STATE OF NEVADA
OFFICE OF THE STATE ENGINEER

RESULTS AND DESCRIPTION OF TEST DRILLING IN ARGENTA SWAMP NEAR BATTLE MOUNTAIN, NEVADA

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INTRODUCTION

In June 1949, the U. S. Geological Survey in cooperation with the State Engineer of Nevada, as part of the State-wide ground-water studies, drilled a test well on the flood plain of the Humboldt River about 4 miles northeast of Battle Mountain. This well was drilled for the purpose of obtaining information concerning the geologic and hydrologic character of the sediments underlying the flood plain, and the quality of the water in those sediments.

The well is on land owned by the U. S. Bureau of Reclamation and reserved for experimental purposes. A permit to drill in the N½SE¼ of sec. 11, T. 32 N., R. 45 E., was obtained from the Bureau and, under section 8 of this permit, the U. S. Geological Survey agreed to furnish the Bureau the results of the test drilling.

The well is 197 feet deep and is cased with 6-inch casing from the surface to 171 feet. The hole is uncased from 171 to 197 feet. The casing is perforated from 167 to 171 feet with ¼-inch slots. A 2-inch casing, adjacent to the 6-inch casing, was driven to a depth of 23 feet. This well penetrates the upper part of a gravel stratum extending in depth from 25 to 125 feet. Both wells are ideally suited for obtaining records of water-level fluctuations. The fluctuations in the deep well should reflect hydrologic conditions in the sand and gravel

stratum from 150 to 171 feet. Those in the shallow well should reflect hydrologic conditions in the sand and gravel stratum from 15 to 125 feet. It is planned that measurements of water levels will be made periodically in both wells. These measurements will be kept on file in the office of the U. S. Geological Survey at Carson City and will be available for public inspection.

The accompanying well log is based on samples of the cuttings collected while drilling was in progress. Briefly, the material encountered consisted of loamy silt from the surface to a depth of 15 feet, water-worn stream-laid sand and gravel from 15 to 125 feet, yellow silt and fine sand from 125 to 150 feet, uniform fine to medium sand from 150 to 171 feet, and greenish-gray clay, locally known as "blue shale," from 171 feet to the bottom of the hole at 197 feet. Material similar to this last-named is believed to persist to a depth of at least 900 feet, and to contain few, if any, permeable gravel aquifers. The two sand and gravel strata, from 15 to 125 feet and from 150 to 171 feet, constitute the most important aquifers encountered in the drilling.

Two water samples were collected while drilling was in progress. One was collected at 57 feet from the 15- to 125-foot aquifer, and the other was collected from the 150- to 171-foot aquifer. Analyses of these samples indicate that, although the waters contained in the two aquifers are of different quality, both are suitable for domestic or irrigation use.

In the numbering system for wells used by the U. S. Geological Survey the drilled 6-inch test well has been assigned number 32/45-11D1, and the 2-inch driven well, 32/45-11D2.

The following three tables give the log of the material penetrated, a log of casing installation, and analyses of the two water samples.

Log of U. S. Geological Survey test well 32/45-11D1

Location: SE¼ sec. 11, T. 32 N., R. 45 E., approximately 4 miles northeast of Battle Mountain, Nev., on the Argenta Swamp portion of the flood plain of the Humboldt River. Owner, U. S. Geological Survey; driller, C. R. Keener. Diameter 6 inches; 6-inch casing to a depth of 171 feet, open hole 171 to 197 feet. Six-inch casing perforated with four rows 2-inch by ¼-inch slots, 167 to 171 feet. Well drilled with churn drill. Log from samples of cuttings collected by U. S. Geological Survey.

Material	Thickness (feet)	Depth (feet)
Silt, gray to dark-gray	15	15
Sand, medium, to medium gravel; coarse sand to coarse gravel	10	25
Sand, coarse, to medium gravel, 70 percent of sample.	15	40
Sand, fine, to coarse gravel; coarse sand to medium gravel, 70 percent of sample	10	50
Sand, fine to medium; no gravel	12	62
Sand, fine, to coarse gravel; coarse sand to medium gravel, 75 percent of sample	10	72
Sand, fine, to coarse gravel; medium sand to coarse gravel, 70 percent of sample	18	90
Clay, streak, light-yellow, less than 1 foot thick at 91 feet	1	91
Sand, fine, to medium gravel; medium sand to medium gravel, 70 percent of sample	4	95
Sand, fine, to coarse gravel; gravel to coarse sand at least 70 percent of sample; light-yellow clay streaks at 97 to 107 feet	22	117
Sand, fine, to medium gravel; medium sand to medium gravel, 70 percent of sample	8	125
Silt, yellowish-gray (5Y7/2); _/ recovery poor; stratum of sandy silt from 145 to 150 feet	25	150
Sand, fine, to medium gravel; fine to medium sand, 40 percent of sample	10	160
Sand, fine to medium; fine sand, 60 percent of sample	11	171
Clay, yellowish-gray (5Y7/2), _/ mixed with greenish-gray clay (5GY7/2) _/ (bluish cast when wet and designated locally as the "blue shale"); noticeable hydrogen sulfide odor. Yellowish clay may be zone of oxidation on top of the greenish-gray clay	7	178
Clay, greenish-gray (5GY6/1), _/ in thin beds (?) ½ to 1 inch thick. Sand in samples probably from sand strata above (150-171 feet). Calcium carbonate abundant in clay	12	190
Clay, greenish-gray and yellowish-gray, in compact thin beds ½ to 1 inch thick. Calcium carbonate abundant in clay	7	197
Total depth	..	197

