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SUGGESTED PROGRAM FOR SAFEGUARDING AGAINST SALT POLLUTION

by

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Samuel F. Turner
October 29, 1969

and

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October 29, 1969

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October 29, 1969

Mr. George Busey, General Manager
Goodyear Farms
P.O. Box 158
Litchfield Park, Arizona 85340

Dear Mr. Busey:

In accordance with our telephone conversations and your purchase order No. 14208, we are transmitting herewith 10 copies of our memorandum entitled, "Suggested Program for Safeguarding Against Salt Pollution".

Mr. Manera and I have discussed this problem in detail and this memorandum represents our opinion. Please feel free to ask any questions.

We thank you for this opportunity to be of service to you.

Very truly yours,

TURNER AND ASSOCIATES

Samuel F. Turner

Samuel F. Turner

SFT/et

SUGGESTED PROGRAM FOR SAFEGUARDING AGAINST SALT POLLUTION

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and

Paul A. Manera

Salt Dome Formation

A program to guard against contamination by salt water must consider the way salt domes are probably formed and the resulting dangers to water-bearing beds that the salt domes penetrate. Therefore, several pages taken from recent Geologic textbooks are included herewith showing salt dome structure.

Salt Dome Contamination Effect

Salt domes often affect the chemical character of the ground water as much as two to four miles from the dome. The effect is not always an increase in salt content. One dome in Texas was located by a halo of high magnesium water. This water caused brain damage in local children and drew attention to the area. Another salt dome was suspected by higher temperatures than normal for certain depth of water wells. Test drilling later proved the dome. High gypsum

content of ground water is as common, or more common, than high salt content. The distance from a salt dome that affected water was found depended upon the amount of fracturing that occurred in the surface of near-surface formations. The above statements are based on my own years of personal experience in the Texas Gulf Coast salt dome region.

Salt Mines, Shafts and Tunnels

While in Texas I inspected several salt mines with shafts and tunnels in the domes and had a chance to see the salt structure in the center of the domes and the breaking and fracturing near the edges of the domes.

Production Wells

Usually in the cores of the domes the salt is solid and unbroken, but near the edges it is broken and often impure. Therefore, the production wells should be near the center of the salt dome core and the danger of salt water escaping from the dome would be reduced to a minimum. The perforations in the production wells should be at least 300 feet below the top of the salt and a similar distance above the known bottom to be sure that the well has at least 300 feet of solid salt around it. The boundaries of the salt dome or salt deposits should be ascertained by careful drilling of "slim holes" in order to locate the production well near the center of the salt and well away from any faults or fractures.

Well Sampling Program

The water from all wells within a five-mile radius of the center of the dome should be sampled and complete analyses made prior to any development on the salt dome so that any future changes in mineral content may be noted and studied. The waters from these same wells should be analyzed at six-month intervals and certainly at least once a year. The samples should be taken within 15 days of the same date each time so that nearly the same pumping conditions apply.

Evaporation Ponds

Evaporation ponds should be lined with impermeable material. I understand that the Texas Oil & Gas Commission now demand that all evaporation ponds in Texas be lined with thick plastic. With any method of lining, leaks may occur and in order that these may be found the evaporation and precipitation in the area should be measured. Thus, it is necessary to run a full weather station in the area measuring wind velocities, evaporation and, if possible, solar energy. Since evaporation from a standard weather bureau pan will not be correct for the evaporation from the salt ponds, a floating pan should be used in the salt pond containing the same liquid as in the pond. The amount of evaporation is usually measured with a Hook gage. This consists of a stainless steel hook beneath a geared rod and

