U.S. DEPARTMENT OF THE INTERIOR
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LOUISIANA STATE UNIVERSITY AGRICULTURAL CENTER
COOPERATIVE EXTENSION SERVICE AND THE
LOUISIANA RICE RESEARCH BOARD

WATER-RESOURCES INVESTIGATIONS REPORT 01-4128
Lovelace, J.K., Frederick, C.P., Fontenot, J.W., and Naanes, M.S., 2001, Louisisna Ground-Water Map No. 12:
Potentiometric Surface of the Chicot Aquifer System in Southwestern Louisiana, June 2000

INTRODUCTION

The Chicot aquifer system is the principal source of fresh ground water in southwestern Louisiana. Figure 1 shows the extent of freshwater in the Chicot aquifer system in southwestern Louisiana and areas where rice usually is grown; rice irrigation is a major use of water from the aquifer system. In 1995, approximately 550 Mgal/d of water were withdrawn from the Chicot aquifer system (Lovelace and Johnson, 1996, p. 90). Withdrawals have lowered water levels in the Chicot aquifer system, creating an elongated cone of depression in the water-level surface over much of the region (Zack, 1971, p. 7-9 and pl. 2).

During the first six months of 2000, rainfall in southwestern Louisiana averaged 19.4 in., which was 8.4 in. below the long-term average, and rainfall in south-central Louisiana averaged 14.4 in., which was 14.2 in. below the long-term average (Louisiana Office of State Climatology, 2000). Much of southwestern Louisiana was in a moderate to severe drought as categorized by the long-term Palmer Drought Severity Index (National Oceanic and Atmospheric Administration Climate Prediction Center, 2000). Because of the lack of freshwater flushing that normally occurs after precipitation, saltwater from the Gulf of Mexico intruded into many coastal streams and canals that normally are used for irrigation during the rice-growing season, making them unusable for irrigation (Louisiana State University Agricultural Center, 2000).

In 1995, about 565 Mgal/d of water were withdrawn from ground and surface sources for rice irrigation in southwestern Louisiana. Of these withdrawals, approximately 250 Mgal/d were supplied from surface sources, and 315 Mgal/d were supplied from the Chicot aquifer system (Lovelace and Johnson, 1996), which was more than one-half of the total water withdrawn from the aquifer system. Estimates of the amount of water required for rice cultivation in southwest Louisiana range from 32 to 46 in. of water per acre of rice field during the primary growing season (February through June). During an average year, about half of this water is supplied by precipitation and half is supplied by irrigation (Covay and others, 1992, p. 6). Data from a survey of farmers conducted during May 2000 indicated a widespread increase in per-acre application of ground water from the Chicot aquifer system for rice irrigation during the 2000 growing season (B.P. Sargent, U.S. Geological Survey, written commun., Dec. 2000), presumably due to the below-normal rainfall. Zack (1971) showed that the amount of ground water withdrawn in southwestern Louisiana in any particular year is inversely proportional to the total rainfall during the rice-growing season.

Additional knowledge about ground-water flow and effects of increased withdrawals on the Chicot aquifer system are needed to assess ground-water-development potential and to protect the resource. To meet this need, the U.S. Geological Survey (USGS), in cooperation with the Louisiana State University Agricultural Center Cooperative Extension Service and the Louisiana Rice Research Board, established a study to monitor water-level changes in wells completed within the Chicot aquifer system and to evaluate changes in the potentiometric surface (water levels). Results are to be reported periodically; this is the first such report.

This report presents a map and data that describe the potentiometric surface of the massive, upper, and "200-foot" sands of the Chicot aquifer system during June 2000. Hydrographs of water levels in selected wells completed in the aquifer system are presented. The potentiometric-surface map can be used for determination of ground-water-flow direction, hydraulic gradients, and effects of withdrawals on the ground-water system. Water-level data are on file at the USGS office in Baton Rouge, La.

Description of the Study Area

The study area, located in southwestern Louisiana, extends across about 9,000 mi2 and includes all or parts of Acadia, Allen, Beauregard, Calcasieu, Cameron, Evangeline, Iberia, Jefferson Davis, Lafayette, Rapides, St. Landry, St. Martin, St. Mary, Vermilion, and Vernon Parishes (fig. 1). The climate generally is warm and temperate with high humidity and frequent rain. The average annual temperature is about 20oC, and the average annual rainfall is 55 in. (National Oceanic and Atmospheric Administration, 1995, p. 7, 9). Much of the area is rural, and rice cultivation is the primary agricultural activity. In 1999, 460,000 acres of rice were planted in southwestern Louisiana (Louisiana Cooperative Extension Service, 2000).

