TEXAS WATER COMMISSION

Joe D. Carter, Chairman
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LD-0564-MR

INVESTIGATION OF GROUND-WATER CONTAMINATION

COLETO CREEK OIL FIELD

VICTORIA COUNTY, TEXAS

By

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Ground Water Division

March 1964

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INTRODUCTION

Statement of Problem

On May 30, 1963 a letter was received from Mr. Kemper Williams, attorney for Wesley Schmidt, regarding alleged contamination of ground water in the Coleto Creek oil field, Victoria County, Texas. The letter stated, "He [Mr. Schmidt] dug a well some 70 feet deep and had good water for over a year, since that time, however, his water has become salified to such an extent that it has been impossible for them to drink the water and it has ruined all the bathroom fixtures."

Mr. L. G. McMillion, Director of the Ground Water Division, instructed the staff of the Waste Disposal Section to conduct a field investigation of the problem in order to prepare a statement, together with such recommendations as may be indicated, for presentation at the June 20, 1963 meeting of the Water Pollution Control Board.

The initial field work was done on June 5, 1963 to determine the conditions that existed in the immediate area of the contamination complaint. Additional field work was done on November 13 and 14, 1963 to obtain information in the entire oil-field area.

Location and Economy

The Coleto Creek oil field is in southwestern Victoria County approximately seven miles southwest of Victoria, Texas (Figure 1).

The economy of the study area is based on oil production with very little agricultural development.

Method of Investigation

During the course of the investigation, completion data were obtained and water levels were measured in water wells in the Coleto Creek oil field (Table 2); twenty-two samples of ground water from water wells and four samples of produced oil-field brine were collected for chemical analysis (Table 3). Water wells, oil and gas wells, and brine disposal facilities were located and plotted on a map of the oil-field area (Plate 1).

GEOLOGY

The geologic formations found between the surface and 3,000 feet below sea level are listed in Table 1 in the order of their age, the youngest being at the top. The area of investigation is on the outcrop of the Lissie Formation which is

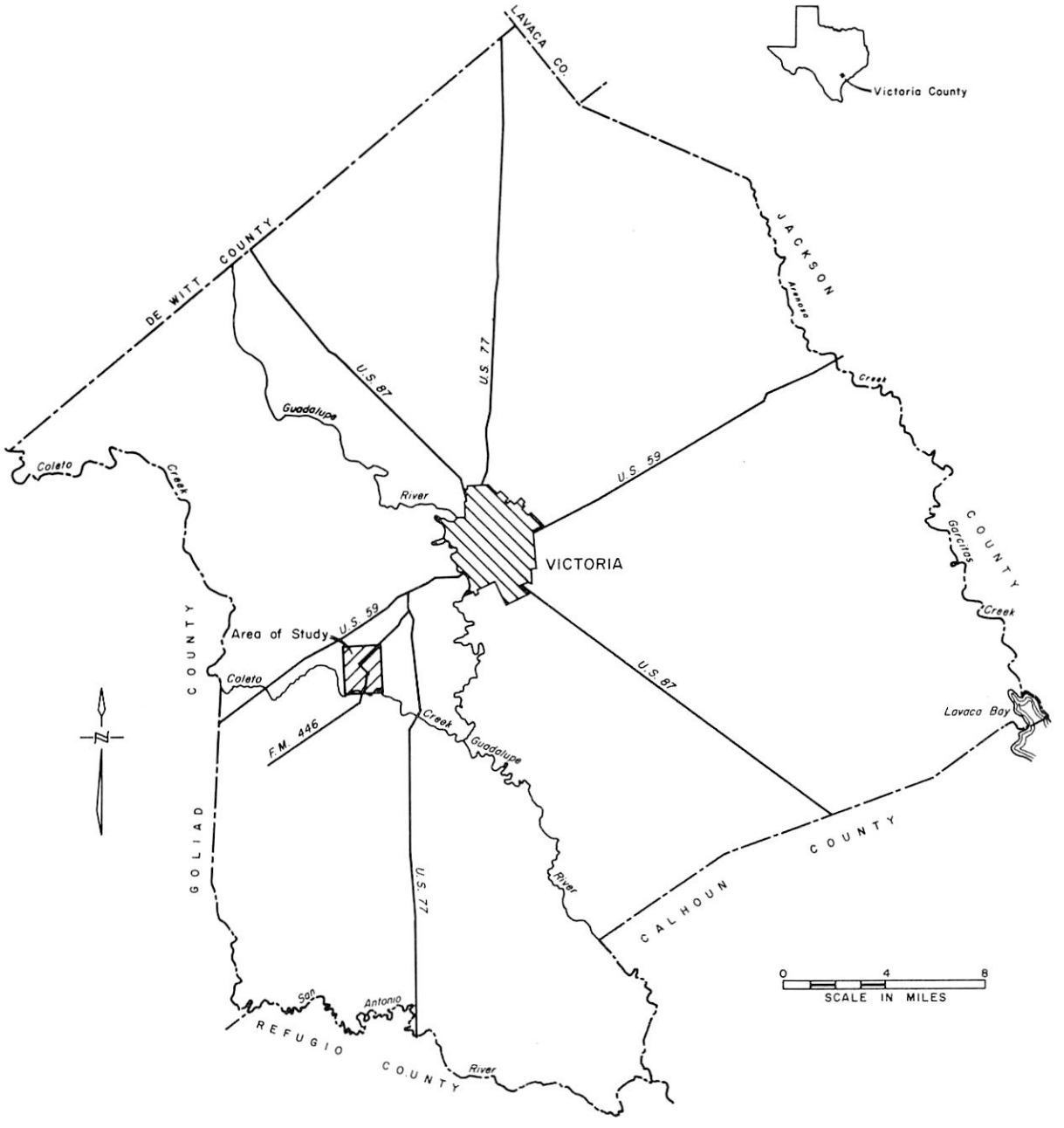

Figure 1

Map Showing Location of Coleto Creek Oil Field,
Victoria County, Texas

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Table 1.--Geologic formations and their water-bearing characteristics, Coleto Creek oil field, Victoria County, Texas

