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Contamination Report No. 3

MEMORANDUM REPORT ON WATER
WELL CONTAMINATION IN THE SASPAMCO AREA,
WILSON COUNTY, TEXAS

By

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Geologist

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SUMMARY OF CONCLUSIONS

Analyses of well waters obtained during this investigation indicate that water in the domestic well belonging to C. T. Hubble is contaminated from a source, or sources, containing considerably greater concentrations of salts, particularly sodium chloride, than does natural water of the Carrizo sand which the well taps. Water from this well contains approximately 1,100 ppm chlorides under heaviest conditions of pumping and approximately 600 ppm chlorides under minimal conditions of pumping. Chloride concentrations of waters from several nearby wells in the same sand, at approximately the same depth, are less than 100 ppm. The Texas Department of Public Health does not recommend water for human consumption which contains over 250 ppm chlorides. On this basis, the water in the Hubble well is indicated to be heavily contaminated by sodium chloride.

Disposal pit no. 1, figure 1, near the Hubble water well is so constructed and geologically situated that it easily disposes approximately 150 barrels of brine per day. This brine percolates downward through 40-50 feet of unsaturated, permeable sand to the water table and then moves along with the ground water to points of natural or artificial discharge. The location of the pit with respect to the Hubble well is such that the normal direction of ground water movement beneath the pit





FIGURE 1.

Geologic map of Saspamco
Area showing locations of
water wells and brine
disposal pits.

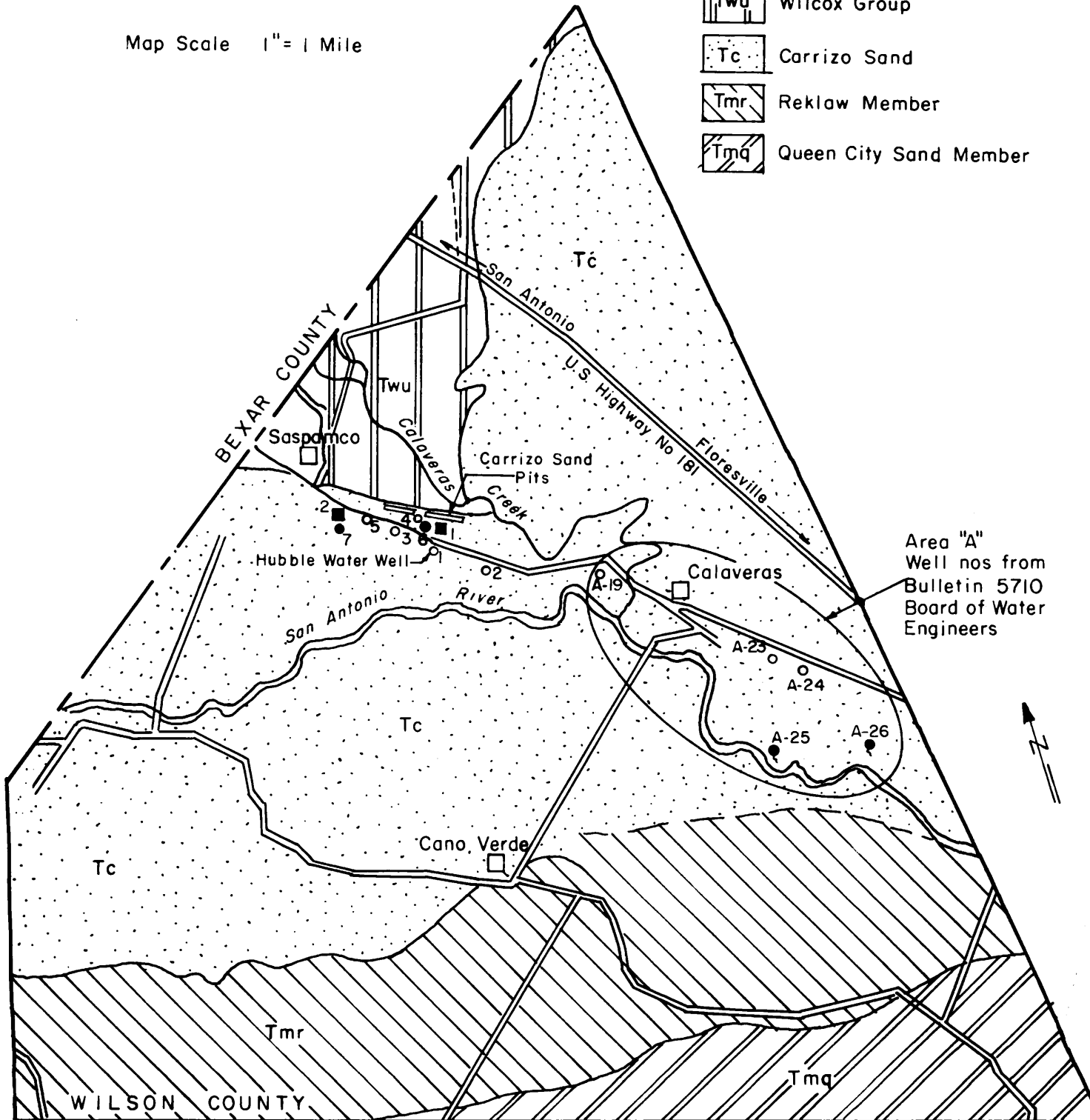
LEGEND

- 2 Domestic Water Well
- 2 Producing Oil Well
- 2 Brine Disposal Pit
- ⊙2 Spring