Acknowledgments

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HYDROGEOLOGY

The Chicot aquifer system underlies most of southwestern Louisiana and parts of the Texas coastal lowlands. The aquifer system is composed of deposits of silt, sand, and gravel interlayered with deposits of clay and sandy clay that dip towards the south and southeast. The sand deposits grade southward from coarse sand and gravel to finer sediments and become increasingly subdivided by clay units. The Chicot aquifer system also thickens eastward, towards the Atchafalaya River area, and is hydraulically connected to alluvial deposits of the Atchafalaya and Mississippi Rivers (Nyman, 1984, p. 4).

The Chicot aquifer system has been divided into three subregions in Louisiana based on the occurrence of major clay units. In the northern part of the study area, the aquifer system is comprised mainly of a single massive sand. The approximate southern boundary of the massive sand is shown in figure 1. South of the massive sand, from eastern parts of Calcasieu and Cameron Parishes to the Atchafalaya River, the aquifer includes upper and lower sand units (Whitman and Kilburn, 1963, p. 10). In central and western Calcasieu and Cameron Parishes, the Chicot aquifer is subdivided into the "200-," "500-," and "700-foot" sands, named after their depths of occurrence in the Lake Charles area (Jones, 1950, p. 2). The "200-foot" sand is stratigraphically equivalent to, and continuous with, the upper sand. Figure 2 shows a partial hydrogeologic column of aquifers in southwestern Louisiana.

Recharge to the Chicot aquifer system occurs in areas where the aquifer deposits crop out in southern Rapides and Vernon Parishes and in northern Allen, Beauregard, and Evangeline Parishes (fig. 1). In these areas, precipitation infiltrates sandy soil and moves slowly downdip toward points of discharge. Additional recharge is supplied from vertical leakage downward through overlying and upward through underlying clay confining units, and from alluvial deposits associated with the Atchafalaya River, which are laterally adjacent to the upper sand unit (Nyman and others, 1990, p. 14). A computer simulation of the aquifer system indicated that, under 1981 conditions, more than 90 percent of the water entering the Chicot aquifer system is withdrawn by wells, and 65 percent of the water withdrawn in the rice-growing area originated as infiltrated precipitation (Nyman and others, 1990, p. 33).

CONVERSION FACTORS AND VERTICAL DATUM

Multiply	By	To obtain
inch (in)	25.4	millimeter
foot (ft)	0.3048	meter
square mile (mi^2)	2.590	square kilometer
million gallons per day (Mgal/d)	3,785	cubic meter per day
acre	4,047	square meter
mile	1.609	kilometer

Sea level: In this report, "sea level" refers to the National Geodetic Vertical Datum of 1929--a geodetic datum derived from a general adjustment of the first-order level nets of both the United States and Canada, formerly called Sea Level Datum of 1929.