_/Color identification from Rock-color chart, Nat. Research Council, 1948.

Log of casing and installation
U. S. Geological Survey test well ~~33~~32/45-11D1

Casing record	Time	Remarks
		June 17, 1949
	8:00 a.m. to	Drilling commenced. Drive shoe installed. Bottom 4 feet of casing perforated with 36 2" by ¼" slots. Hub driven to land surface, south side casing, for water-level reference point. Drilled open hole to 18 feet.
22'7" coupling 22'7" 10'6" 33'1" weld	10:00 a.m. to 10:40 a.m.	Casing installed and driven to 22 feet. Bailed to 22 feet. Water level, -7.15 feet from reference point at land surface.
	to	Casing installed and driven to 33 feet. Bailed to 33 feet.
33'1" 10'6¼" 43'7¼" coupling	12:50 p.m. to	Casing installed and driven to 43 feet. Bailed to 43 feet.
	2:30 p.m.	Casing installed and driven to 54 feet.
43'7¼" 10'7½" 54' 2 3/4" weld	to 4:00 p.m. to 4:30 p.m.	Bailed to 54 feet. Test for yield = 34.3 gallons per minute, drawdown 4½ feet. End of bailer test. Water sample collected here. Temperature 54° F.
		June 18, 1949
54' 2 3/4" 10' 5 1/4" 64' 8" coupling	8:00 a.m. to	Water level, -7.70 feet from reference point. Drove casing to 64 feet. Bailed to 62 feet. Sand heaving in casing.
64'8" 10'9 3/4" 75'5 3/4" weld	11:05 a.m.	Casing installed and driven to 75 feet and bailed to that depth. Water level, -9.25 feet 10 minutes after bailing.
75'5 3/4" 10'10¼" 86'4" coupling	12:50 p.m. to 4:00 p.m. to 4:30 p.m.	Casing installed, driven to 86 feet and bailed to 86 feet. Cut casing.
		June 19, 1949
86'4" 10'8 3/4" 97' 3/4" weld	8:00 a.m. to	Water level, -10.39 feet; casing installed and driven to 97 feet. Bailed to 97 feet. Water level, -30.15 feet (casing plugged?).

Log of casing and installation of well 33/45-11D1 (continued)

Casing record	Time	Remarks
	June 19, 1949 (continued)	
97' 3/4" 10'9" 107'9 3/4" coupling	10:20 a.m.	Casing installed and driven to 107 feet. Bailed to 107 feet. Water level, 8.7 feet 10 minutes after bailing stopped.
107'9 3/4" 12'1" 119'10 3/4"	1:10 p.m. to	Casing installed and driven to 119 feet. Bailed to 119 feet.
119'10 3/4" 10'00" 129'10 3/4" coupling	3:10 p.m. to 4:50 p.m.	Casing driven to 129 feet.
	June 20, 1949	
129'10 3/4" 10' 8 1/2" 140' 7 1/4" weld	8:00 a.m. to 9:00 a.m.	Bailed to 129 feet. Drilled open hole to 142 feet. Casing installed and driven to 140 feet. Silty sand heaved in casing when drilling open hole below 145 feet.
140'7 1/4" 10'8 3/4" 151'4" coupling	1:35 p.m. to 2:40 p.m.	Casing installed and driven to 150 feet. Bailed to 150 feet.
	June 21, 1949	
151'4" 11'1" 162'5" weld	8:00 a.m. to	Water level, -19.33 feet; installed casing, drove to 162 feet, and bailed to 162 feet.
162' 5" 10'00" 172'5"	12:00 noon to 5:30 p.m.	Water level, -10.93 feet 10 minutes after bailing stopped. Casing installed and driven to 172 feet. Bailed to 172 feet, drilled open hole to 197 feet, and bailed to 197 feet.
	June 22, 1949	
2" casing +2' to -24'	8:00 a.m.	Drove 24 feet of 2-inch casing adjacent to 6-inch casing. Casing perforated bottom 4 feet. Shaped to drive point on end. Water level inside 6-inch casing, -6.95 feet below reference point. Water level outside 6-inch casing, -7.30 feet below reference point.
	10:30 a.m. to 11:00 a.m.	Made caps for two wells. Surged and developed 6-inch well. Water sample collected. Temperature 55 3/4° F. In 8-minute test, yield was 252 gallons or 31.5 gallons per minute; drawdown, 39 feet; specific capacity, less than 1 gallon per minute per foot.