A G E		Stratigraphic Unit	Approximate maximum thickness (feet)	Character of formation	Water-bearing characteristics
System	Series				
Quaternary	Pleistocene	Lissie Formation	600	Thick beds of sand containing lentils of gravel and layers of clay, silt, and some caliche.	Yields large supplies of fresh water to municipal, industrial, and agricultural wells in Victoria County.
Tertiary	Pliocene	Goliad Sand	400	Predominantly sandstone and sand containing some clay, caliche, and gravel.	Yields large supplies of fresh water for municipal, industrial and agricultural use in Victoria County.
	Miocene(?)	Lagarto Clay	1,000±	Clay and sandy clay containing interbedded layers of sand and sandstone.	Not known to yield water to wells in Victoria County. However contains fresh to slightly saline water in northern Victoria County.
	Miocene	Oakville Sandstone	500±	Crossbedded sand and sandstone containing interbedded sandy, ashy, or bentonitic clay.	Not known to yield water to wells in Victoria County. Contains the base of the fresh or slightly saline water in northwest part of Victoria County.
	Miocene(?)	Catahoula Tuff	1,000±	Predominantly volcanic tuff and tuffaceous clay containing sandstone lentils.	Does not contain fresh or slightly saline water in Victoria County.

composed of thick beds of sand containing lentils of gravel interbedded with clay and silt. This formation yields large supplies of fresh water to municipal, industrial and agricultural wells in Victoria County. The Lissie Formation has greater areal extent of more prolific sands than any other part of the fresh water-bearing section in the Gulf Coast. The approximate maximum thickness of the Lissie Formation in Victoria County is 600 feet.

The Goliad Sand, which underlies the Lissie Formation, is composed predominately of sandstone and sand containing some clay, caliche and gravel. This formation yields large supplies of fresh water for municipal, industrial and agricultural use in Victoria County. The approximate maximum thickness of the Goliad Sand in Victoria County is 400 feet.

The Lagarto Clay, which underlies the Goliad Sand, is composed of clay and sandy clay interbedded with layers of sand and sandstone. The Lagarto is not known to yield water to wells in Victoria County, although the upper sands apparently contain water of usable quality in the oil-field area.

The Oakville Sandstone and Catahoula Tuff will not be discussed in this report since they do not contain water of usable quality in the area of investigation.

The formations strike toward the northeast and dip to the southeast at less than 20 feet per mile in the area.

GROUND WATER

Occurrence

Ground water of usable quality is produced from the Lissie Formation and possibly from the Goliad Sand in the Coleto Creek oil field. The base of water of usable quality, as determined from interpretation of electric logs, occurs to a depth of about 1,400 feet below land surface.

Recharge to the Lissie Formation is through precipitation that falls on the outcrop. Most of the precipitation is used up by evaporation, transpiration, or runoff, however, a small part percolates through the soil to become ground water.

The water in the outcrop is under water-table conditions, however, as the water moves downdip and passes beneath beds having lower permeability, it is under sufficient pressure to rise above the point that it is encountered in a well and is under artesian conditions. The movement of ground water in the area is to the southeast with local movement toward Coleto Creek (Plate 1).

Quality

Marvin, Shafer and Dale, (1962), report that "Chemical analyses indicate that the greater part of the fresh [0 to 1,000 ppm (parts per million) total dissolved solids] or slightly saline [1,000 to 3,000 ppm total dissolved solids] ground water in Victoria County is suitable for public, industrial and agricultural uses." They also report that the chloride content of most of the samples

collected in Victoria County during their study was within the limits set by the U. S. Public Health Service for drinking water on interstate carriers (250 ppm).

The native quality of water produced from shallow wells, (less than 100 feet), in the Lissie Formation in the Coleto Creek oil field, is of the calcium-magnesium-bicarbonate variety. The water is hard with an occasional indication of sulphur odor. Chemical analyses of native water from the shallow well indicate a chloride content of 23 ppm to 95 ppm, and total dissolved solids content of 249 ppm to 573 ppm.

Chemical analyses of native water produced from the deeper wells, (195 to 800 feet), indicate a chloride content of 112 ppm to 123 ppm, and total dissolved solids content of 780 ppm to 820 ppm.

BRINE PRODUCTION AND DISPOSAL

Production

An inventory of salt water production and disposal for the calendar year 1961, which was made by the Texas Railroad Commission in cooperation with the Texas Water Commission and Texas Water Pollution Control Board, indicates that during 1961, 1,916,253 barrels of salt water were produced in the Coleto Creek oil field.

Disposal

Of the total salt water produced in the field, the inventory indicates that 100 percent was disposed of into open unlined surface pits. The pits in the field are constructed in the sandy Lissie Formation and range in depth from 15 to 20 feet. Generally there are two pits at each disposal location with the second, or overflow pit, being the deeper of the two. Examples of the types of pits being used in the field are indicated in Figures 2 through 7.

On June 21, 1962 the Water Commission recommended approval of an application of Quinette and Leiderman to dispose of 2,000 barrels of produced brine per day into the zone 3,175 to 3,350 feet in the Terrell A-1 Salt Water Disposal Well. The well reportedly had 10-3/4 inch surface casing set to 450 feet with an unknown amount of cement, 7 inch long string set at 4,437 feet with an unknown amount of cement, with disposal proposed through 2-7/8 inch tubing set at 3,125 feet on a packer. The injection interval was to be perforated and block squeezed to prevent upward migration of the injected brine around the long string.

On June 22, 1962 the Water Commission recommended disapproval of an application of Rupert Cox to dispose of 700 barrels of produced brine per day into the zone 4,631 to 4,639 feet in his John Zimmer Well 6. The well was completed with 10-3/4 inch surface casing set at 520 feet with 300 sacks of cement, 5-1/2 inch long string set at 4,657 feet with 300 sacks of cement, with disposal proposed down the long string through perforations. The disapproval was based on the fact that the well had short surface casing with the possibility of corrosion of the long string and resultant contamination of fresh water which occurs to an approximate depth of 1,050 feet in the well.

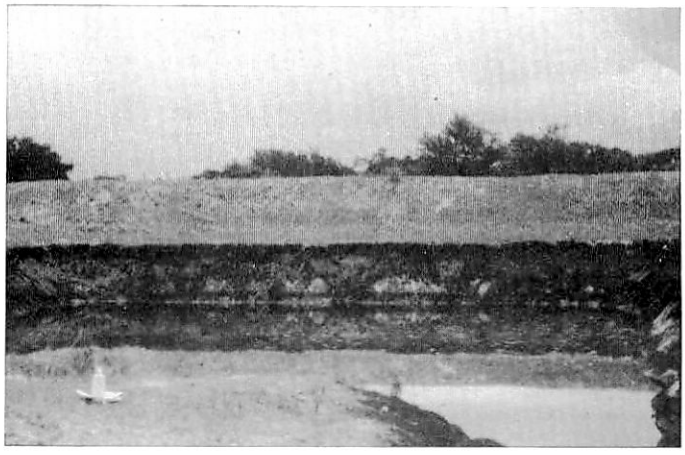

Figure 2

View of Second Pit on Bay Oil and Gas Zimmer Lease. Pit Approximately 20 Feet Deep. Chloride Content of Water from Lease 27,000 ppm

