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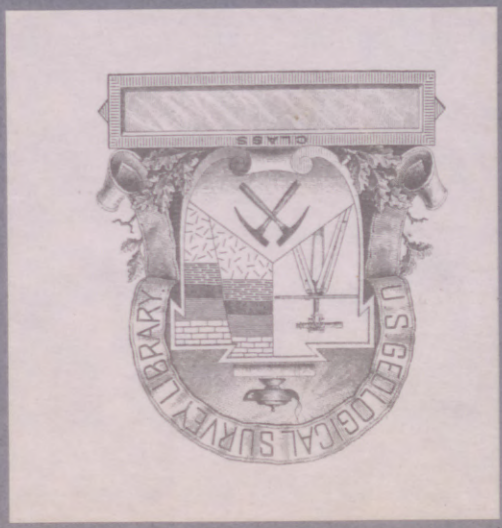

UNITED STATES

DEPARTMENT OF THE INTERIOR

GEOLOGICAL SURVEY

RECONNAISSANCE OF THE WATER RESOURCES IN THE VICINITY OF PROPOSED DEEP-WELL INJECTION SITES IN SOUTHEAST DADE COUNTY, FLORIDA

by

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Open File Report

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Prepared by the
UNITED STATES GEOLOGICAL SURVEY
in cooperation with the
DADE COUNTY WATER AND SEWER AUTHORITY

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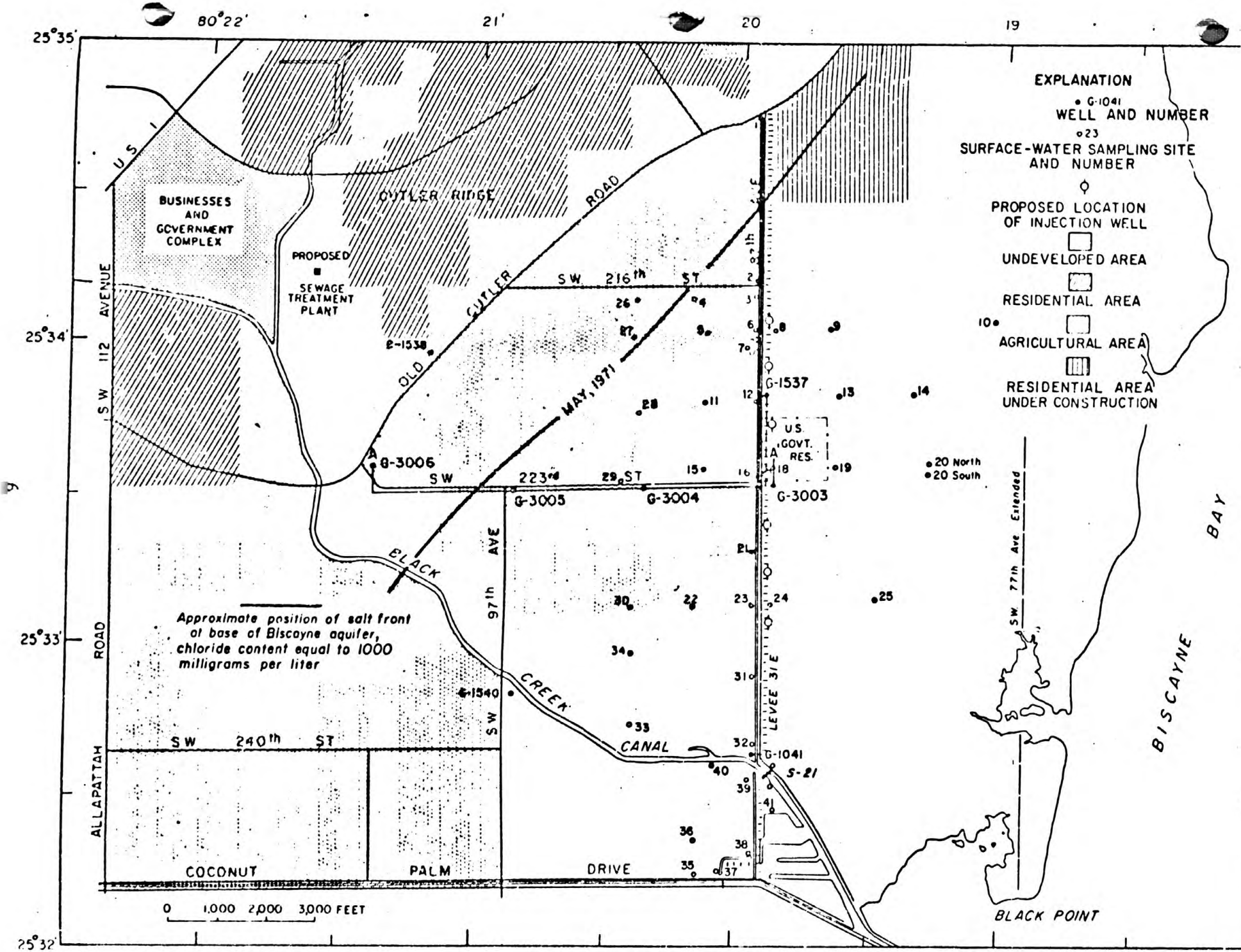
INTRODUCTION

