

TEMPORARY CONTAMINATION OF A DEEP WELL*

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THERE was a phenomenal rainfall in Alabama from the night of December 7th until the morning of December 10th, 1919. A precipitation of 9.6 ins. was recorded at Montgomery for this period, with like amounts for Selma, Birmingham, Gadsden, Lanett and other points. The Coosa and Tallapoosa rivers rose with unprecedented rapidity, until a flood stage of 57.1 ft. was reached on the Alabama River, the highest water recorded since 1886. The north portion of Montgomery was flooded, the water reaching the roofs of the houses in many places. Not realizing the situation, the operating engineer at the water works left at his usual time on the evening of December 9th. He was called to the plant just before the water began entering at 1.30 a.m. of December 10th. Trouble was experienced in operating, as the water was kept out of the motors with great difficulty, and it stood from 1 to 2 ft. over the north yard where there are four 52-ft. circular concrete storage reservoirs, 20 ft. deep.

Flood Water Covered Wells

Montgomery is supplied with water from 18 deep wells in the north portion of the city and two in the east portion. The northern wells draw water from depths varying from 200 to 600 ft. and are pumped by air. These wells discharge into the four circular concrete reservoirs, with a combined storage capacity of approximately 1,200,000 gals. From these basins the water is pumped to the mains, at the rate of about 3,000,000 gals. per 24 hours. The two eastern wells draw water from depths of 75 to 135 ft. respectively. These have an approximate capacity of 2,000,000 gals. per 24 hours, and are pumped by submerged, vertical multi-stage deep well centrifugal pumps, electrically driven, operating normally at 125 lbs. pressure and discharging directly into the mains.

The flood water rose above the ground level at every well. The air-lift or northern wells have well heads wherein the air exhausts and the water is collected before leaving for the collecting basins. These wells were assumed to be tight, as no water or air leaks ever showed. The well heads remained in each instance above high water level. The eastern wells were assumed to be tight, as the outside casing terminated in a concrete box, through one vertical side of which the discharge tee on the discharge pipe was run. This box was covered with the base plate of the motor, the joint being well cemented, and the stuffing box for the vertical shaft watertight.

Health Officer Was Worried

The county health officer became anxious about the water and went to the plant at noon on December 11th. The four basins are numbered consecutively from west to east. Basin No. 1 was found to contain clear water, the flood water level being above the ground level but 5 ft. below the basin rim. The water in Basin No. 2 was low, and slightly turbid. In Basin No. 3 the supply was also low, the water being very turbid. Basin No. 4 contained slightly turbid water. The depth of flood water increased from Basin No. 1 to Basin No. 4, the depth about the latter being 2 ft. or more. A slight infiltration below ground was seen in Basins No. 2 and No. 3. These were at once cut out of service and Basins No. 1 and No. 4 used for pumping.

Samples for analysis were taken from the mains and the analyses made in the State Laboratory. *B. coli* showed in all dilutions, with the total bacteria too numerous to count.

No pumps were operating on December 12th until 5.00 p.m., due to the water power dam having failed and the local stand-by steam plant being temporarily out of service.

*Paper presented to the American Water Works Association.

At this time the flood waters had receded far enough to permit an inspection of the wells at the pumping station. Two of these were found to be delivering a very turbid water. They were at once turned into Basins No. 2 and No. 3, which were not being used, but which had been connected with the outfall, so as to drain as soon as the river was low enough to permit it.

On December 13th, the city commission, in conference with the health officer, advised the people, through the press, to boil all water used for strictly domestic purposes. No attempt was made to sterilize the whole supply as no one connected with the water department was informed as to the practical methods.

Not until the morning of December 15th could the city health officer secure the aid of the state sanitary engineer, who had been held at Speigners by a railway wash-out. When he reached the city, a temporary chlorinating apparatus, consisting of two barrels, a curb cock to control the solution, and a feed pipe into the effluent was installed on December 15th so as to dose all the water from the air lift wells in Basins No. 1 and No. 4 at the pumping station. As Basins 2 and 3 were out of service, this cared for all the water delivered by the air lift wells, including the two cut out on account of turbidity, which had cleared up and been put back into service on account of water shortage. The 700,000-gal. filter plant, normally handling water from the river for the use of the railroads, had been flooded and put out of commission. This caused the railroads to draw on the domestic supply, which was to that extent short.

Temporary Chlorinating Equipment Installed

The chlorine dose was regulated by hand and controlled by the ortho-tolidine test, a residual amount of 0.2 part per million being obtained. Samples for analysis were taken from each well.

Only one of the eastern wells was in service. The water which it delivered was entering the supply untreated, under a pressure of 120 lbs. It was not possible to chlorinate this supply as no pressure apparatus was available. An examination showed the well was not water-tight. Fine straw had been sucked in large quantities towards the foundation around the discharge pipe. Upon examination it was at once seen that one side of the concrete box forming the motor base and terminating the outside casing, was gone completely, leaving the annular space between the 16-in. outer casing and the 8-in. discharge pipe open for the entrance of the flood waters.

A two-barrel apparatus for chlorine, introduced as a solution of chloride of lime, was installed. The dose was controlled chemically as at Basins No. 1 and No. 4 and the amount was held at the same standard. When the pump was not in operation, there could be heard a small stream of water splashing on the annular water surface between the outer casing and the drop pipe. This could not come from the drop pipe, as it immediately empties upon the stopping of the motor, the water running back through the centrifugal pump. This led to the belief that there was a leak in the casing which must be discovered by a mirror or by cutting the foundation, as direct sight was not possible. Any leak in this casing was doubly dangerous, as an open ditch draining a considerable area flows within 15 ft. of the well.

Samples Showed Gross Pollution

The results of the analyses made on the samples taken December 15th showed that the air-lift wells, which had furnished turbid water, had been grossly polluted, as were both of the eastern wells. A second set of samples was analyzed and the results confirmed those of the first set.

The basins at the pumping station are connected to the river through an overflow and flow-off pipe. The lower pipes are controlled by gate valves, the upper ones by check valves, with no gate valve in the line. The overflow pipe from Basins 1 and 2 enters one side of a tee, with a check valve between Basin 2 and the fitting. Basins 3 and 4 are so connected in series to the other arm