Figure 3

View of Pits on Wofford Cain Gaugler Lease. Reported Brine Production 238 barrels per day. Chloride Content 28,000 ppm

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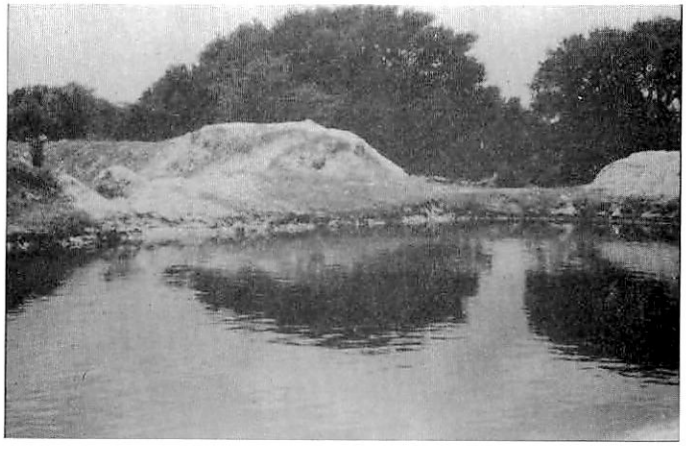

Figure 4

View of Pit on Quinette and Leiderman Terrell Lease. Reported Brine Production 1,700 barrels per day. Chloride Content 27,700 ppm

Figure 5

View of Second Pit on Quinette and Leiderman Terrell Lease

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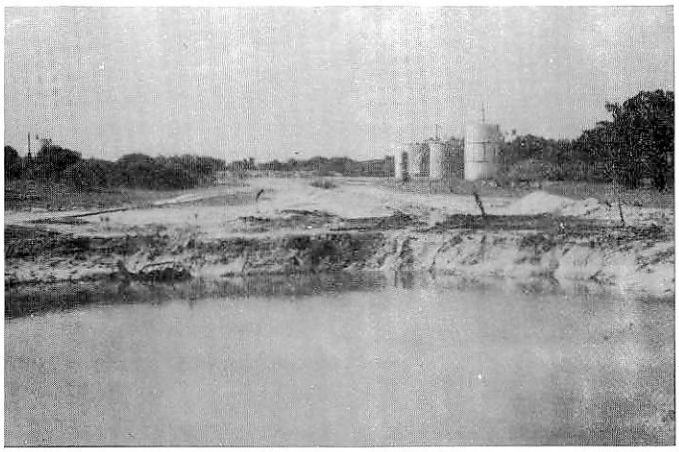

Figure 6

View of Pit on Quinette and Leiderman Kastner Lease. Brine Flows from Pipe in Background into Trench and Down to Pit by Gravity. Reported Brine Production 761 barrels per day. Chloride Content 25,900 ppm

Figure 7

View of Second Pit on Quinette and Leiderman Kastner Lease.
Pit Small and Deep in Extremely Sandy Soil

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Chemical analyses of samples of oil-field brine produced in the field indicate an average chloride content of 27,000 ppm and total dissolved solids content of 44,000 ppm (Table 3).

SUMMARY OF CURRENT INVESTIGATION

The complaint received from Mr. Williams indicated only one contaminated well, however data collected in the oil-field area during the investigation indicate that several wells have been affected.

Water wells in the area produce from two distinct zones; a shallow zone (less than 100 feet) and a deep zone (195 to 800 feet). Water wells producing from the shallow zone range in depth from 54 to 90 feet. In an attempt to determine the native quality of water being produced from the shallow zone, water samples were taken from 14 wells. Chemical analyses of water from these wells indicate that the native quality of water being produced is of the calcium-magnesium-bicarbonate variety.

Figure 8 is a graphic representation of the produced brine, the native quality of water, and the contaminated water which shows the effect of brine contamination on the chemical character of shallow ground water in the Lissie Formation. Figure 9 shows chemical analyses of the shallow ground water in the Coleto Creek oil field represented by three points plotted in trilinear diagrams. As shown in these illustrations, water from Wells 1, 2, 8 and 16 has been contaminated. In addition to these wells, Well 4 and two abandoned wells near Well 9 have reportedly been contaminated (Plate 1).

Well 4, which is owned by Fred Maurer, was drilled in 1895 to a depth of 83 feet and reportedly produced water of usable quality until about a year and a half ago. At that time water from the well reportedly became so salty that the cattle refused to drink. A 1935 chemical analysis of a water sample from the well indicated a chloride content of 98 ppm (Table 3). A water sample could not be obtained during this investigation because the well had been abandoned and plugged. Two wells located near Well 9 were abandoned reportedly because of contamination by salt water.

Well 1, which is owned by Wesley Schmidt, was drilled in 1959 to a depth of 75 feet and the water from the well was reportedly of good quality for over a year. At the time of this investigation, water samples were obtained from the well after it had been pumped for one minute, and after it had been pumped five hours. Chemical analyses of the water samples obtained from this well indicate a chloride content of 2,490 ppm and 2,400 ppm, respectively.

Well 2, which is owned by Roy Schmidt, was drilled in 1954 to a depth of 67 feet. The chemical analysis of the water sample obtained from this well indicates a chloride content of 381 ppm.

Well 8, which is owned by Edgar Maekers, was drilled in April, 1963 to a depth of 57 feet. The chemical analysis of the water sample obtained from this well indicates a chloride content of 2,700 ppm.

Well 16, which is owned by P. J. Bittlebrun, was drilled in May, 1963 to a depth of 65 feet. The chemical analysis of the water sample obtained from this well indicates a chloride content of 225 ppm.