Deep-well injection has been selected by the Dade County Water and Sewer Authority as a means of disposing treated waste water in southeast Dade County. Preliminary plans call for the construction of a county-owned sanitary sewage treatment plant and several 3,000-foot deep injection wells at 1,000-foot intervals on Levee 31E. As a first stage, drilling of seven wells, capable of accepting, in the aggregate, 30 mgd (million gallons per day) of treated liquid waste, is planned. The locations of the proposed sites (fig. 1) were selected by the consultants for the Authority.

A reconnaissance was made in the vicinity of the proposed well sites to determine the chloride content of surface and ground water because this information is needed to formulate plans for the safe disposal of salt water during drilling and testing of the injection wells. The reconnaissance was part of a cooperative program with the Dade County Water and Sewer Authority to investigate the hydrologic effects of injecting treated waste water into a deep saline aquifer.

The area of investigation is near Cutler Ridge in southeast Dade County. It occupies about 5½ square miles bounded on the east by S.W. 77th Avenue extended, on the west by S.W. 97th Avenue, on the south by Coconut Palm Drive, and on the north by Old Cutler Road (fig. 1). The area for the investigation was selected by the Authority and their consultants.


80°22'
21'
20
19
25°35'
25°34'
25°33'
25°32'
EXPLANATION
G-1041
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AGRICULTURAL AREA
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BUSINESSES AND GOVERNMENT COMPLEX
PROPOSED SEWAGE TREATMENT PLANT
SW 112 AVENUE
CUTLER ROAD
OLD CUTLER
MAY, 1971
SW 216th ST
G-1538
G-1537
G-3006
SW 223rd ST
29
G-3005
G-3004
G-3003
U.S. GOVT. RES.
20 North
20 South
BLACK CREEK
97th AVE
SW 77th Ave Extended
LEVEE 31E
BISCAYNE BAY
Approximate position of salt front at base of Biscayne aquifer, chloride content equal to 1000 milligrams per liter
G-1540
SW 240th ST
CANAL
G-1041
S-21
ALLAPATTAH ROAD
COCONUT
PALM
DRIVE
BLACK POINT
0 1,000 2,000 3,000 FEET

A considerable amount of knowledge was available at the start of the investigation, part of which has been documented, and part in survey files, unpublished. Most of the area is underlain by the Biscayne aquifer that contains salty water at various depths. The approximate farthest inland extent of the salt front at the base of the aquifer under the drought condition of May 1971 is shown in figure 1 (Hull and Wimberly, 1972).

Samples of water were collected from 8 wells and 44 surface-water sites (figure 1) on February 22, May 18, and August 4, 1972 for determination of chloride content. Chloride content was used as a measure of salinity. Chloride content in natural waters of Dade County usually ranges between 12 mg/l (milligrams per liter) in rainfall and 19,000 mg/l in sea water. On August 3, 1972 profiles of the specific conductance of ground water were made in four wells. The specific conductance values were converted to chloride content based on a relation developed between chloride content and conductance for numerous samples of natural waters in southeast Florida. The results of samplings in the area are presented in Table 1. Chloride in surface-water samples ranged from 15 to 14,600 mg/l, and in ground-water samples from 26 to 11,500 mg/l.