Note: Numbers opposite symbols correspond to numbers used in tables or in text references

-  Twu Wilcox Group
-  Tc Carrizo Sand
-  Tmr Reklaw Member
-  Tmq Queen City Sand Member

Map Scale 1" = 1 Mile



is, in general, from the pit toward the well. Therefore, the brine is transported to or near the vicinity of the Hubble well where it is received by the pump as a mixture of brine and ground water, resulting in an increase in the concentration of all normal constituents of the well water.

Though no other allegations of water well contamination were received in the Sasparamco area, pit no. 2, figure 1, is probably contaminating the normal quality of water in at least one nearby well (no. 5, figure 1) and probably water beneath other areas down-gradient from the pit. Water from this well contained 222 parts per million chlorides which, though still within potable limits, is a considerably higher concentration than those found in nearby wells which averaged less than 100 parts per million chlorides.

Only two producing oil wells are present in the area with which this report is concerned; these wells produce approximately 700 barrels of brine per day, all of which is disposed through unlined earthen pits into the Carrizo sand, a formation which normally contains ground water of excellent quality in this area.

INTRODUCTION

On Tuesday, August 19, 1958, pursuant to a request from the office of the Attorney General, the writer traveled to the residence of Mr. C. T. Hubble, which is 3/4 mile south of the Sasparamco community, approximately 25 miles southeast of San Antonio, in Wilson County, Texas. The

objectives of this trip were to investigate alleged contamination of a water well and, if corroborated, to determine the probable source of contamination.

The information obtained from the complainant is summarized as follows: Mr. Hubble purchased his farm in April of 1952. At the time of the purchase, the water well was reported to afford excellent water as did all nearby wells of similar depth, ranging from 70-85 feet. The water quality continued to be excellent until January or February of 1958, when increased hardness and a foreign taste were noticed. Use of the water for all purposes continued in spite of worsening quality and taste until May or June of 1958 when a salty taste and strong odor made it unfit for drinking. Since then, water for cooking and drinking has been hauled from a neighbor's well, the contaminated water being used for all other purposes, including the watering of stock.

In July, Mr. Hubble sent a water sample to the Texas Department of Health, which reported finding *Bacillus coli* in the water, indicating probable pollution from animal sources. (*Bacillus coli* is an organism which is in the systems of all warm-blooded animals; the analysis is used as an index to pollution from animal sources and has partially superseded nitrate analysis as an indication of such pollution.) The Health Department reportedly made no mineral analyses on the water but referred Mr. Hubble to private chemical laboratories.

After receipt of the bacteriological analysis in July, the well was cleaned out to see if some small animal had fallen in it, but none was found upon removal of a large volume of coarse sand from the bottom of the well. The well was pumped continuously (at approximately 5gpm) for some time after cleaning, after which the odor and taste of the water was

said to be worse than before. A sample was taken at this time (August 10, 1958) and subsequently was analyzed by a commercial laboratory in San Antonio with results as tabulated in item 1, table 1. The chloride concentration was reported to be 1,020 ppm.

Mr. Hubble stated that the odors of the well water and of the brine effluent from the separator at a nearby oil tank-battery are similar. A strong odor of hydrogen sulfide gas was noticed by the writer in the latter water and also a pronounced odor, possibly but not certainly, of hydrogen sulfide gas.

Oil was discovered in the area in 1954, approximately two years after Mr. Hubble purchased the farm; production is obtained from fractures in the Austin chalk. Seven to ten producing wells were completed initially but all except two have been abandoned. Reportedly, little gas was associated with the oil reservoir and pressures steadily declined.

Mr. Hubble reported that brine from a nearby oil well (no. 6, figure 1) was, for two years, discharged into a small earthen pit from which it was hauled away for disposal with no reported ill effects on water wells in the community; however, approximately two years ago the operator ceased hauling the brine and started disposing directly into a pit excavated into permeable sand which permits infiltration to the subsurface. Mr. Hubble believes that brine disposed into this pit is the source of contamination in his well.