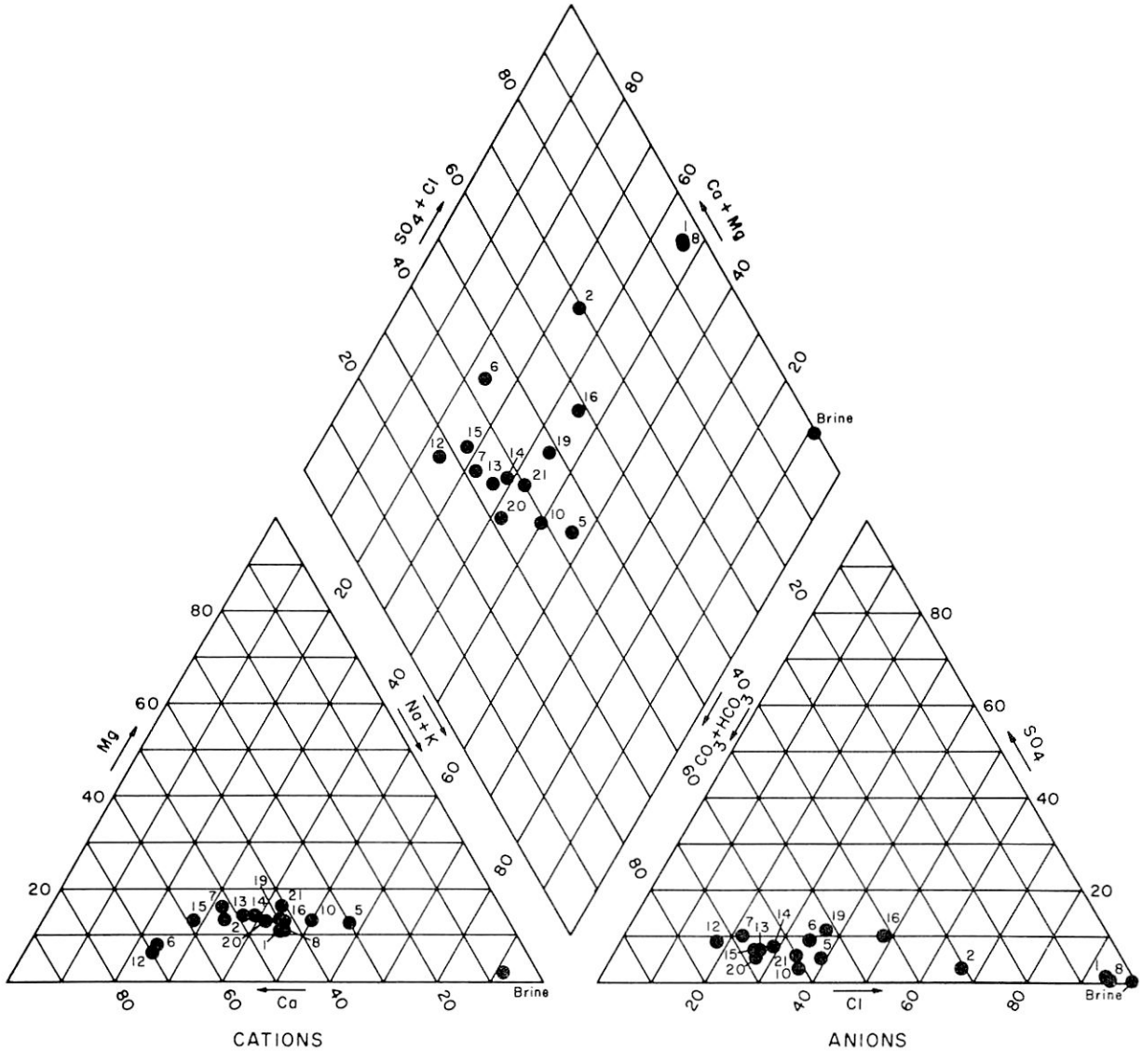

Figure 9

Chemical Analyses of Shallow Ground Water in the Coleto Creek Oil Field, Victoria County, Texas, Represented by Three Points Plotted in Trilinear Diagram

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A study of chemical analyses of water samples obtained from Wells 5, 10, 19 and 21 indicates that water from these wells has been altered from the native quality of water produced from the shallow zone in this area. Well 5, which is owned by J. H. Gilley, Jr., was drilled in 1940 to a depth of 90 feet. The chemical analysis of the water sample obtained from this well indicates a chloride content of 149 ppm.

Well 10, which is owned by A. T. Pantel, was drilled in 1955 to a depth of 77 feet. The chemical analysis of the water sample obtained from this well indicates a chloride content of 126 ppm. A sulphur odor was also detected in this well.

Well 19, which is owned by Adolph Pribyl, was drilled in the early 1900's to a depth of 65 feet. The chemical analysis of the water sample obtained from this well indicates a chloride content of 144 ppm.

Well 21, which is owned by Joe Machalec, is apparently a shallow well, although completion information on the well could not be obtained during the investigation. The chemical analysis of the water sample obtained from this well indicates a chloride content of 112 ppm.

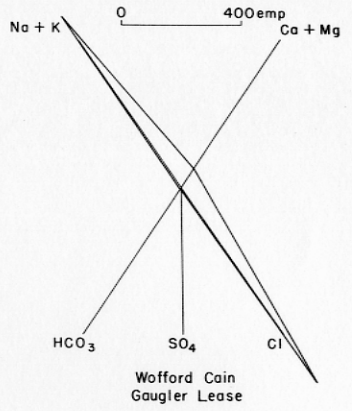
Water samples were obtained from six wells which produce from the deep (195 to 800 feet) zone. Figure 10 shows pattern diagrams illustrating the chemical character of deep ground water in the area. Figure 11 shows chemical analyses of deep ground water represented by three points plotted in trilinear diagrams. A study of the chemical analyses of water samples obtained from wells producing from this zone indicates no apparent contamination problem. Wells 3 and 9 were drilled to replace contaminated shallow wells. Well 3 was drilled in 1963 to a depth of 195 feet to replace the contaminated well of Mr. Maurer (Well 4). The water produced from this well must be aerated before it is used because of the sulphur odor. Well 9, which is owned by A. C. Green, was drilled in 1961 to a depth of 207 feet to replace two shallow wells that reportedly became contaminated. The water from this well also has a strong sulphur odor and must be treated before it is used.

Possible sources of contamination to the shallow ground water in the field include (1) oil or gas well blowouts which occurred in the past, and (2) use of unlined surface pits for disposal of produced brine.

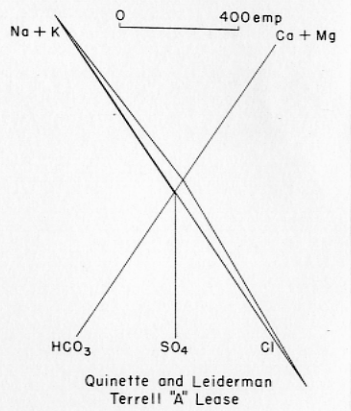
Three blowouts are indicated on the map of the Coleto Creek oil field (Plate 1). These blowouts are located on the Bay Oil and Gas Zimmer Lease, Averill and Marcox Terrell Lease and Quinette and Leiderman Kastner "A" Lease. No information was available on the blowout located on the Zimmer lease.

