

ANALOG-MODEL STUDIES OF THE EFFECTS OF RECHARGE WELLS ALONG THE HOUSTON SHIP CHANNEL ON POTENTIOMETRIC SURFACES OF THE CHICOT AND EVANGELINE AQUIFERS, HOUSTON, TEXAS

Because of increasing concern about the continuing decline of water levels in the Houston area, an electric analog model was used to determine the effects on the potentiometric surfaces resulting from recharging water through wells along the Houston Ship Channel into the two major aquifers, the Chicot and Evangeline.

The model conditions simulated for this study are too complex to be described in detail. The upper model layer simulated the hydrologic conditions in the lower unit of the Chicot aquifer undifferentiated. The simulation included clay compaction and vertical leakage as well as transmissivity and storage. The lower model layer simulated the hydrologic conditions in the Evangeline aquifer which underlies the Chicot aquifer.

Fifteen hypothetical wells were modeled recharging the aquifers at 1,000 gallons per minute each while concurrently increasing the annual ground-water pumping from the aquifers. Table 1 shows the distribution of the water recharged to aquifers by wells.

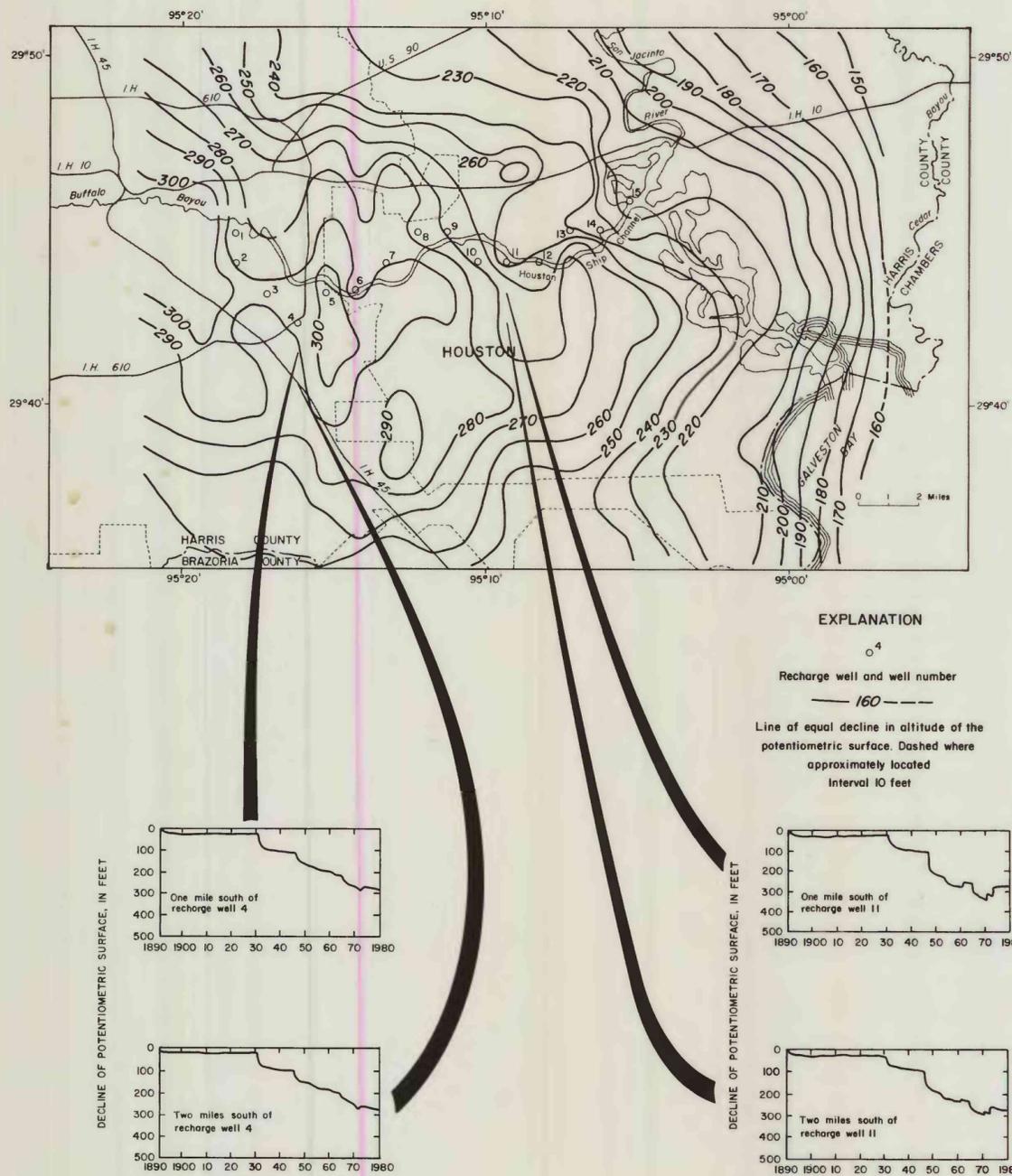
Figure 1 and the associated hydrographs show the simulated decline of the altitude of the potentiometric surface of the lower unit of the Chicot aquifer and Chicot aquifer undifferentiated from 1890-1980. The hydrographs, which show the effect of recharge at various distances from two of the 15 recharge wells, indicate that the effect of recharge in the aquifer under artesian conditions is nearly immediate after recharge is introduced, but only temporarily interrupts the downward trend of declining water levels in wells.