Table 1.--(Cont.) Chloride content in samples of water from wells and surface water sites, 1972.

		CHLORIDE CONTENT IN MILLIGRAMS PER LITER		
	Sample	Sampling Date		
Well No.	Depth	February 22, 1972	May 18, 1972	August 4, 1972
		Wells		
G 1537	27 ft.	4,050	3,640	6,100
G 1538	50 ft.	30	26	39
G 1540	46 ft.	140	790	1,480
G 1041	34 ft.		800	2,100
G 3003	40 ft.			11,500
G 3004	41 ft.			2,400
G 3005	50 ft.			160
G 3006	52 ft.			120

LAND USE AND DRAINAGE

The four kinds of land use shown on figure 1 were generalized from the field reconnaissances and from aerial photography. Levee 31E divides the drainage of fresh water on the west from the salt water on the east. Part of the area west of Levee 31E is used for agriculture. The area east of Levee 31E is mostly undeveloped but the northern part of this area is under development for residential use. Few, if any, irrigation wells are near the proposed injection-well sites because the area is underlain by salty ground water at shallow depths.

Black Creek Canal crosses the south part of the area and discharges into Biscayne Bay below the S-21 Control. L 31E borrow canal, a drainage canal just west of Levee 31E, extends from sampling site 1, southward to Black Creek Canal. Before L 31E borrow canal and Levee 31E were constructed, a series of east flowing drainage ditches, about a quarter of a mile apart, drained the area by discharging excess water into Biscayne Bay through a mangrove swamp. Levee 31E truncated these drainage ditches. The segments west of the levee flow into L 31E canal. The segments east of the levee continue to flow into Biscayne Bay. These east flowing ditches are not shown on figure 1.

Because the canals are in hydraulic connection with the permeable limestone of the Biscayne aquifer, surface-water and ground-water levels are closely related. Both are controlled by the operation of automatic gates at S-21. During the wet season (June-November) the gates open and excess runoff in the area is discharged to Biscayne Bay. The average yearly highest ground-water level during 1959-70 was about 4 feet above msl (mean sea level) (Hull, 1972, fig. 7). During the dry season (December-May) the gates are usually closed and water levels in the area are sustained slightly above mean sea level by recharge from Black Creek Canal. The yearly average lowest ground-water level in the area during 1959-70 was about 1.5 feet above msl (Hull, 1972, fig. 6). The averages used were for the period of record 1959-70.

CHLORIDE CONCENTRATIONS IN SURFACE WATER AND GROUND WATER

Water samples for determination of chloride were collected in February, May, and August 1972 (table 1). The samples were collected from near the bottom of each well and each surface-water sampling site. Depth of water at surface-water sites ranged from 2 feet to 7 feet, and depth of wells sampled ranged from 27 feet to 52 feet. The February, 1972, sampling included 26 surface-water sites and 3 wells. In February chloride concentrations in surface water west of Levee 31E ranged from 15 to 80 mg/l. Concentrations east of Levee 31E ranged from 28 to 4,040 mg/l. Chloride content in ground water at the bottom of the 3 wells ranged from 30 to 4,050 mg/l.

The May 1972 sampling included the February sampling sites plus another 18 surface-water sites and 1 well. Chloride concentrations were higher in May than in February because water levels were lower over the entire area and recharge from rainfall and Black Creek Canal was less. Concentrations west of the levee ranged from 15 to 180 mg/l. The increase in chloride from February to May was greatest east of the levee where chlorides ranged from 110 to 14,600 mg/l. Chloride in water at the bottom of the four wells in May 1972 ranged from 26 to 3,640 mg/l.