the hook is brought up until it barely forms a pimple on the water surface. The gage is equipped with a vernier so that the water level may be measured accurately within one-thousandth of an inch. This measurement is usually made inside a stilling pipe according to Weather Bureau instructions. An electronic method for determining leakage may be used in addition to the measurement of the evaporation. Electrodes are placed at different depths and different locations beneath the pit before it is placed in operation. Heavy plastic coated wires are led from these electrodes to an instrument pit at the side of the evaporation pond. In the instrument pit either the resistance may be measured by an ohmmeter or the conductivity may be measured with an ammeter. A great increase in the conductance or a decrease in the resistance would indicate either moisture or salt water, depending upon the amount of change. It is my opinion that the evaporation rate should be accurately measured and the electrodes used as supplementary means of measurement as an increase in the rate of loss from the evaporation pond above the amount of evaporation would indicate a leak. Another approach to the determination of the amount of evaporation is the determination of the amount of solar energy present. Then with the mineral content of the pond water known, the amount of possible evaporation can be computed. Personally, I like the actual

determination of the evaporation better.

Drilling and Sealing Production Wells

The production wells should be cased with stainless steel casing or possibly with plastic casing. No perforations should be allowed except those 300 feet into the salt. All production wells should be pressure-cemented back to the surface of the ground from the top of the perforations, or approximately the top 1,100 feet. By pressure-cementing I mean that the cement should be pumped to the bottom of the hole and pumping continued until cement comes out of the annulus around the casing at the surface of the ground. As an additional safeguard, the interior of the wells should be photographed with a downhole camera at least once a year. The yearly photographs should be filed for comparative purposes in the following years. Some ground movements have occurred in the area as evidenced by the large cracks that have opened, and it is possible that the casing will be broken by such movement.

In my opinion, all wells should be drilled by the rotary method, both the larger production wells and the exploration wells, or "slim holes". By this is meant holes with a minimum diameter necessary for completion of the drilling with cores taken at some intervals.

All wells should be electric logged. The electric logs, drill cuttings samples, photographs, and all other data should be stored in a safe place and available for scientific study.

Structural Geology by Marland P. Billings, Prof. of Geology at Harvard University; Pub. by Prentice-Hall, Inc. 1954

unknown because in the search for petroleum there is ordinarily little

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Hoyt, H. W., "Seismograph Evidence on Depth of Salt Core at Vinton, Texas," *Geology*, Vol. XI, pp. 128-131, 1916.

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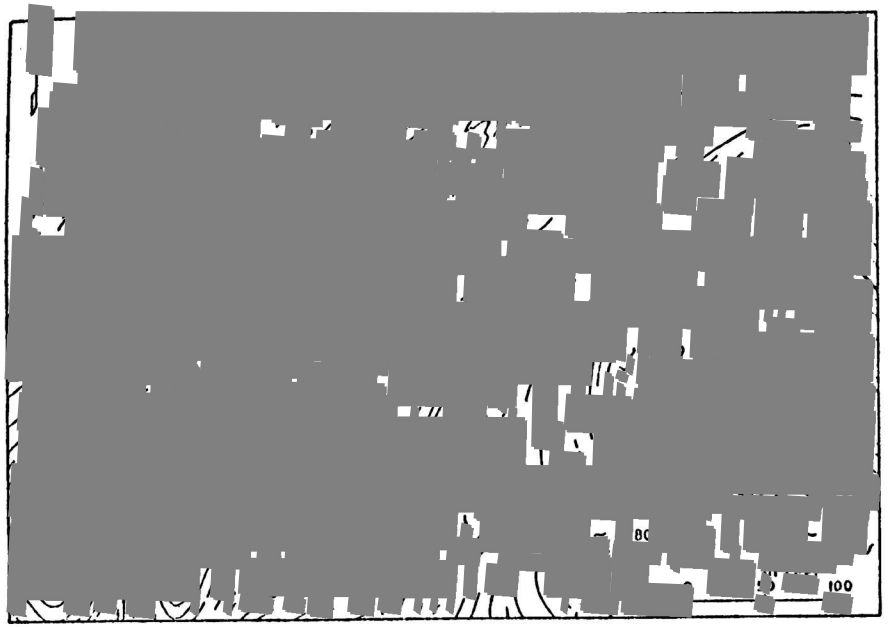

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op. cit., p. 240.