The Quinette and Leiderman Kastner "A" Well 6 has cratered around the casing making a hole about 6 feet in diameter and 6 feet deep. The "Christmas Tree" which is still on the casing is leaning in the hole at about a 45° angle. At the time of the investigation water was standing in the hole around the casing and gas was bubbling through it. The chemical analysis of the water sample obtained from the water in the hole indicates that this was probably rainwater which had collected in the hole (Table 3).

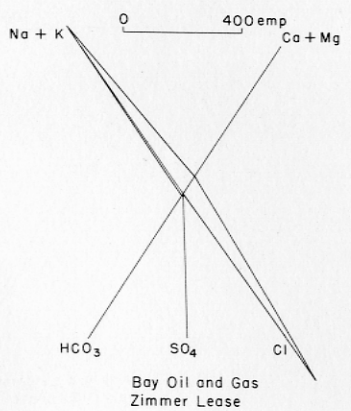
The Averill and Marcox Terrell Well 5 apparently blew out in the early 1940's. The well site currently is a crater about 200 feet in diameter and of undermined depth which is full of water. At the time of this investigation,



Wofford Cain
Gaugler Lease

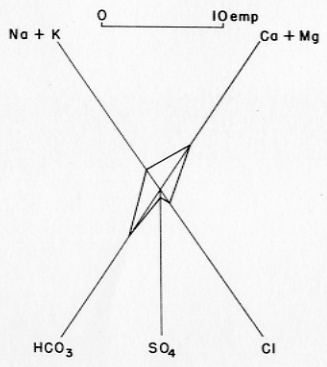


Quinette and Leiderman
Terrell "A" Lease

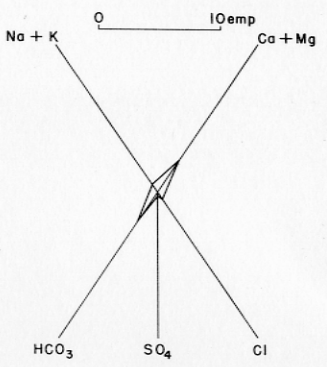


Bay Oil and Gas
Zimmer Lease

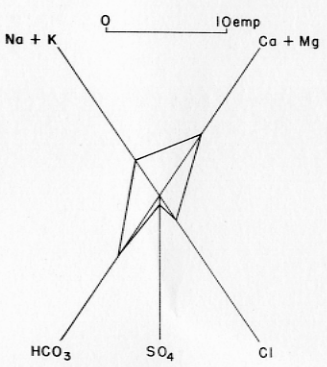
Oil-Field Brine



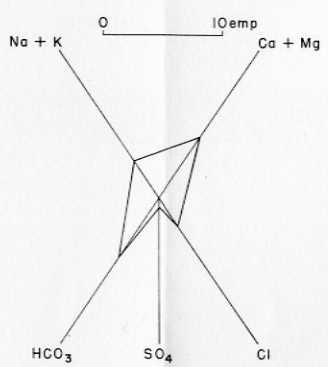
Well 7
O.G. Martin
89'



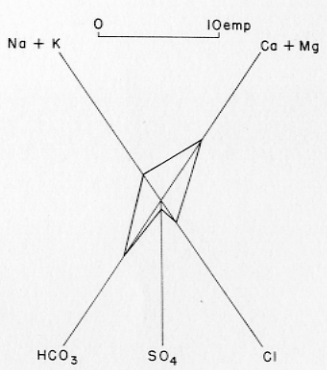
Well 12
Mrs. John Zimmer
65'



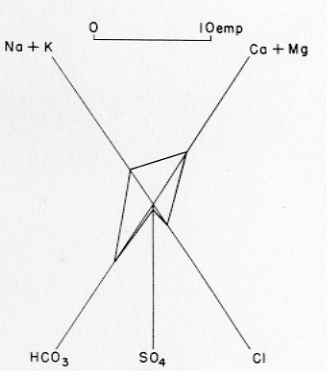
Well 13
W.J. Gaugler
62'



Well 14
W.J. Gaugler
63'

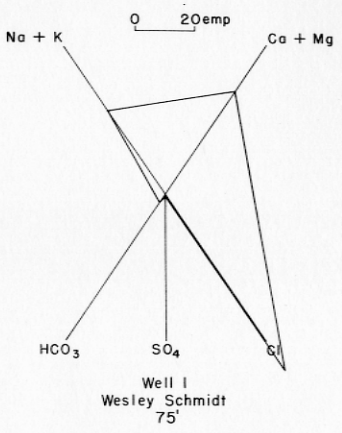


Well 15
Gus Zimmer
68'

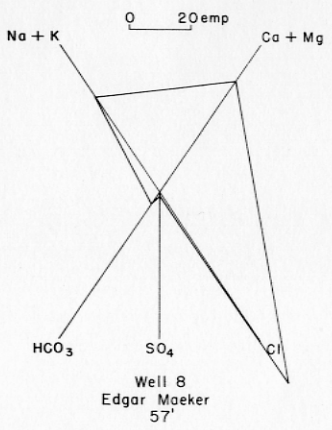


Well 20
Herman Dietzel
68'

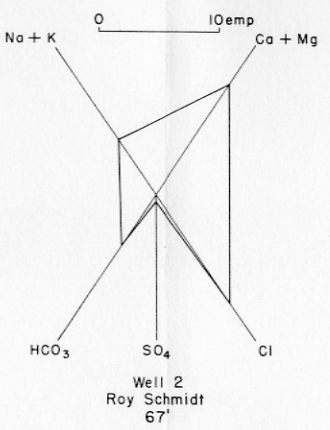
Native Water



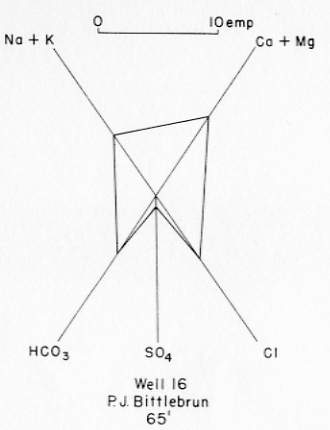
Well 1
Wesley Schmidt
75'



Well 8
Edgar Maeker
57'



Well 2
Roy Schmidt
67'



Well 16
P.J. Bittlebrun
65'

Contaminated Water

Figure 8

Pattern Diagrams Illustrating the Effects of Brine Contamination on the Chemical Character of Shallow Ground Water in the Lissie Formation, Coleto Creek Oil Field, Victoria County, Texas

