In cooperation with the Harris-Galveston Subsidence District, City of Houston, Fort Bend Subsidence District, and Lone Star Groundwater Conservation District

Water-Level Altitudes 2008 and Water-Level Changes in the Chicot, Evangeline, and Jasper Aquifers and Compaction 1973–2007 in the Chicot and Evangeline Aquifers, Houston-Galveston Region, Texas

By Mark C. Kasmarek and Natalie A. Houston

Scientific Investigations Map 3031

U.S. Department of the Interior
U.S. Geological Survey

U.S. Department of the Interior
DIRK KEMPTHORNE, Secretary

U.S. Geological Survey
Mark D. Myers, Director

U.S. Geological Survey, Reston, Virginia: 2008

For product and ordering information:
World Wide Web: http://www.usgs.gov/pubprod
Telephone: 1-888-ASK-USGS

For more information on the USGS—the Federal source for science about the Earth,
its natural and living resources, natural hazards, and the environment:
World Wide Web: http://www.usgs.gov
Telephone: 1-888-ASK-USGS

Suggested citation:
Kasmarek, M.C., and Houston, N.A., 2008, Water-level altitudes 2008 and water-level changes in the Chicot, Evangeline, and Jasper aquifers and compaction 1973–2007 in the Chicot and Evangeline aquifers, Houston-Galveston region, Texas: U.S. Geological Survey Scientific Investigations Map 3031,4 p., 17 sheets.

Contents

Figures

Tables

Vertical Datum

Vertical coordinate information is referenced to the National Geodetic Vertical Datum of 1929 (NGVD 29).

Horizontal coordinate information is referenced to the North American Datum of 1927 (NAD 27)

Water-Level Altitudes 2008 and Water-Level Changes in the Chicot, Evangeline, and Jasper Aquifers and Compaction 1973–2007 in the Chicot and Evangeline Aquifers, Houston-Galveston Region, Texas

By Mark C. Kasmarek and Natalie A. Houston

Abstract

This report, done in cooperation with the Harris-Galveston Subsidence District, the City of Houston, the Fort Bend Subsidence District, and the Lone Star Groundwater Conservation District, is one in an annual series of reports that depicts water-level altitudes and water-level changes in the Chicot, Evangeline, and Jasper aquifers, and compaction in the Chicot and Evangeline aquifers in the Houston-Galveston region, Texas. The report contains 17 sheets and 16 tables: 3 sheets are maps showing current-year (2008) water-level altitudes for each aquifer, respectively; 3 sheets are maps showing 1-year (2007–08) water-level changes for each aquifer, respectively; 3 sheets are maps showing 5-year (2003–08) water-level changes for each aquifer, respectively; 4 sheets are maps showing long-term (1990–2008 and 1977–2008) water-level changes for the Chicot and Evangeline aquifers, respectively; 1 sheet is a map showing long-term (2000–2008) water-level change for the Jasper aquifer; 1 sheet is a revision of a previously published water-level-altitude map for the Jasper aquifer for 2003; 1 sheet is a map showing site locations of borehole extensometers; and 1 sheet comprises graphs showing measured compaction of subsurface material at the sites from 1973 or later through 2007, respectively. Tables listing the data used to construct the aquifer-data maps and the compaction graphs are included.

Introduction

This report is one in an annual series of reports that depicts water-level altitudes and water-level changes in the Chicot, Evangeline, and Jasper aquifers, and compaction in the Chicot and Evangeline aquifers in the Houston-Galveston region, Texas. The Houston-Galveston region comprises Harris, Galveston, Fort Bend, Waller, and Montgomery Counties and adjacent parts of Brazoria, Grimes, Walker, San Jacinto, Liberty, and Chambers Counties. The report was done in cooperation with the Harris-Galveston Subsidence District, the City of Houston, the Fort Bend Subsidence District, and the Lone Star Groundwater Conservation District.

The U.S. Geological Survey (USGS) has published annual reports of water-level altitudes and water-level changes for the Chicot and Evangeline aquifers in the Houston-Galveston region since 1979; and annual reports of same for the Fort Bend subregion (Fort Bend County and adjacent areas) since 1990. The USGS first published a water-level-altitude map for the Jasper aquifer in the greater Houston area (primarily Montgomery County) in 2001.