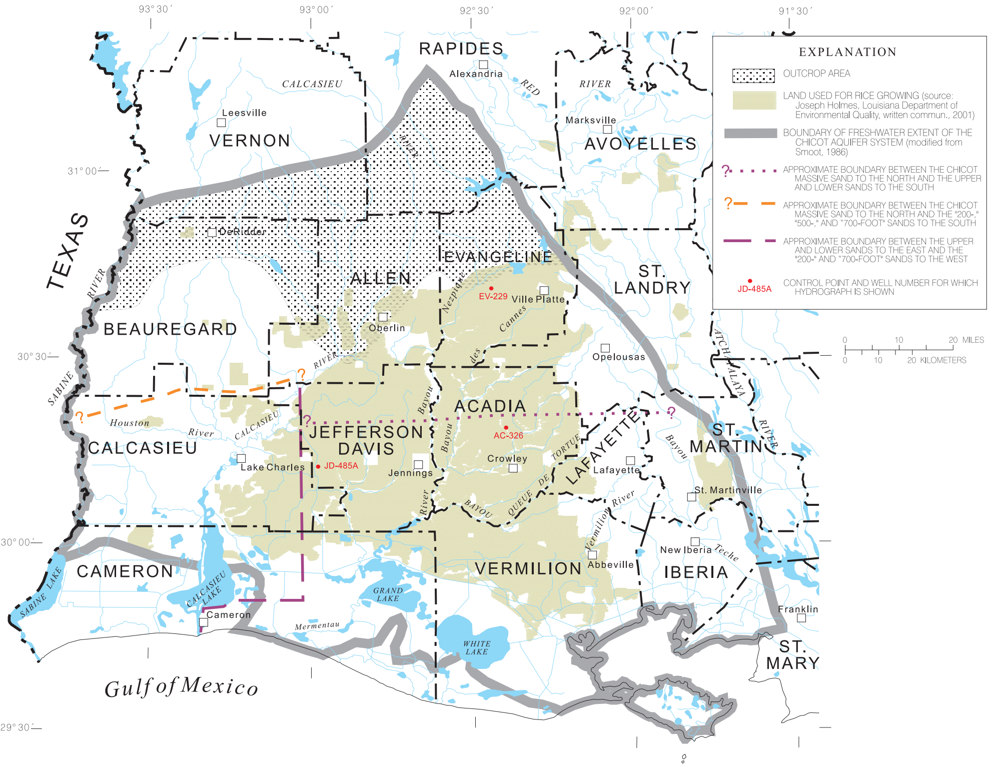

Figure 1. Location of study area in southwestern Louisiana.

System	Series	Aquifer	Aquifer	
			Lake Charles area	Rice growing area
Quaternary	Pleistocene	Chicot aquifer system	"200-foot" sand of Lake Charles area	Chicot aquifer, upper sand unit
			"500-foot" sand of Lake Charles area "700-foot" sand of Lake Charles area	Chicot aquifer, lower sand unit

Figure 2. Partial hydrogeologic column of aquifers in southwestern Louisiana (modified from Lovelace and Lovelace, 1995, p. 10).

POTENTIOMETRIC SURFACE

A potentiometric-surface map (fig. 3) was constructed using water-level data from wells completed in the massive, upper, and "200-foot" sands of the Chicot aquifer system (table 1, fig. 1). Water levels were measured during June 2000; water levels typically decline (due to seasonal withdrawals) to their yearly low during June (fig. 4). Water levels can fluctuate seasonally as much as 40 ft in some areas in response to pumping for rice irrigation. Water levels were measured using steel or electrical tapes marked with 0.01 ft gradations; wells in which water levels were measured were not being pumped at the time the measurements were made.

The highest water level, about 167 ft above sea level, was measured in the outcrop area of the Chicot aquifer system in northwestern Beauregard Parish. Water levels more than 50 ft below sea level were recorded in parts of Acadia, Calcasieu, Evangeline, and Jefferson Davis Parishes. The lowest water levels, more than 70 ft below sea level, extended over an area of about 60 mi^2 in southern Evangeline Parish.

Ground water moves through the aquifer system from areas of higher hydraulic head to lower hydraulic head, and the direction of flow is perpendicular to equipotential (contour) lines of the potentiometric surface. During June 2000, flow in the aquifer was generally towards rice-growing areas of Acadia Parish, Jefferson Davis Parish, southern Evangeline Parish, eastern Calcasieu Parish, and parts of surrounding parishes. In the northern part of the study area, flow in the massive sand generally was towards the south and southeast along the dip of sediments. In the southern part of the study area, flow in the upper sand and the "200-foot" sand was to the north from coastal areas towards rice-growing areas. Along the eastern extent of the aquifer system, flow generally trended westward.

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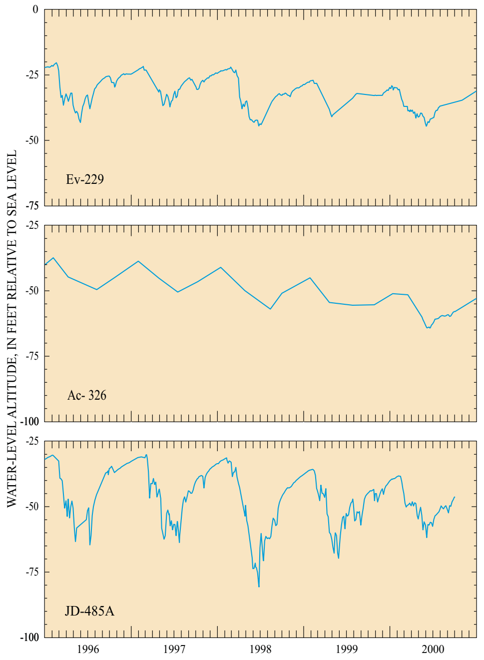

Figure 4. Water levels in the Chicot aquifer system for wells Ev-229 (Evangeline Parish), Ac-326 (Acadia Parish), and JD-485A (Jefferson Davis Parish).