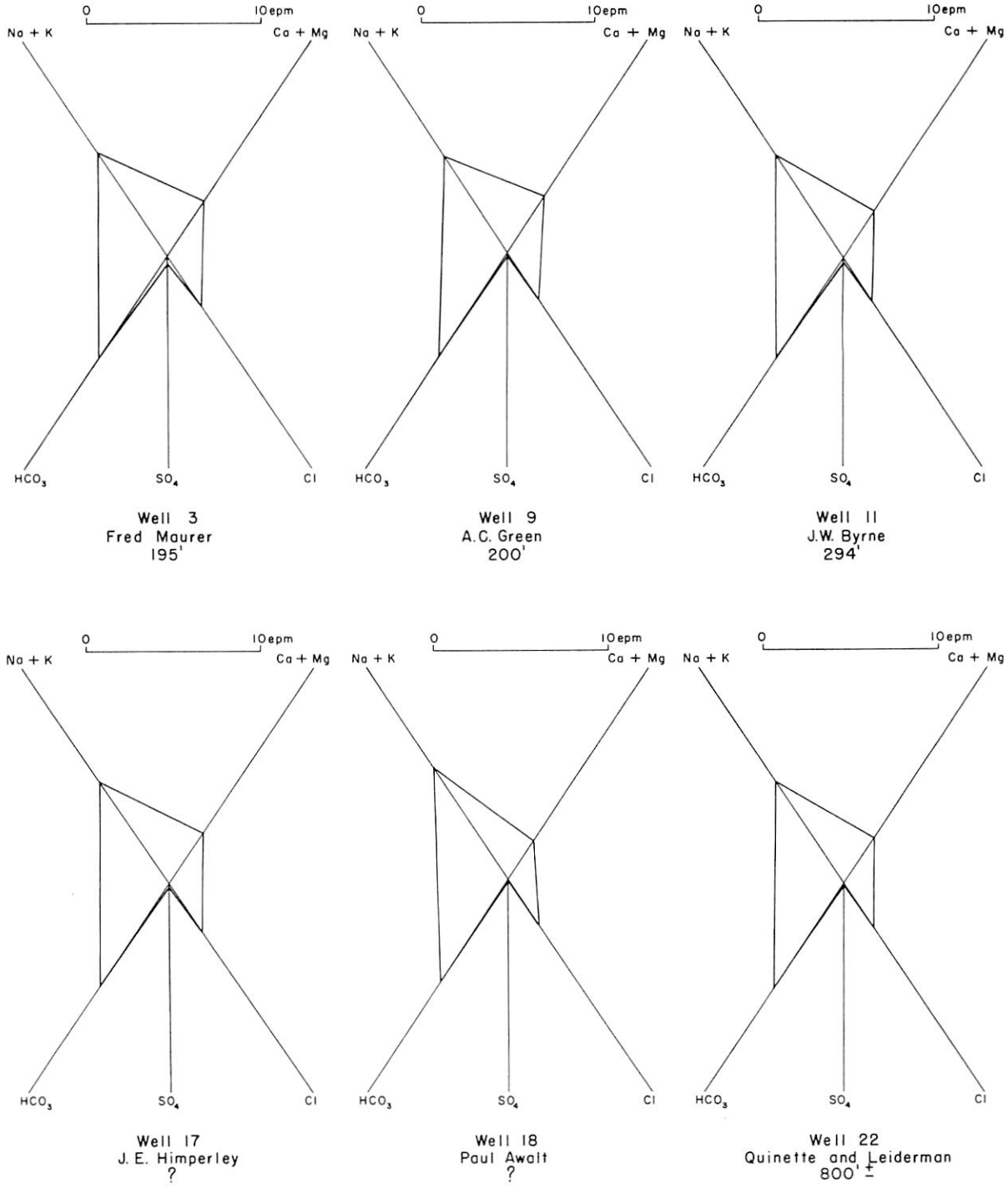


Figure 10

Pattern Diagrams Illustrating the Chemical Character of Deep Ground Water in the Lissie Formation, Coleto Creek Oil Field, Victoria County, Texas

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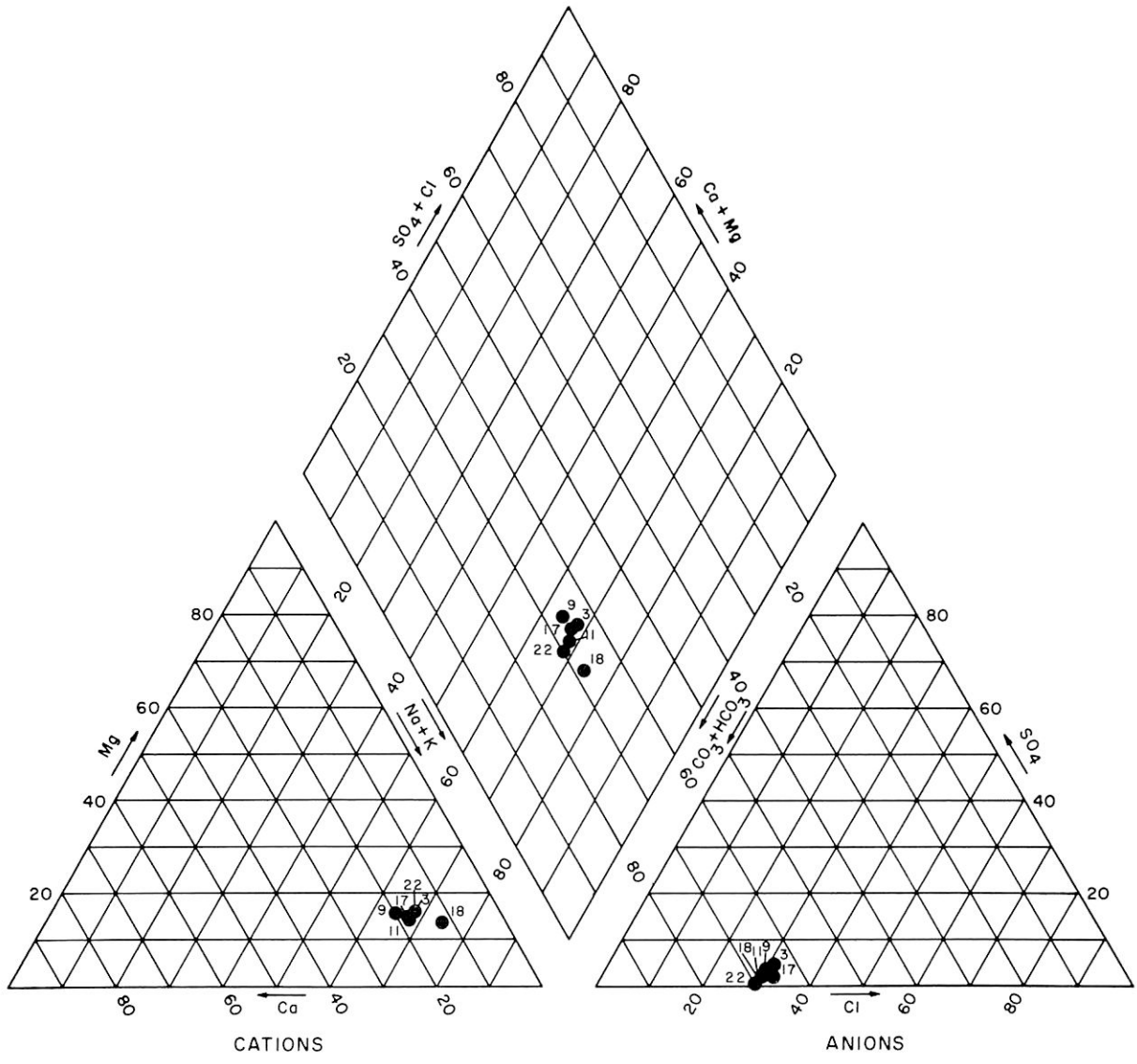