This report contains maps showing current-year (2008) water-level altitudes for each of the three aquifers; maps showing 1-year (2007–08) water-level changes for each aquifer; maps showing 5-year (2003–08) water-level changes for each aquifer; maps showing long-term

(1990–2008 and 1977–2008) water-level changes for the Chicot and Evangeline aquifers; a map showing long-term (2000–2008) water-level change for the Jasper aquifer; and revision of a previously published water-level-altitude map for the Jasper aquifer for 2003. The report also contains graphs showing measured compaction of subsurface material at 11 sites from 1973 or later through 2007. Tables listing the data used to construct each of the maps and the compaction graphs also are included. The text included here, except for a brief summary of the geohydrology of the region, is intended to document the methods used to construct the maps rather than to describe water-level altitudes and changes in the three aquifers.

Geohydrology

The Chicot aquifer (in Holocene- and Pleistocene-age sediments), Evangeline aquifer (in Pliocene- and Miocene-age sediments), and Jasper aquifer (in Miocene-age sediments) are the three primary aquifers in the Gulf Coast aquifer system (Baker, 1979; 1986). The lowermost Jasper aquifer is separated from the Evangeline aquifer by the Burkeville confining unit. The hydrogeologic units are laterally discontinuous fluvial-deltaic deposits of gravel, sand, silt, and clay that dip and thicken from northwest to southeast. The aquifers thus crop out in bands inland from and approximately parallel to the coast and become progressively more deeply buried and confined toward the coast. The Chicot aquifer outcrop, which comprises the youngest sediments, is the closest of the aquifer outcrops to the coast, followed farther inland by the Evangeline aquifer outcrop and then farthest inland by the Jasper aquifer outcrop.

The Chicot aquifer can be differentiated from the geologically similar Evangeline aquifer on the basis of hydraulic conductivity (Carr and others, 1985, p. 10). The Jasper aquifer can be differentiated from the Evangeline aquifer in the outcrops on the basis of water levels (higher in the Jasper than in the Evangeline) and in the downdip parts of the aquifers on the basis of position relative to the Burkeville confining unit.

The water in the aquifers is fresh (less than 1,000 milligrams per liter dissolved solids concentration) in the region but becomes more saline in the downdip and deeply buried parts of the aquifers near the coast (Baker, 1979). In the natural ground-water-flow system, water recharges the aquifers in the unconfined outcrop areas, moves downward and coastward, and discharges upward as diffuse upward leakage in the confined downdip areas.

The authors express appreciation to the owners and operators of wells throughout the study area. This report could not have been done without their assistance in granting access to wells and providing pertinent information.

Water-Level Altitudes and Water-Level Changes

Water-level altitudes were obtained by steel tape, by air line, and from reports of well operators. Most wells are pumped once daily, but some are pumped more frequently. Multiple measurements were made when wells were not being pumped; however, antecedent conditions and pumping status of nearby wells were not always known. Most measurements were made in January and February, the months when water levels usually are highest. Water-level altitude is indicated on the maps by contours of equal water-level altitude at various intervals.

For the 1-year (2007–08) change maps, water-level changes were computed as the difference in water-level altitude at each point (well) for which a water-level-altitude measurement was made in 2008 and 2007. Change on the 1-year maps is indicated by point differences.

For the 5-year (2003–08) change maps, water-level changes were computed the same as for the 1-year maps—the difference in water-level altitude at each point for which a water-level-

altitude measurement was made in 2008 and 2003. Change on the 5-year maps is indicated by contours of equal water-level change. Each 5-year map was created by contouring the set of mapped point differences.

For the historical (2000–2008, 1990–2008, 1977–2008) change maps, water-level changes were computed as the difference in water-level altitude at each point (well) for which a water-level-altitude measurement was made in 2008 and the water-level altitude at that point on a gridded surface of the historical water-level-altitude map. Change on the historical maps is indicated by contours of equal water-level change. Each historical change map was created by contouring the set of mapped point differences. Gridded-surface values for historical water-level altitudes rather than actual measured values were used to compute differences (mapped point values) because many of the wells measured in 2000, 1990, and 1977 were no longer available for measurement in 2008. Thus using the gridded surface yielded many more point values than would have been available using the subset of wells measured in both 2008 and the historical year. For the subset of wells measured in both 2008 and the historical year, the mapped point values used were the differences in measured water levels between 2008 and the historical year rather than the differences between 2008 measured values and historical-year gridded-surface values—although the historical-year measured and gridded values are equal for the majority of points and very close for most others.