Figure 2 shows the simulated effect on the potentiometric surface of the lower unit of the Chicot aquifer and Chicot aquifer undifferentiated resulting from recharging through the 15 wells during 1973-80. The declines shown in figure 1 would have been greater by the values shown in figure 2 without the introduction of recharge water from the 15 wells. The decrease in declines resulting from the recharge ranged from less than 10 feet to more than 60 feet.

Figure 3 and the associated hydrographs show the simulated decline in the altitude of the potentiometric surface of the Evangeline aquifer resulting from large withdrawals from the aquifer during 1890-1980. The effect of recharge is rapid, but only temporarily interrupts the downward trend of declining water levels in wells.

Figure 4 shows the simulated effect on the altitude of the potentiometric surface of the Evangeline aquifer of recharge through the 15 wells during 1973-80. Additional declines in the altitude of the potentiometric surface of 10 feet to more than 50 feet would have resulted if the recharge from the wells had not been introduced.

FIGURE 1.-SIMULATED DECLINE IN THE ALTITUDE OF THE POTENTIOMETRIC SURFACE OF THE LOWER UNIT OF THE CHICOT AQUIFER AND CHICOT AQUIFER UNDIFFERENTIATED DUE TO PUMPING, 1890-1980 AND RECHARGE BY WELLS, 1973-80



EXPLANATION
○⁴
Recharge well and well number
— 160 —
Line of equal decline in altitude of the potentiometric surface. Dashed where approximately located
Interval 10 feet

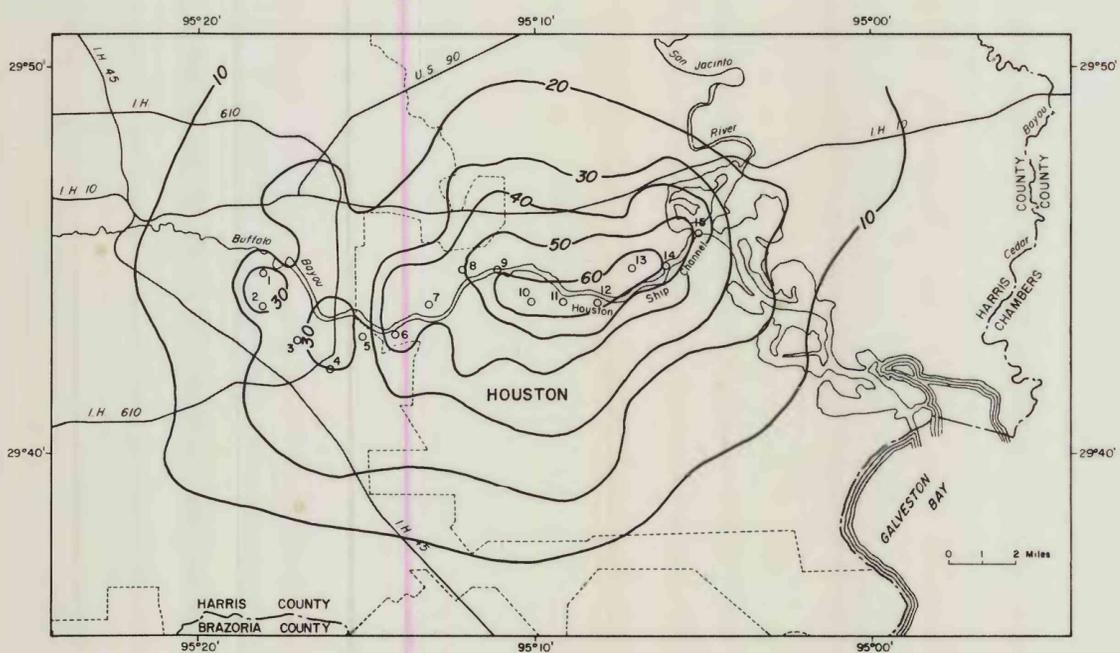
DECLINE OF POTENTIOMETRIC SURFACE, IN FEET
One mile south of recharge well 4
One mile south of recharge well 11
Two miles south of recharge well 4
Two miles south of recharge well 11

Hydrographs of simulated potentiometric surfaces

TABLE 1.-RECHARGE RATES

Well	Rate of recharge	
	Undifferentiated and lower unit of the Chicot aquifer (gpm)	Evangeline aquifer (gpm)
1	0	1000
2	0	1000
3	0	1000
4	0	1000
5	0	1000
6	200	800
7	300	700
8	400	600
9	600	400
10	700	300
11	900	100
12	1000	0
13	1000	0
14	1000	0
15	1000	0

FIGURE 2.-DECREASE IN THE DECLINE OF THE ALTITUDE OF THE POTENTIOMETRIC SURFACE OF THE LOWER UNIT OF THE CHICOT AQUIFER AND CHICOT AQUIFER UNDIFFERENTIATED DUE TO RECHARGE BY WELLS, 1973-80



EXPLANATION
○⁴
Recharge well and well number
— 30 —
Line of equal difference between altitudes of the potentiometric surfaces
Interval 10 feet

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1973