Figure 11

Chemical Analyses of Deep Ground Water in the Coleto Creek Oil Field, Victoria County, Texas, Represented by Three Points Plotted in Trilinear Diagram

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gas was bubbling through the water with some force at many spots. A chemical analysis of water obtained from the crater indicates a chloride content of 24,110 ppm. The brine being held in the crater could possibly be affecting water wells in the South Coleto Creek field, however, ground-water information was not obtained in that area.

The unlined surface pits which have been used for disposal of produced salt water are completed on the sandy Lissie Formation and range in depth from 15 to 20 feet. As previously indicated, there are generally two pits at each disposal location with the second or overflow pit being the deeper of the two. In general the pits were constructed using a dragline with the material that was dug out of the pits being placed around the top (Figures 2 through 7). At the time of the investigation all pits visited in the field contained water and were being used. Because of the sandy permeable nature of the Lissie Formation in the area, salt water that is placed in the pits will move to the water table and then in the direction of ground-water movement to points of natural or artifical discharge. The water wells which have been contaminated and the possibly contaminated wells are all located down the hydraulic gradient from surface pits (Plate 1).

CONCLUSIONS

1. The Coleto Creek oil field is on the outcrop of the Lissie Formation which is one of the most prolific aquifers in the Gulf Coast area.

2. Water wells in the Coleto Creek oil field produce from two zones within the Lissie Formation; a shallow zone (less than 100 feet) and a deep zone (195 to 800 feet).

3. The movement of ground water in the Lissie Formation in the oil-field area is toward Coleto Creek.

4. The native quality of the shallow ground water in the Lissie Formation in the Coleto Creek oil field is of a calcium-magnesium-bicarbonate variety.

5. Several wells that produce ground water from the shallow zone have been contaminated by salt water. No contamination was apparent in the deep zone.

6. Possible sources of contamination of the shallow ground water in the area are oil or gas well blowouts and use of unlined surface pits.

Information obtained did not indicate that contamination was occurring from the blowouts in the area. The fact that the deep zone has not been affected by salt water would indicate that the contamination is occurring from surface downward rather than from the depth upward.

Produced oil-field brine which is being disposed of into open unlined surface pits constructed in the unconsolidated sand of the Lissie Formation is the most probable source of the contamination of the shallow zone. The brine which is placed in the pits does not evaporate but rather moves vertically to the water table and subsequently in the direction of ground-water movement in the area. Wells 1, 2, 4, 8, 16 and two abandoned wells located near Well 9 have been

contaminated by salt water. The contaminated wells are located down the hydraulic gradient from surface pits in the area. The chemical quality of the water from Wells 5, 10, 19 and 21 has been altered from the native quality, which may be indicative of the initial stages of contamination.

RECOMMENDATIONS

1. It is recommended that the use of unlined surface pits as a means of disposal of oil-field brine be eliminated in the Coleto Creek oil field. In any area where unlined surface pits are used on the Lissie Formation, similar problems will be found.

2. The condition of all oil and gas wells in the area should be checked prior to initiation of full-scale subsurface disposal. As disposal of oil-field brines by means of injection wells increases, contamination of ground water by brines moving from cratered or unplugged wells will be an ever-increasing possibility.

REFERENCES

Marvin, R. F., Shafer, G. H., and Dale, O. C., 1962, Ground Water Resources of Victoria and Calhoun Counties, Texas: Texas Board of Water Engineers* Bull. 6202, 147 p.

Texas Water Commission and Texas Water Pollution Control Board, 1963, A statistical analysis of data on oil-field brine production and disposal in Texas for the year 1961, from an inventory conducted by the Texas Railroad Commission: Unpublished rept. 17 vols.

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* Name of Agency changed to Texas Water Commission January 30, 1962

Table 2

Records of water wells in Coleto Creek oil field, Victoria County, Texas

Well	Owner	Driller	Date completed	Depth of well (ft.)	Casing		Water-Bearing unit	Water Level		Method of lift	Use of water	Remarks
					Diameter (in.)	Depth (ft.)		Below land surface datum (ft.)	Date of measurement			
1	Wesley Schmidt	Ed Leeper	1959	75	4	-	Lissie	-	-	J	D	Reportedly pump 700 gph
2	Roy Schmidt	do	1954	67	4	-	do	-	-	J	D	Reportedly pump 400 gph
3	Fred Maurer	Slim Thompson	1963	195	-	-	do	48.12	7-11-63	C	D	M.P. top of W.D.C. 1.5' above LSD
4	do	-	1895	83	4	-	do	46.7	12-3-58	N	N	
5	J. H. Gilley, Jr.	-	1940	90	2 ½	80	do	45.0	-	J	D	
6	Victor Machalec	-	1903	54	-	-	do	-	-	C	D	
7	O. G. Martin	Ed Leeper	1961	89	-	-	do	-	-	J	D	
8	Edgar Maeker	-	1963	57	4	57	do	-	-	J	D	Cased to bottom Cemented all way
9	A. C. Green	Mound Co.	1961	207	4	207	do	43.0	5-11-61	J	D	Bottom joint slotted
10	A. T. Pantel	Ed Leeper	1955	77	4	-	do	-	-	J	D	Sulphur odor, uses water filter
11	J. W. Byrne	Slim Thompson	1959	294	5 ½	-	do	-	-	J	D	Slight sulphur odor
12	Mrs. John Zimmer	-	1950	65	4	-	do	-	-	J	D	
13	W. J. Gaugler	-	1948	62	4	-	do	-	-	J	D	
14	do	-	1894	63	-	-	do	-	-	C	S	
15	G. A. Zimmer	Ed Leeper	1954	68	4	-	do	-	-	J	D	
16	P. J. Bittlebrun	Ed Leeper	1963	65	4	-	Lissie	-	-	J	D	
17	J. E. Himperley	-	-	200+	-	-	do	-	-	J	D	Sulphur odor
18	Paul Awalt	-	-	-	4	-	do	-	-	J	D	
19	Adolph Pribyl	-	1900's	65	4	-	do	54.33	11-14-63	C	D	
20	Herman Dietzel	-	1958	68	4	-	do	-	-	J	D	
21	Joe Machalec	-	-	-	-	-	do	-	-	C	D	
22	Quinette & Leiderman	-	-	800±	-	-	do	-	-	J	D-S	