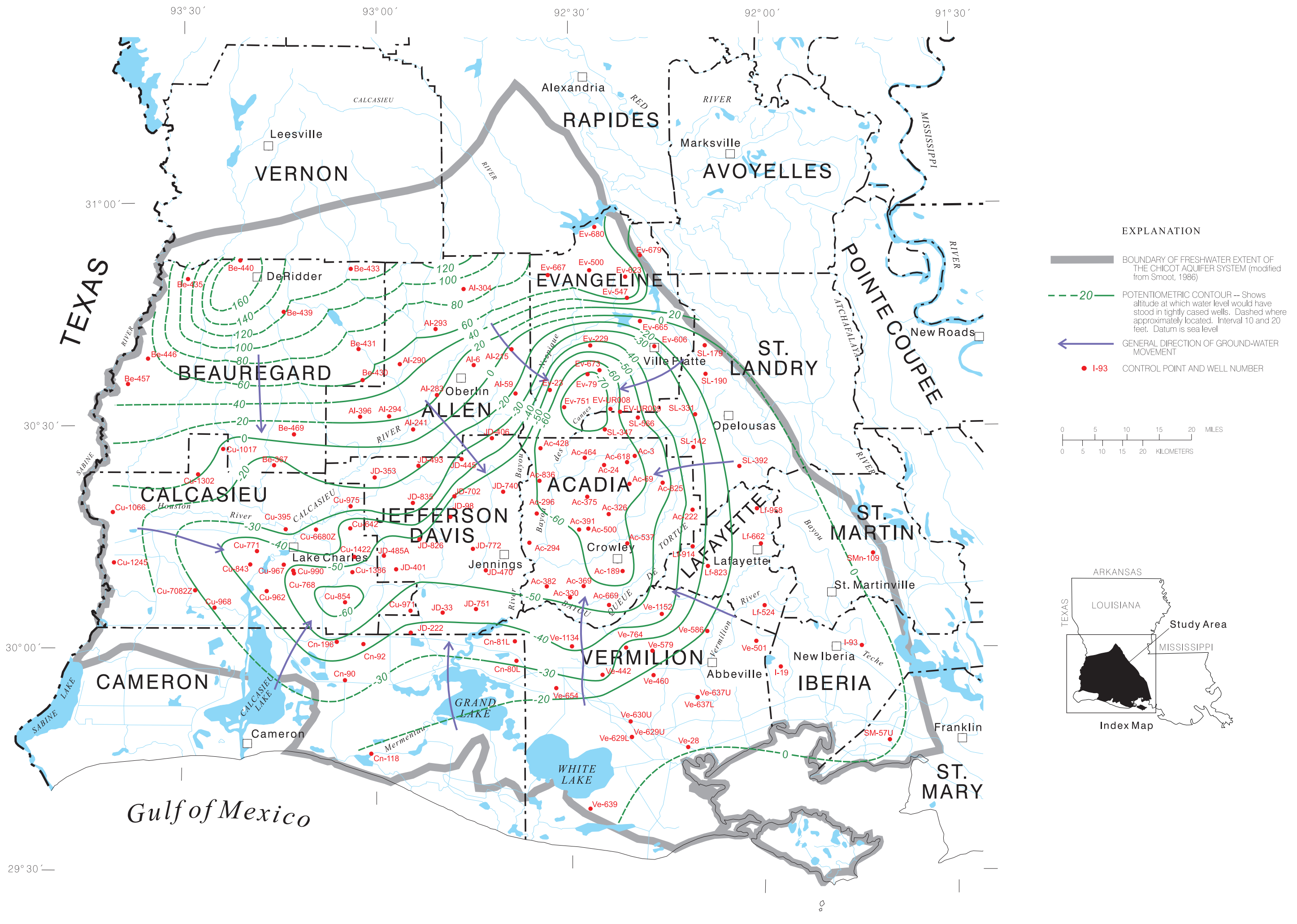

Figure 3. Potentiometric surface of the massive, upper, and "200-foot" sands of the Chicot aquifer system in southwestern Louisiana, June 2000.