GEOLOGY

The writer made a brief geological reconnaissance of the Saspanco area which revealed that the Hubble well and all nearby oil production and disposal facilities in the Saspanco field are underlain by a coarse-grained sandstone of considerable thickness into which deep pits have been excavated by the San Antonio Sewer Pipe and Manufacturing Company. Figure 1 is a geologic map which shows locations of water wells, oil wells, sand pits, and salt water disposal pits sampled or inspected during this investigation. The sand pits expose 40 to 60 feet of cross-bedded, brownish-white, medium-to-coarse-grained sandstone which is mapped as the Carrizo sand in Bulletin 5710 of the United States Geological Survey and Board of Water Engineers, entitled "Ground-Water Geology of Wilson County, Texas." The sand is continuous from the sand pits to the Hubble well (no. 1, figure 1), which is very close to them.

The area surrounding the Hubble well is underlain by three to six feet of reddish-brown, alluvial clay overlying a few feet of "caliche" which, in turn, overlies the massive section of light-colored Carrizo sand. The sand removed from the bottom of the Hubble well is similar in mineralogical and physical character to sand examined in the sand pits.

OCCURRENCE OF GROUND WATER

Adequate water-level data were not obtained to determine the exact direction of movement of ground water in the Carrizo sand in this

locality; however, it is known that, in general, ground water movement in the outcrop area of the formation is toward the San Antonio River.

Assuming that this is true in the vicinity of the Hubble water well, water introduced into the Carrizo sand through pit 1, figure 1, would percolate downward until the water table is encountered approximately 65 feet below land surface; it would then move along with the ground water, at the same time settling to lowest points in the reservoir because of its greater density. Little chemical diffusion of the brine into the ground water body is believed to occur within short distances. Inspection of figure 1 reveals that the Hubble well lies generally down-gradient from the pit; brine is therefore expected to move toward the well, probably augmented by pumping effects from the well.

Ground water in the Carrizo sand in the Sasfamco area is indicated to occur under unconfined conditions because the wells, which are 70-80 feet deep, contain only six to eight feet of water. The sand appears clean and fairly uniform in grain size, indicating a high degree of permeability.

BRINE PRODUCTION AND DISPOSAL

Two producing oil wells and associated brine disposal pits are present in the area; the pits were receiving continuous flows of brine from separators. The pit closest to the Hubble well (pit no. 1, figure 1), appeared to be an irregular-shaped excavation into the Carrizo sand, reportedly made for the purpose of obtaining sand. It

was full of brine but an adjacent, empty pit showed the top of the permeable sand to be approximately ten feet below ground level at the site of the pit. The brine displayed a greenish-yellow color and a strong sulfurous odor. Figures submitted to the Texas Railroad Commission by Mr. William Forney, the operator, in the latter part of 1957, indicated that 149 barrels of brine were produced daily from this one-well lease on T & N O Railroad Company property. At the time of this investigation, the writer estimated 155 barrels per day were disposed at the lease on the basis of reported continuous pumping. Daily oil production from the lease is approximately 11.5 barrels, according to records of the Texas Railroad Commission.

Disposal of brine from the other producing well was to two man-made pits (no. 2, figure 1) by overflow from one to another with a standby pit alongside which was just beginning to receive a slight flow of brine from the second pit. The pits were excavated through the alluvial clay and "caliche" to what appeared to be porous sand. The shallow geologic section under this salt water pit is essentially the same as that described above, consisting principally of 50 to 60 feet of Carrizo sand underlying eight to ten feet of clay and "caliche". Brine was estimated to be flowing to these pits at a rate of 15-20 gpm; it displayed the same color and odor as did the brine disposed into pit no. 1. This estimated rate of flow amounts to approximately 550 barrels per day, assuming continuous pumping of the well. The operator-reported brine production rate in files of the Texas Railroad Commission for this lease was 114 barrels per day in the autumn of 1957.

CHEMICAL CHARACTER OF WELL WATERS

During this investigation water samples were taken from the Hubble water well and four other domestic water wells nearest to it. A sample of the brine disposed to pit no. 1, figure 1, was also taken. Partial chemical analyses of all samples were performed by laboratories of the Texas Department of Health. Results of these analyses are presented in table 1. Only the Hubble well contained chlorides in excess of 250 ppm according to Health Department analyses. It was reported to contain only 570 ppm chlorides compared with 1,020 ppm as reported by Texas Testing Laboratories. The difference in these analyses is considered to be caused by sampling the water under pumping and non-pumping conditions of the well, as indicated in table 2. A chloride analysis of the water sampled on August 29 after two to three days of semi-continuous pumping of the well showed a chloride concentration of 1,188 ppm.