Chloride concentrations were lower in August 1972 than in May 1972 but not as low as in February 1972. West of the levee, in August, concentrations in surface water ranged from 18 to 158 mg/l. East of the levee in August the concentrations ranged from 242 to 4,040 mg/l. Chloride content in ground water at the bottom of the wells in August ranged from 39 mg/l in the most westerly well to 11,500 mg/l in the most easterly well (G 3003).

Before the August sampling four additional observation wells were drilled in a line perpendicular to the coast and parallel to 223rd Street. The chloride analyses of water samples from these wells show the position of the salt front in the Biscayne aquifer along this east-west line on August 3, 1972 (fig. 2). Chloride concentration profiles in the wells were determined from specific conductance measurements made at about 5-foot intervals. Where sharp increases occurred, conductance values were measured at 1-foot intervals. Chloride profiles were also made for wells G 1537, G 1538, and G 1540. Results of the profiling in the seven wells are shown on figures 3, 4, and 5.

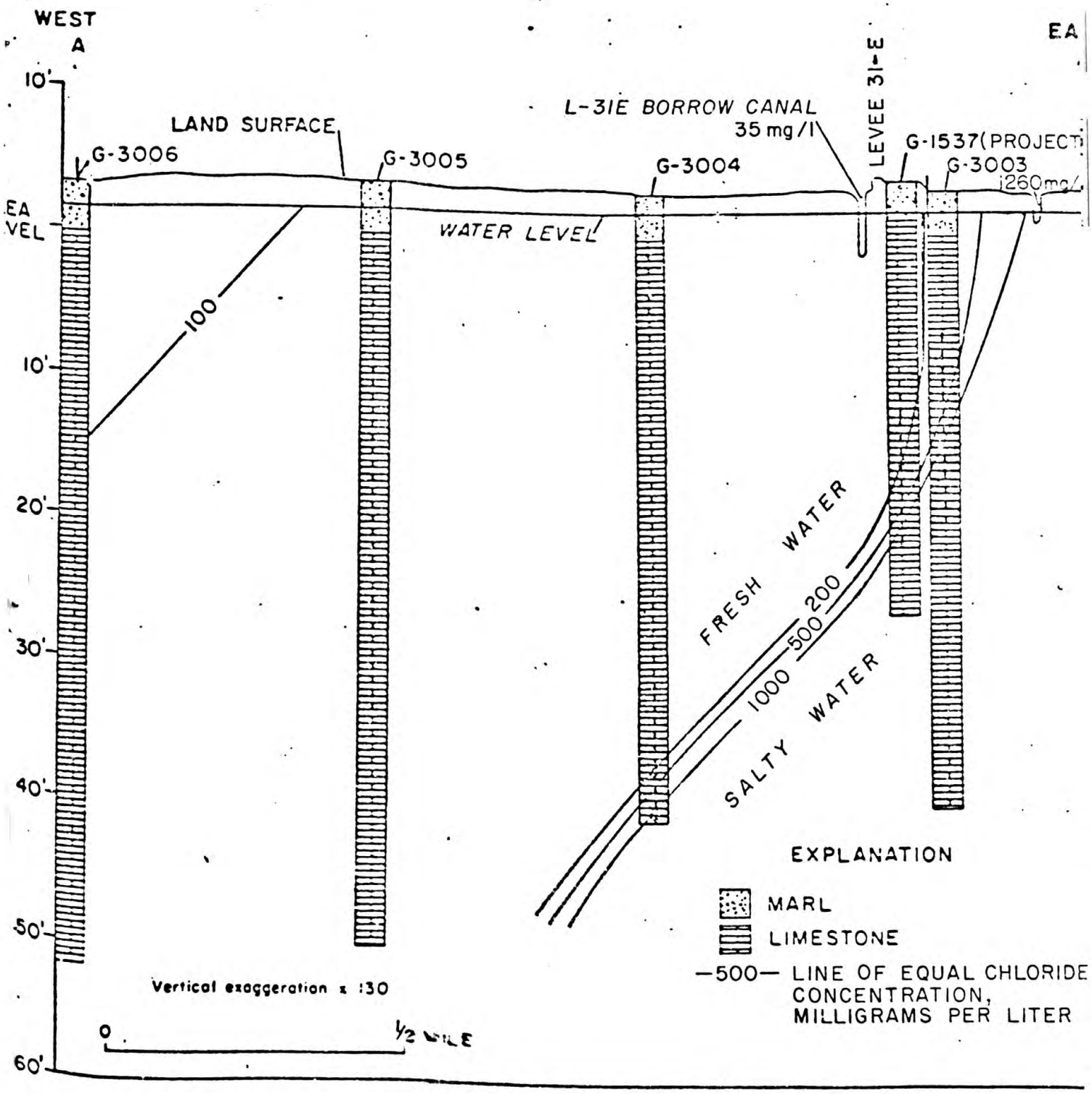


Figure 2. Section A-A' showing the approximate position of the salt front on August 3, 1972

Chloride concentrations in water in August, 1972 from the two most easterly wells, G-1537 and G-3003 just east of Levee 31E, increased rapidly between 15 and 21 feet (fig. 3). In well G-3003 the concentration increased from about 1,000 to 9,500 mg/l. This increase might be related to intrusion along a highly permeable zone in the formation at that depth. Both wells extend below the salt front.

Figure 4 shows that the salt front in August, 1972 was near the bottom of wells G-1540 and G-3004 which are west of Levee 31E. Should the salt front move inland, water containing 1,000 mg/l chloride will rise in the wells and the chloride concentrations at the bottom of the wells will increase.

Figure 5 shows that the chloride concentrations in August, 1972 were less than 200 mg/l in wells G-3005, G-3006, and G-1538, indicating that at these locations the aquifer contained fresh water for its full thickness. In May, 1971 (fig. 1) the approximate position of the 1,000 mg/l chloride line was west of well G-3005, indicating that salty water at that time existed at the bottom of the well.