Table 1. *Water-level data used to construct the potentiometric-surface map of the massive, upper, and "200-foot" sands of the Chicot aquifer system, June 2000*

[Aquifer code: 112CHCT, massive sand; 112CHCTU, upper sand; and 11202LC, "200-foot" sand. --, no data]

Well no.	Latitude (degrees)	Longitude (degrees)	Aquifer code	Altitude of land surface (feet relative to sea level)	Depth of well (feet)	Date	Depth to water level (feet below land surface)	Altitude of water level (feet relative to sea level)
Acadia Parish								
Ac- 3	302623	921939	112CHCT	50.00	338	6-6	111.69	-61.69
Ac- 24	302511	922426	112CHCT	41.00	284	6-27	109.18	-68.18
Ac- 69	302236	922029	112CHCT	43.00	--	6-1	107.88	-64.88
Ac- 189	301050	922138	112CHCTU	25.84	--	6-14	90.38	-64.54
Ac- 222	301904	921040	112CHCTU	36.00	--	6-14	72.48	-36.48
Ac- 294	301443	923607	112CHCTU	25.00	260	6-14	78.63	-53.63
Ac- 296	301839	923457	112CHCTU	31.00	250	6-7	89.38	-58.38
Ac- 326	301832	922345	112CHCTU	25.80	202	6-6	89.98	-64.18
Ac- 330	300719	922949	112CHCTU	12.00	280	6-14	63.72	-51.72
Ac- 369	300850	922742	112CHCTU	15.00	280	6-8	73.07	-58.07
Ac- 375	302053	922705	112CHCTU	36.00	315	6-27	102.07	-66.07
Ac- 382	300849	923326	112CHCTU	11.00	292	6-8	65.74	-54.74
Ac- 391	301628	922822	112CHCTU	21.00	256	6-6	82.11	-61.11
Ac- 428	302729	923420	112CHCT	42.00	203	6-7	104.78	-62.78
Ac- 464	302610	922727	112CHCT	40.00	248	6-27	104.67	-64.67
Ac- 500	301635	922656	112CHCTU	22.00	248	6-6	85.16	-63.16
Ac- 537	301434	922053	112CHCTU	25.00	211	6-8	86.26	-61.26
Ac- 618	302533	922051	112CHCT	40.00	249	6-7	106.70	-66.70
Ac- 669	300615	922346	112CHCTU	15.00	176	6-20	68.40	-53.40
Ac- 825	302244	921518	112CHCT	43.00	265	6-8	97.91	-54.91
Ac- 836	302304	923431	112CHCT	37.00	275	6-7	97.75	-60.75
Allen Parish								
Al- 6	303845	924443	112CHCT	80.00	--	6-28	67.21	12.79
Al- 59	303454	923812	112CHCT	73.00	250	6-28	93.95	-20.95
Al- 215	304052	923848	112CHCT	70.00	207	6-28	78.79	-8.79
Al- 241	303004	925411	112CHCT	42.97	62	6-19	34.65	8.32
Al- 283	303443	925028	112CHCT	62.00	93	6-20	40.84	21.16
Al- 290	303853	925616	112CHCT	65.00	103	6-23	18.94	46.06
Al- 293	304337	925040	112CHCT	100.00	84	6-22	32.92	67.08
Al- 294	303150	925756	112CHCT	48.00	142	6-19	26.27	21.73
Al- 304	304901	924616	112CHCT	114.00	104	6-23	20.21	93.79
Al- 396	303147	930228	112CHCT	57.00	315	6-23	32.86	24.14
Beauregard Parish								
Be- 367	302513	931552	112CHCT	45.00	455	6-27	71.20	-26.20
Be- 430	303644	930204	112CHCT	120.00	123	6-1	59.68	60.32
Be- 431	304055	930242	112CHCT	70.00	84	6-1	6.70	63.30
Be- 433	305145	930356	112CHCT	132.00	82	6-1	7.62	124.38
Be- 435	305019	932924	112CHCT	129.00	124	6-1	20.39	108.61
Be- 439	304556	931425	112CHCT	169.00	189	6-1	48.27	120.73
Be- 440	305251	932114	112CHCT	212.00	169	6-1	45.07	166.93
Be- 446	303933	933536	112CHCT	83.00	157	6-1	26.70	56.30
Be- 457	303606	933842	112CHCT	95.00	155	6-1	48.25	46.75