Water from the Lucio well (no. 5, figure 1) contained 222 ppm chlorides; this well was reported by the owner to have been contaminated beyond potability approximately two years ago but to have improved greatly since then; water from this well is now used for drinking but the chloride concentration is still higher in the well than is the normal chloride concentration of waters from Carrizo wells of this area, as indicated by chemical analyses of water from wells no. 2, 3, and 4, figure 1, which contained from 35 to 96 ppm. No typical analysis can be constructed for water in the Carrizo sand in the immediate vicinity of Saspanco from analytical data presented in table 1 because all

constituents showed appreciable well-to-well variation. It is suspected that the different chemical analyses of Carrizo water in the immediate area of these wells reflect the effects of brine disposal in the general area, some to a greater and some to a lesser extent. However, the normal chloride concentration of Carrizo water in this area is indicated to be less than 100 ppm; on this basis, waters of the Hubble well and probably the Lucio well are both contaminated.

Table 2 presents (1) an average analysis of five waters from a group of Carrizo wells (see area "A", figure 1) some distance removed from the Sasparamco oil field area which is indicated to be representative of uncontaminated water of the Carrizo sand, (2) analyses of water from the Hubble well taken under pumping and non-pumping conditions (3) an analysis of brine from a producing oil well (no. 6, figure 1) which is disposed to an earthen pit approximately 250 yards from the Hubble home. Comparison of these analyses indicates that the water from the Hubble well contains much greater concentrations of all constituents than does water from wells of area "A". Comparison of the brine analyses with water from the Hubble well shows that much greater concentrations of all constituents are present in the brine, enough to raise the concentrations of constituents of normal Carrizo waters to levels indicated in the Hubble well.

Brine disposal to pit no. 2, figure 1, is not alleged to be contaminating any water well; however, it is believed that the water in the Lucio well is either affected by the original source of contamination, reportedly a previously-used pit, or by existing pits. No water wells

exist immediately down-gradient from these salt water pits to provide samples for chemical analyses of ground water, but it is reasonably certain that water in the Carrizo sand is contaminated under these areas.

Table 1.—Quality of water in selected wells, Saspanco area,
Wilson County, Texas /1

Map Num- ber	Well owner	Type and depth of well (ft.)	Date sampled	Chemical Constituents (ppm)								Remarks
				Calcium	Magne- sium	Sodium	Bicar- bonate	Sul- phate	Chlo- ride	Ni- trate	Total hardness as CaCo ₃	
		Dug 73	8/10/58*	104	23	603	not reported	70	1,020	none	not reported	Sample taken from tap at pressure tank after heavy pumping.
1	C. T. Hubble		8/19/58	88	19	310	195	52	570	less than 0.4	300	Sample taken from tap at pressure tank after little pumping.
2	Alberto Carvajal	Dug 33	8/19/58	136	22	58	278	62	96	100	433	Sample taken from tap at pressure tank.
3	Tom Guajardo	Dug 80-85	8/19/58	45	14	20	160	19	35	12	170	Sample taken from tap in well casing.
4	Peter Alvarado	Dug 80-90	8/19/58	88	12	49	232	47	92	less than 0.4	270	Sample taken from tap at pressure tank.
5	G. Lucio	Dug 80	8/19/58	84	14	140	221	64	222	3.9	270	Sample taken from tap at pressure tank.
6	T&NO Railroad (oil well)	Drilled 3,000	8/19/58	272	125	4,850	698	975	7,600	less than 0.4	1,200	Sample taken from separator effluent.

/1 All analyses are by the Texas Department of Health, unless otherwise noted.

* Analyses by Texas Testing Laboratories, San Antonio, Texas

Table 2.—Chemical analyses of normal Carrizo water, produced brine, and water from the Hubble well

Location of analysis (on figure 1)	Description of analysis	Time of sampling (mo. & yr.)	Chemical Constituents (ppm)						Total hardness as CaCO ₃	Remarks
			Calcium & magnesium	Sodium & potassium	Bicarbonate	Sulfate	Chloride			
Area "A"	Average of five analyses of Carrizo water in Area "A", Figure 1, away from the oil-producing area.	February 1936	19	21	96	11	29	69	Wells A-19, 23, 24; Springs A-25, 26 from Bulletin 5710 BWE; analyses by Works Progress Administration, 1936.	
		August 28, 1958* <u>1</u>	--	--	--	--	1,188	--	Sample taken from tap at pressure tank after 2-3 days of pumping.	
1	Water from C. T. Hubble well	August 19, 1958**	107	310	195	52	570	300	Sample taken from tap at pressure tank after 2-3 minute's flow.	
		August 10, 1958* <u>2</u>	127	603	--	70	1,020	--	Sample reportedly taken from tap after continued pumping while cleaning well.	
6	Water from oil well on T&NO Railroad lease	August, 1958	379	4,850	698	975	7,600	1,200	Sample taken from oil-gas separator effluent.	

* Sample analyzed by commercial laboratory, San Antonio, Texas.

** Sample analyzed by Texas Department of Health.

1 Only chlorides were determined on this sample.

2 Sample also analyzed by Texas Department of Health with approximately the same results.