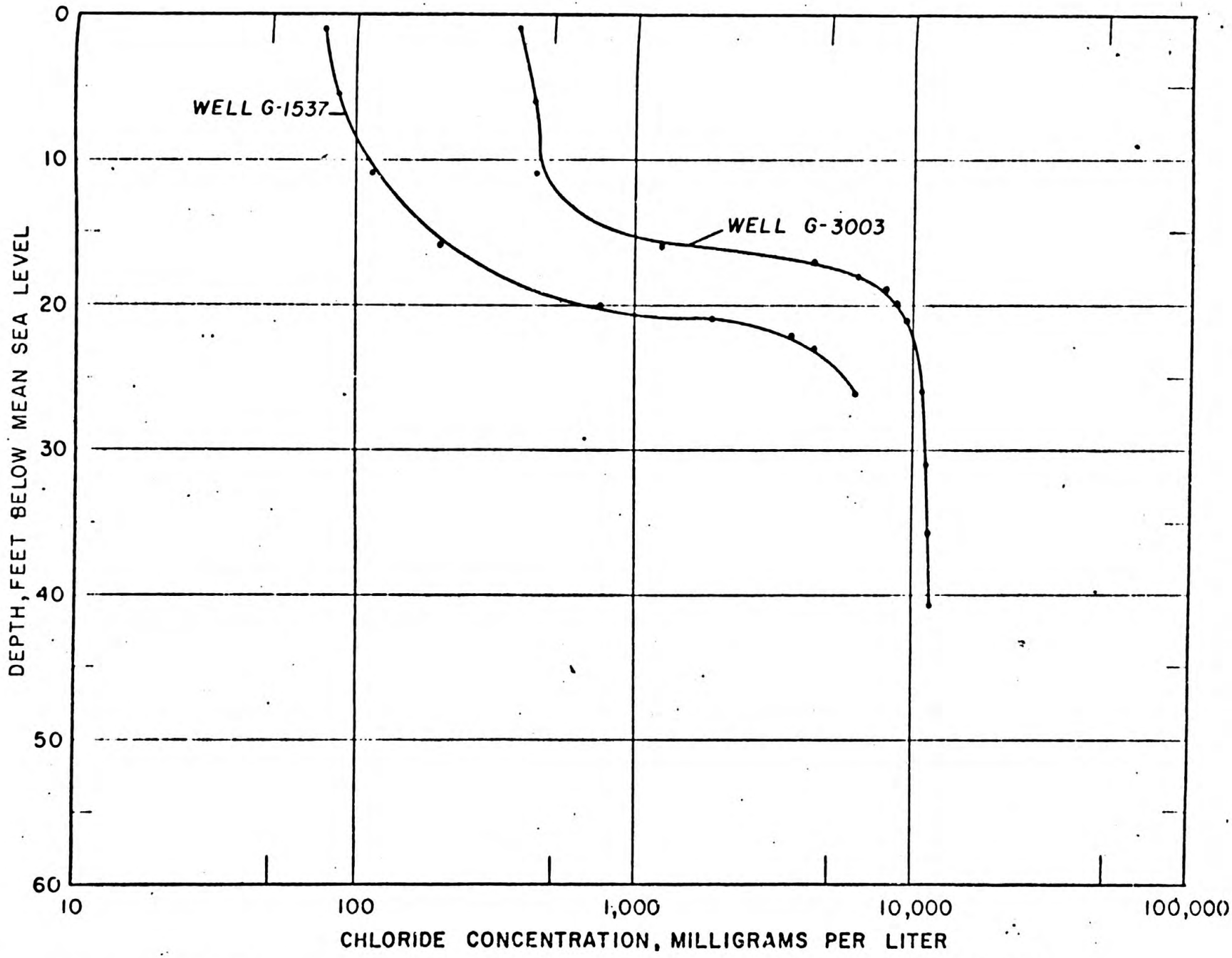