Be- 469	302923	931246	112CHCT	84.00	380	6-21	71.37	12.63
Calcasieu Parish								
Cu- 395	301634	931402	11202LC	12.00	200	6-27	40.21	-28.21
Cu- 642	301641	930359	11202LC	19.00	287	6-1	64.32	-45.32
Cu- 768	301036	931244	11202LC	11.53	306	6-14	68.83	-57.30
Cu- 771	301336	931830	11202LC	17.76	241	6-8	63.21	-45.45
Cu- 843	301148	931932	11202LC	12.00	205	6-8	56.01	-44.01
Cu- 854	300643	930447	11202LC	20.00	430	6-8	83.64	-63.64
Cu- 962	300812	931658	11202LC	11.00	287	6-21	53.36	-42.36
Cu- 967	301147	931419	11202LC	12.00	240	6-14	58.95	-46.95
Cu- 968	300557	932504	11202LC	10.00	276	6-28	40.18	-30.18
Cu- 971	300534	925437	112CHCTU	5.00	500	6-13	47.94	-42.94
Cu- 975	301941	930356	11202LC	20.00	237	6-13	48.65	-28.65
Cu- 990	301059	931251	11202LC	14.00	183	6-14	65.86	-51.86
Cu-1017	302719	932342	112CHCT	72.50	351	6-27	75.40	-2.90
Cu-1066	301840	934107	11202LC	25.00	255	6-28	34.81	-9.81
Cu-1245	301200	934044	11202LC	11.00	136	6-28	16.43	-5.43
Cu-1302	302357	932742	11202LC	45.00	180	6-27	43.56	1.44
Cu-1386	301048	930348	11202LC	24.00	324	6-9	78.75	-54.75
Cu-1422	301250	930320	11202LC	22.00	262	6-9	63.06	-41.06
Cu-6680Z	301632	930919	11202LC	11.00	170	6-21	43.15	-32.15
Cu-7082Z	300816	932805	11202LC	13.00	260	6-28	42.94	-29.94
Cameron Parish								
Cn- 80L	295846	923811	112CHCTU	4.73	481	6-20	39.00	-34.27
Cn- 81L	300125	923825	112CHCTU	4.45	478	6-20	41.84	-37.39
Cn- 90	295611	930448	11202LC	3.19	396	6-20	37.48	-34.29
Cn- 92	300104	930156	11202LC	5.50	443	6-8	49.41	-43.91
Cn- 118	294615	930042	112CHCTU	5.00	638	6-28	24.02	-19.02
Cn- 196	300122	930604	11202LC	10.00	420	6-8	59.31	-49.31
Evangeline Parish								
Ev- 23	303521	923250	112CHCT	51.06	360	6-1	104.19	-53.13
Ev- 79	303727	922657	112CHCT	55.00	250	6-1	125.66	-70.66
Ev- 229	304120	922630	112CHCT	65.66	231	6-1	109.56	-43.90
Ev- 500	305130	922636	112CHCT	117.52	120	6-1	50.16	67.36
Ev- 547	304745	922045	112CHCT	113.38	80	6-1	52.60	60.78
Ev- 606	304111	921629	112CHCT	75.00	255	6-27	104.84	-29.84
Ev- 623	305036	922058	112CHCT	137.20	96	6-1	68.86	68.34
Ev- 665	304435	921845	112CHCT	59.29	100	6-1	71.80	-12.51
Ev- 667	305055	923306	112CHCT	122.20	91.5	6-1	48.39	73.81
Ev- 673	303800	922504	112CHCT	60.00	247	6-1	128.32	-68.32
Ev- 679	305335	921835	112CHCT	46.00	70	6-1	7.34	38.66
Ev- 680	305714	922551	112CHCT	120.00	89	6-1	56.97	63.03
Ev- 751	303301	923037	112CHCT	53.00	275	6-1	125.18	-72.18
Ev-UR008	303247	922331	112CHCT	56.00	--	6-1	124.22	-68.22
Ev-UR009	303222	922206	112CHCT	58.00	--	6-27	117.61	-59.61
Iberia Parish								
I- 19	295748	915710	112CHCTU	9.72	460	6-9	18.96	-9.24
I- 93	300035	914433	112CHCTU	18.53	585	6-9	22.14	-3.61
Jefferson Davis Parish								
JD- 33	300517	924931	112CHCTU	7.18	350	6-7	50.97	-43.79
JD- 98	301813	924824	112CHCTU	35.00	--	6-22	88.37	-53.37
JD- 222	300236	925435	112CHCTU	4.61	300	6-7	43.62	-39.01
