, was about 5,930 feet long and had one crosscut (referred to as the First North Lateral) about 2,800 feet long. The portal is about 3,900 feet west-northwest of the Austin Reservoir and 510 feet below it. According to reports, the tunnel accomplished the desired result of draining the workings in Lander Hill. The quantity of water available from the tunnel in 1935 was sufficient to operate a mill near the portal only about 2 hours a day. When the tunnel was visited in July 1949, an estimated 30 gallons of water per minute was discharging from the portal. At present the portal of the tunnel is caved and the extent to which underground workings are open is not known. Some additional water might be obtained by extensive renovations of the tunnel, although under continuous-flow conditions the added increment would probably be small.

One way of utilizing ground-water storage in the tunnel east of the caved part might be by drilling a well to penetrate the tunnel about at its juction with the First North Lateral. This would permit withdrawal from storage within the tunnel system, but under continuous pumping conditions the yield probably would be about the same as or somewhat less than the 30 gallons per minute now discharged from the portal. The location of this juction is shown on the U. S. Geological Survey topographic sheet of the Austin area _/ at an indicated depth below land surface of about 450 feet.

_/Austin Area, Reese River mining district, Lander County, Nevada. U. S. Geological Survey topographic map, unedited advance sheet subject to correction.

Reese River Valley adjacent to the Austin area.--According to Waring _/ small flows with low artesian heads have been obtained from

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_/Waring, G. A., Ground water in Reese River and adjacent parts of Humboldt River basin, Nevada: U. S. Geol. Survey Water-Supply Paper 425-D, p. 113, 1918.

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wells in the lower parts of Reese River Valley, 6 to 10 miles southwest of Austin, at depths ranging from 107 to 450 feet. The flows were obtained from zones of fine black sand in the valley fill.

To date wells have not encountered water-bearing zones capable of yielding moderate to large quantities of water. However, the possibilities of obtaining water in quantity have not been fully explored.

Natural losses from ground water in Reese River Valley by evaporation and transpiration are substantial. Part of the ground water lost by these processes can be recovered by wells, but the total amount is limited to the safe yield of the valley.

The quantity and rate at which ground water may be obtained will depend in part upon locating suitable water-bearing zones. The degree of such development will also depend in part upon the degree of necessity for additional water.

QUALITY OF WATER

During the investigation the writer collected two samples of water, one designated sample 1, at the sediment trap in Marshall Canyon that receives water from tunnels 1, 2, and 3, and the other designated sample 2, from the tunnel in Pony Canyon. The temperature of the water at both localities was 49° F. at the time the samples were taken. The chemical analyses listed below were made at the Salt Lake City laboratory of the U. S. Geological Survey.

	Sample 1 (Parts per million)	Sample 2 (Parts per million)	U. S. Public Health Service Limit recommended
Silica (SiO_2)...............	21	20	
Iron (Fe)..................	0.05	0.04	0.3
Calcium (Ca)................	38	39	
Magnesium (Mg)..............	9.4	7.8	125
Sodium (Na)................	20	15	
Potassium (K)...............	4.6	4.2	
Bicarbonate (HCO_3)..........	182	151	
Sulfate (SO_4)...............	21	25	250
Chloride (Cl)...............	10	10	250
Fluoride (F)................	0.1	0.1	1.5
Nitrate (NO_3)...............	0.6	1.5	
Boron (B)..................	0.03	0.03	
Manganese (Mn)..............	0.00	0.00	
Dissolved solids: Sum-ppm..	214	197	1,000
Hardness as $CaCO_3$:			
Total....................	133	129	
Noncarbonate..............	0	6	
Date of collection..........	7/26/49	7/27/49	

As shown in the above table, the two analyses are well under the limits recommended by the U. S. Public Health Service for water used on interstate carriers.

When the stream flow from Pony Canyon is used, bacteriological analyses would be desirable because of the susceptibility to pollution.

The chemical character of the water from the Clifton tunnel probably is not materially affected by the mineralized rocks it penetrates, but the decay of old timbers may result in an unpleasant taste.

METHODS OF SPRING DEVELOPMENT

Collecting or impounding structures for springs are of various types. The object of all the structures is to capture the maximum amount of spring discharge and underflow, as well as to incorporate necessary features of permanence and protection from pollution. In the case of hillside springs, such as those in Marshall Canyon, there are several structures that will safely and efficiently capture the maximum amount of ground water. They may be enumerated as follows: (1) Tunnel, (2) V-shaped collecting wall (dam), (3) contour ditch, and (4) contour bench.

The tunnel system for collecting ground water is now being used. On the stock range V-shaped walls, with ends extending back into the hillside, are commonly used to intercept underflow from seep-spring areas. Commonly water is withdrawn by a pipe equipped with a strainer inserted through the wall at the apex. As described by Hamilton, _/ the wall

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_/Hamilton, C. L., and Jepson, H. G., Stock-water developments: wells, springs, and ponds: U. S. Dept. Agr., Farmers Bull. 1859, pp. 26-28, 1940.

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should be carried deep enough into the hillside to reach a good foundation and to cut off underflow. An infiltration gallery may be formed by placing well-rounded cobbles, medium gravel, and sand in successive layers upstream from the apex.

The contour ditch has been frequently employed as a means of collecting surface flow and underflow from hillside spring areas. This type of structure involves trenching to bedrock immediately below the spring area, laying drain tile in the floor of the ditch, and finally backfilling the ditch first with cobbles or coarse gravel and then with fine gravel or sand. The permeable sand and gravel intercepts the underflow and conveys it to the drain tile where it may then be carried into the water system.

A modified version of the above structure has been constructed in some areas by excavating a bench or wide roadway immediately below the spring area. However, the inside edge of the bench must be far enough into the hillside to intersect the bedrock surface, thus intercepting the underflow. By means of suitable drainways the water is then conveyed into the water system. In all cases care must be taken that no pollution enters the water supply, and periodic sampling is necessary to insure that the supply is not contaminated by harmful bacteria.

SUMMARY

The results of this investigation suggest that in the Austin area a total of about 125 gallons per minute could be obtained by full development of the existing spring areas, present tunnels, and the Clifton tunnel.

Additional ground water could be obtained in Marshall and Pony Canyons at lower altitudes than the present developed sources. However, ground water in Pony Canyon within the town site limits of Austin would be susceptible to pollution and proper precautionary measures would be warranted if the water were used for domestic supply. The amount of water available in these canyons would be limited to the amount of underflow at the place of development and also by the efficiency of such development.

Ground water could be obtained from Reese River Valley adjacent to the Austin area. The quantity potentially available is substantial but would depend in part upon locating suitable water-bearing zones in the valley fill.