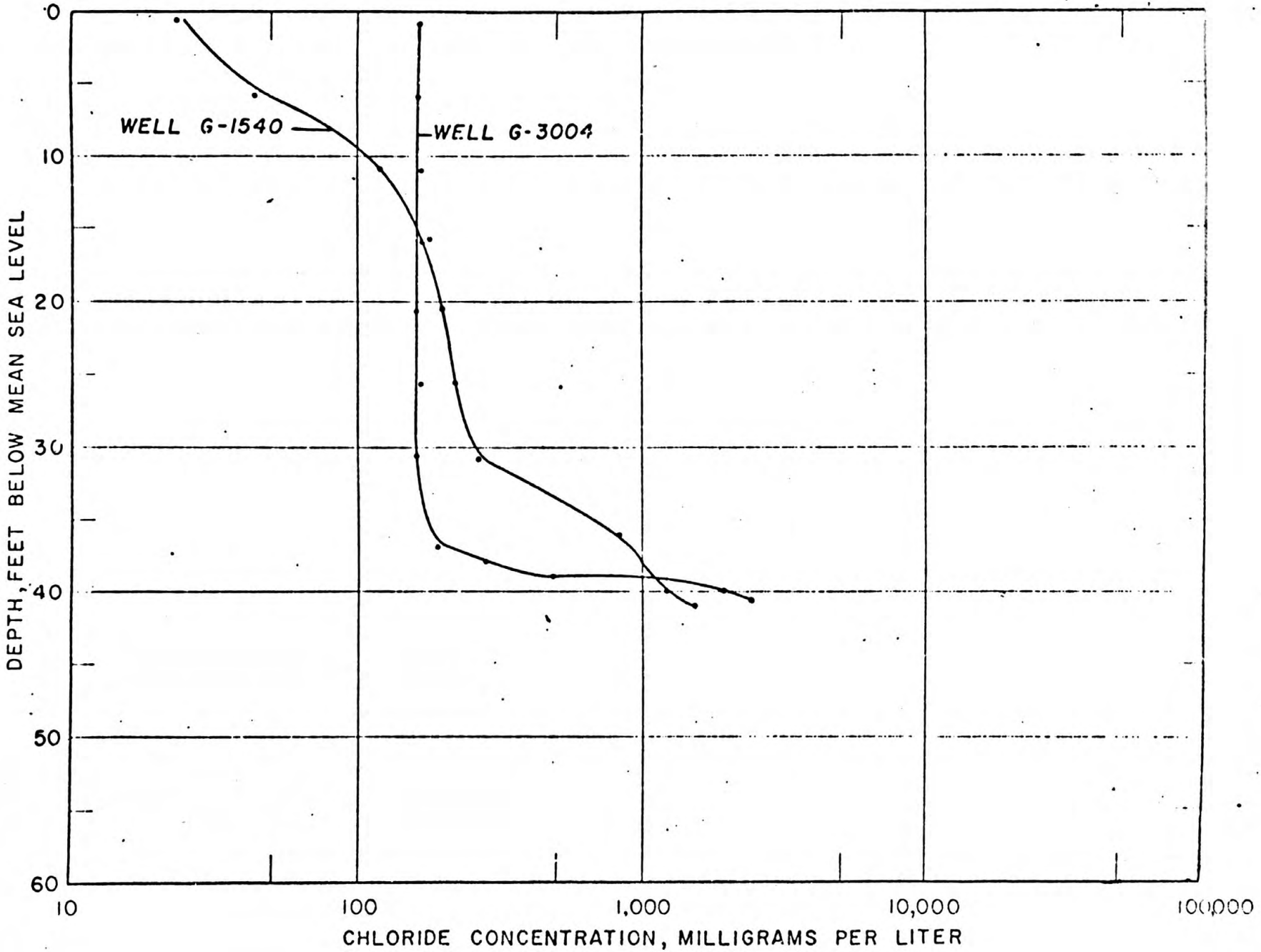