JD- 353	302334	930011	112CHCT	25.00	300	6-28	41.79	-16.79
JD- 401	301110	925651	112CHCTU	14.00	282	6-7	72.32	-58.32
JD- 406	302852	924150	112CHCT	50.00	450	6-22	82.09	-32.09
JD- 445	302602	924638	112CHCT	47.82	262	6-16	79.32	-31.50
JD- 470	301106	924254	112CHCTU	10.00	325	6-7	68.17	-58.17
JD- 485A	301300	925845	112CHCTU	21.36	290	6-7	80.85	-59.49
JD- 493	302509	925321	112CHCT	37.95	220	6-6	57.09	-19.14
JD- 702	302101	924746	112CHCT	35.00	236	6-6	85.31	-50.31
JD- 740	302137	924010	112CHCT	35.00	264	6-6	90.04	-55.04
JD- 751	300547	924426	112CHCTU	10.00	193	6-7	56.56	-46.56
JD- 772	301354	924455	112CHCTU	27.00	340	6-16	86.38	-59.38
JD- 826	301513	925314	112CHCTU	26.00	225	6-28	76.27	-50.27
JD- 835	302008	925414	112CHCTU	31.00	280	6-28	53.94	-22.94
Lafayette Parish								
Lf- 524	300605	915935	112CHCTU	25.00	174	6-9	27.25	-2.25
Lf- 662	301426	920006	112CHCTU	40.37	152	6-8	51.09	-10.72
Lf- 823	301127	920822	112CHCTU	30.00	363	6-9	59.02	-29.02
Lf- 914	301407	921042	112CHCTU	30.00	250	6-8	68.11	-38.11
Lf- 958	301922	920102	112CHCTU	50.00	115	6-8	54.72	-4.72
St. Landry Parish								
SL- 142	302732	921029	112CHCT	50.00	235	6-7	83.84	-33.84
SL- 179	304116	920836	112CHCT	55.23	94	6-5	56.85	-1.62
SL- 190	303725	920830	112CHCT	74.36	175	6-6	84.78	-10.42
SL- 331	303200	921005	112CHCT	62.00	119	6-6	91.46	-29.46
SL- 347	302959	922418	112CHCT	50.00	300	6-1	119.18	-69.18
SL- 392	302455	920320	112CHCT	46.74	126	6-7	55.39	-8.65
SL- 566	303134	921908	112CHCT	51.00	250	6-7	103.23	-52.23
St. Martin Parish								
SMn- 109	301304	914240	112CHCTU	11.34	375	6-22	9.74	1.60
St. Mary Parish								
SM- 57U	294749	914023	112CHCTU	8.72	638	6-28	11.02	-2.30
Vermilion Parish								
Ve- 28	294705	921150	112CHCTU	6.74	260	6-6	7.13	-0.39
Ve- 442	295650	922450	112CHCTU	5.42	281	6-6	36.68	-31.26
Ve- 460	295645	921655	112CHCTU	9.78	300	6-20	29.01	-19.23
Ve- 501	300117	920056	112CHCTU	21.62	227	6-5	29.51	-7.89
Ve- 579	300003	921704	112CHCTU	14.00	239	6-20	40.76	-26.76
Ve- 586	300240	920832	112CHCTU	15.40	259	6-5	34.88	-19.48
Ve- 629L	294825	922020	112CHCTU	1.79	487	6-6	10.83	-9.04
Ve- 629U	294825	922020	112CHCTU	1.79	457	6-6	9.70	-7.91
Ve- 630U	295031	922032	112CHCTU	4.75	498	6-6	15.66	-10.91
Ve- 637L	295345	921007	112CHCTU	4.06	243	6-7	14.69	-10.63
Ve- 637U	295345	921007	112CHCTU	4.06	198	6-7	13.56	-9.50
Ve- 639	293845	922649	112CHCTU	5.84	608	6-6	11.30	-5.46
Ve- 654	295504	923201	112CHCTU	9.60	267	6-20	33.82	-24.22
Ve- 764	300030	922109	112CHCTU	15.00	250	6-20	43.84	-28.84
Ve-1134	300042	922933	112CHCTU	5.00	190	6-20	45.55	-40.55
Ve-1152	300501	921534	112CHCTU	10.00	235	6-20	56.57	-46.57

Louisiana Ground-Water Map No. 12:

Potentiometric Surface of the Chicot Aquifer System in Southwestern Louisiana, June 2000

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By

2001

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