Table 3

Chemical Analyses of Ground Water and Oil-Field Brine, Coleto Creek oil field, Victoria County, Texas

(Analyses Given are in Parts Per Million Except Specific Conductance and pH)

Well	Owner	Depth of Well (ft.)	Date of Collection	Silica (SiO_2)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Dissolved Solids	Total Hardness as $CaCO_3$	Specific Conductance (Micromhos at 25° C.)	pH
Brine	Bay Oil & Gas Zimmer lease	NA	6-6-63	-	1,080	199	15,700	337	5	27,000	0.3	0.4	44,128	3,510	12,000	6.7
Brine	Quinette & Leiderman Terrell "A"Lease	NA	6-5-63	-	640	165	16,300	122	1	27,700	0.3	0.4	44,838	2,270	12,000	8.0
Brine	Wofford Cain Gaugler Lease	NA	6-5-63	-	1,090	227	15,900	371	1	28,000	0.3	0.4	45,411	3,650	12,000	7.2
Brine	Quinette & Leiderman Kastner Lease	NA	6-5-63	-	660	429	14,800	366	1	25,900	0.7	0.4	42,113	3,410	12,000	7.2
Brine	Averill & Marcox Terrell Lease (Blow out No. 5)	NA	11-13-63	10	1,600	195	13,600	128	5	24,110	0.7	0.4	39,585	4,800	12,000	7.1
1	Wesley Schmidt	75	6-5-63	33	640	101	750	259	33	2,400	0.3	0.4	4,088	2,020	7,540	6.9
1	do	do	do	31	650	95	770	234	23	2,490	0.3	0.4	4,171	2,010	7,750	6.8
1	do	75	1963	-	688	124	800	522	-	2,520	-	-	4,388	-	-	7.4
2	Roy Schmidt	67	6-5-63	27	178	27	127	314	24	381	0.2	0.4	920	560	1,810	7.2
3	Fred Maurer	195	6-5-63	26	40	22	163	426	18	123	0.5	0.4	603	190	1,120	7.4
4	do	83	1935	-	-	-	-	336	-	98	-	-	-	270	-	-
5	J. H. Gilley, Jr.	90	6-6-63	31	64	18	136	375	30	149	0.3	0.4	609	232	1,103	7.5
6	Victor Machalec	54	6-6-63	25	115	8	47	267	36	95	0.4	22	484	321	867	7.7
7	O. G. Martin	89	6-6-63	27	71	13	49	287	36	49	0.3	0.4	384	229	690	7.4

Table 3 (Continued)

Well	Owner	Depth of Well (ft.)	Date of Collection	Silica (SiO_2)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Dissolved Solids	Total Hardness as $CaCO_3$	Specific Conductance (Micromhos at 25° C.)	pH
8	Maeker	57	6-6-63	33	700	119	878	293	54	2,700	0.3	15	4,641	2,240	8,430	7.2
9	A. C. Green	207	6-6-63	28	42	21	151	436	8	115	0.4	0.4	578	357	1,080	7.6
10	A. T. Pantel	77	11-13-63	25	77	17	116	382	18	126	0.4	0.4	565	263	1,005	7.4
11	J. W. Byrne	294	11-13-63	26	37	17	161	425	5	109	0.5	0.4	563	163	980	7.6
12	Mrs. John Zimmer	65	11-13-63	28	59	3	22	182	19	23	0.2	5.5	249	161	425	7.0
13	W J. Gaugler	62	11-13-63	40	96	17	81	367	33	84	0.5	19	553	312	930	7.2
14	W J. Gaugler	63	11-13-63	42	94	17	89	366	35	97	0.6	16	573	304	962	7.2
15	G A. Zimmer	68	11-13-63	28	101	13	54	349	31	76	0.4	0.4	472	307	820	7.3
16	P. J. Bittlebrun	65	11-13-63	42	116	22	141	350	67	225	0.5	0.4	781	380	1,350	7.2
17	J. E. Himperley	200+	11-14-63	24	38	19	164	431	5	123	0.5	0.4	590	175	1,025	7.7
18	Paul Awalt		11-14-63	19	26	17	177	433	4	113	0.5	0.4	569	133	995	7.7
19	Adolph Pribyl	65	11-14-63	38	103	19	117	353	61	144	0.5	35	690	339	1,165	7.2
20	Herman Dietzel	68	11-14-63	31	80	15	80	359	23	77	0.6	1.5	487	262	830	7.3
21	Joe Machalec		11-14-63	40	80	19	95	353	29	112	0.6	0.4	550	277	943	7.4
22	Quinette & Liederman	800±	11-14-63	20	34	21	161	445	4	107	0.4	0.4	563	171	994	7.9
Blow out No. 6A*			11-13-63	7	137	22	14	170	319	10	0.6	0.4	593	433	865	7.3

* Analysis of rainwater in surface depression as altered by gases emanating from the well.

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EXPLANATION

- PROPOSED DRILLING LOCATION
- PRODUCING OIL WELL
- PRODUCING GAS WELL
- DRY HOLE
- ABANDONED GAS WELL
- ABANDONED OIL WELL
- INJECTION WELL
- BLOWOUT
- DISPOSAL PIT
- WATER WELL
- ABANDONED WATER WELL
- CONTAMINATED WATER WELL
- POSSIBLY CONTAMINATED WATER WELL

1 0 1 2

SCALE IN THOUSANDS OF FEET

Plate I

Map of Coleto Creek Oil Field, Victoria County, Texas, Showing Location of Water Wells, Oil and Gas Wells, and Salt Water Disposal Facilities

Texas Water Commission