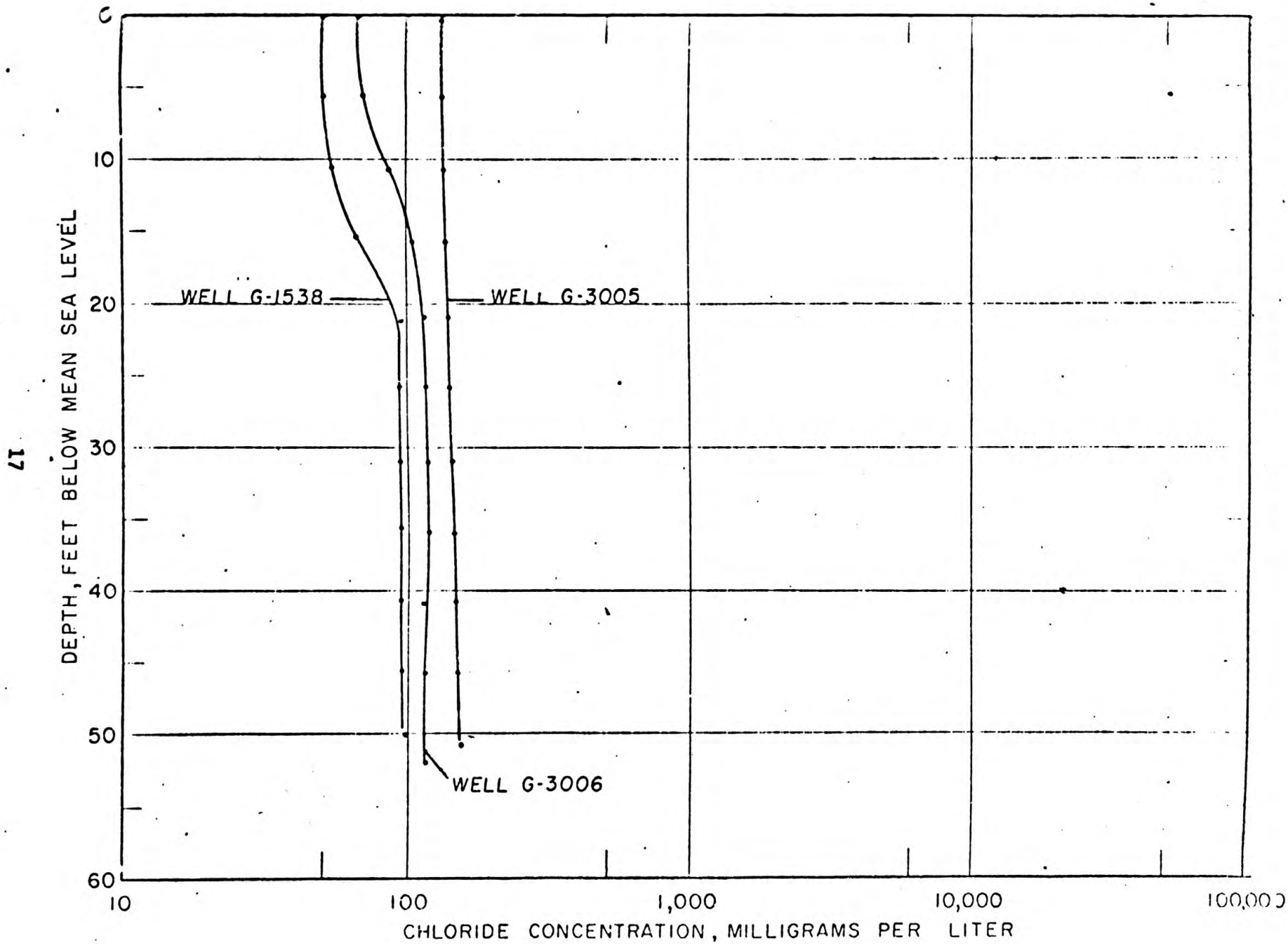