Analyses of two water samples _/
U. S. Geological Survey test well 33/45-11D1
32

Analysis number	Source	Date of collection	Temperature (°F.)	Parts per million											Hardness (as $CaCO_3$)	Specific conductance (K x 10^6 at 25° C.)	Percent sodium
				Dissolved solids	Silica (SiO_2)	Calcium (Ca)	Magnesium (Mg)	Sodium and potassium (Na and K)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Boron (B)			
3174	15-125 feet	6/17/49	54	578	31	77	16	108	366	111	54	0.6	0.1	0.04	258	902	48
3175	158-171 feet	6/22/49	56	320	47	36	15	46	178	49	38	.7	.1	.04	152	460	40

_/ Analyses by U. S. Geological Survey, Salt Lake City Laboratory

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Discussion of material penetrated

The sediments penetrated by the well consist of stream-laid silt, sand and gravel, and lacustrine clays. From the surface to 15 feet drilling encountered gray silt mixed with plant fragments. From 15 to 125 feet in depth the sediments are uncemented poorly sorted stream-laid sand and gravel ranging in size from fine sand (diameter 0.25 mm) to coarse gravel (diameter 6 cm). The prevailing size is fine gravel (diameter 2-3 mm), although a 12-foot stratum of medium to coarse sand was penetrated from 50 to 62 feet. Pebbles are subangular to well rounded, depending upon the rock type. Chert, subangular to subrounded, and of varying hues from olive green to black, is the most common rock type, (about 40 percent of the coarse gravel), whereas well-rounded pebbles of quartzite, granite, gneiss, and milky quartz together constitute about 30 percent of the coarse sediments. Rounded pebbles of chert-cemented pebble conglomerate are commonly found, as well as rounded calcium carbonate nodules from the Humboldt (?) formation. Volcanic rocks (rhyolite and hornblende andesite, as well as some intermediate types) constitute about 15 percent of the coarse sediments.

These sediments are not cemented, although light-yellow clay-like lenses were encountered in them at 91, 97, and 107 feet. All are believed to be less than 1 foot thick. Pannings from above the clay strata recovered abundant magnetite and garnet; other heavy minerals include apatite, zircon, and olivine (?). No placer gold was found.

The highlands of the Humboldt River drainage system are believed to have furnished these sediments, which were deposited under aggrading conditions at a time when the river system carried a greater volume of water than it does now. It is believed that the varying stages of Pleistocene Lake Lahontan may have had sufficient influence over the river system to cause deposition of these coarse sediments.

From 125 to 150 feet the drill penetrated light-yellow clayey silt containing less than 5 percent of medium sand, whereas from 150 to 171 feet it encountered fine to medium sand. The sand grains in the clayey silt, as well as in the sand stratum, are of the same composition as that of the gravel stratum from 15 to 125 feet. They are, therefore, from a similar source. The uniformity in texture indicates quieter conditions of deposition.

At 171 feet drilling encountered greenish-gray clay. The well ends in this material at 197 feet. The clay, locally known as "blue shale," is believed to persist to a depth of at least 900 feet. Reportedly, a well about 10 miles south of the test well encountered "blue shale" at 50 feet and bottomed in similar material at 900 feet. This formation is believed to have been deposited under lacustrine conditions and may be of Tertiary age.

Analyses of water

Water samples were collected from the test well while drilling was in progress. The casing and drilling methods used permitted the samples to be withdrawn from the desired aquifers without fear of contamination from above. These samples are indicative of the quality of the ground water in the Argenta Swamp portion of the flood plain of the Humboldt River.

Sample 3174 was collected from a depth of 54 feet and it is believed to be characteristic of the water throughout the gravel aquifer from 15 to 125 feet. The analysis indicates that this water is of good quality and suitable for either domestic or irrigation use.

Sample 3175, collected from the aquifer between 158 to 171 feet, is of even better quality.

The water from the shallow aquifer (15 to 125 feet) can be obtained economically, as the aquifer has highly favorable water-yielding characteristics. The water of better quality from the lower aquifer (158 to 171 feet) probably can be obtained in large quantities only by means of special well construction, including screens.