Figure 3. Profiles of chloride concentrations in wells G-1537 and G-3003, Aug. 3, 1972


WELL G-1540
WELL G-3004
DEPTH, FEET BELOW MEAN SEA LEVEL
0
10
20
30
40
50
60
10
100
1,000
10,000
100,000
CHLORIDE CONCENTRATION, MILLIGRAMS PER LITER


0
10
20
30
40
50
60
DEPTH, FEET BELOW MEAN SEA LEVEL
WELL G-1538
WELL G-3005
WELL G-3006
10
100
1,000
10,000
100,000
CHLORIDE CONCENTRATION, MILLIGRAMS PER LITER

SITE ASSESSMENT

Drilling of deep injection wells along Levee 31E at the locations proposed by the Dade County Water and Sewer Authority and their consultants is not expected to affect the fresh ground-water supply. The sites are all coastward from the inland extent of the salt front of May 1971 (fig. 1). Placing the wells on the levee will afford protection to the wells from storm-produced tides.

The proposed injection well-site locations along the top of Levee 31E at the locations will allow the disposal of salt water--produced during drilling--in two different ways. First, the salt water can be dumped into one or more of the many drainage ditches that flow east from Levee 31 E to Biscayne Bay. Second, because all sites are coastward from the inland position of the salt-water front in the Biscayne aquifer--selected by Dade County to coincide with the position of the 1,000 mg/l chloride line of May 1971 (fig. 1)--the salt water produced during drilling at all sites could be pumped into wells tapping the base of the Biscayne aquifer. These wells, of course, would need to be cased from land surface to a depth appreciably below the position of the fresh-water salt-water interface in each well.

The same two salt-water disposal methods could be utilized at sites immediately west of the Levee 31 E canal. Drilling water could be piped over the levee and into the east flowing ditches or it might be injected into the base of the Biscayne aquifer. If injection of drilling water into the base of the Biscayne aquifer is contemplated, at sites immediately west of the canal, care should be taken to confirm the premise that the position of the 1,000-mg/l chloride line at the base of the Biscayne aquifer, shown on figure 1, is indeed west of the site.

If the decision is made to drill the deep injection wells immediately west of the Levee 31E canal, precautions would still need to be taken both to prevent spill of salt water at land surface and to prevent leakage of salt water into the uppermost parts of the Biscayne aquifer in order to further protect those fresh-water-bearing parts of the Biscayne that are west of--and also above (fig. 2)--the position of the 1,000-mg/l chloride line.

REFERENCES

Hull, J.E., 1972, Hydrologic conditions during 1970 in Dade County, Florida: U.S. Geol. Survey open-file report, 80 p.

Hull, J.E., and Wimberly, E.T., 1972, Hydrologic conditions during 1971 in Dade County, Florida: U.S. Geol. Survey open-file report, 104 p.