For the Chicot and Evangeline aquifers, maps show approximate water-level altitudes in 2008, water-level changes from 2007 to 2008, and approximate water-level changes from 2003 to 2008, from 1990 to 2008, and from 1977 to 2008 (figs. 1–10). For the Jasper aquifer, maps show approximate water-level altitudes in 2008, water-level changes from 2007 to 2008, and approximate water-level changes from 2003 to 2008 and 2000 to 2008 (figs. 11–14). This report contains one additional map: a revised Jasper aquifer water-level-altitude map for 2003 (fig. 15), which supersedes the map of Kasmarek and Lanning-Rush (2003, sheet 11). The map was revised on the basis of water-level data for the Jasper aquifer that became available subsequent to publication of the original map (John Nelson, LBG-Guyton Associates, written commun., 2006).

For the Chicot aquifer maps, 190 water-level measurements were used for the 2008 altitude (table 1), 176 water-level pairs were used for the 2007–08 change (table 2), 154 water-level pairs for the 2003–08 change (table 3), 156 water-level pairs for the 1990–2008 change (table 4), and 149 water-level pairs for the 1977–2008 change (table 5).

For the Evangeline aquifer maps, 351 water-level measurements were used for the 2008 altitude (table 6), 333 water-level pairs were used for the 2007–08 change (table 7), 220 water-level pairs for the 2003–08 change (table 8), 289 water-level pairs for the 1990–2008 change (table 9), and 246 water-level pairs for the 1977–2008 change (table 10).

For the Jasper aquifer maps, 89 water-level measurements were used for the 2008 altitude (table 11), 81 water-level pairs were used for the 2007–08 change (table 12), 60 water-level pairs for the 2003–08 change (table 13), and 81 water-level pairs for the 2000–2008 change (table 14). The data used to construct the revised Jasper aquifer water-level-altitude map for 2003 are listed in table 15.

Three maps, one for each aquifer (appendix), show the locations of wells used to make each map. Sequential index numbers for wells on each map link the well locations to the tabular data for the respective map, as the index numbers are common to both the map and the associated table.

Compaction

Compaction of subsurface material is measured continuously by 13 borehole extensometers at 11 sites (fig. 16). Graphs of compaction from 1973 or later through 2007 for 12 of the 13 extensometers are shown in figure 17; data for the graphs are listed in table 16. Compaction

measured by the shallower of two extensometers at the Clear Lake site is not shown because it is similar to that measured by the deeper extensometer at the site.

References

Baker, E.T., Jr., 1979, Stratigraphic and hydrogeologic framework of part of the Coastal Plain of Texas: Texas Department of Water Resources Report 236, 43 p.

Baker, E.T., Jr., 1986, Hydrology of the Jasper aquifer in the southeast Texas Coastal Plain: Texas Water Development Board Report 295, 64 p.

Carr, J.E., Meyer, W.R., Sandeen, W.M., and McLane, I.R., 1985, Digital models for simulation of ground-water hydrology of the Chicot and Evangeline aquifers along the Gulf Coast of Texas: Texas Department of Water Resources Report 289, 101 p.

Gabrysch, R.K., 1979, Approximate altitude of water levels in wells in the Chicot and Evangeline aquifers in the Houston area, Texas, spring 1977 and spring 1978: U.S. Geological Survey Open-File Report 79–334, 4 sheets.

Kasmarek, M.C., 1997, Water-level altitudes in wells completed in the Chicot and Evangeline aquifers, Fort Bend County and adjacent areas, Texas, January–February 1990: U.S. Geological Survey Open-File Report 97–784, 2 sheets.

Kasmarek, M.C., and Houston, N.A., 2007, Water-level altitudes 2007 and water-level changes in the Chicot, Evangeline, and Jasper aquifers and compaction 1973–2006 in the Chicot and Evangeline aquifers, Houston-Galveston region, Texas: U.S. Geological Survey Scientific Investigations Map 2968, 18 sheets.

Kasmarek, M.C., and Lanning-Rush, Jennifer, 2003, Water-level altitudes 2003 and water-level changes in the Chicot, Evangeline, and Jasper aquifers and compaction 1973–2002 in the Chicot and Evangeline aquifers, Houston-Galveston region, Texas: U.S. Geological Survey Open-File Report 03–109, 15 sheets.

University of Texas, Bureau of Economic Geology, 1968, Geologic atlas of Texas, Beaumont sheet: Austin, scale 1:250,000.

University of Texas, Bureau of Economic Geology, 1974, Geologic atlas of Texas, Austin Sheet: Austin, scale 1:250,000.

Appendix—Well Location Maps

—Map showing location of wells, Chicot aquifer.
—Map showing location of wells, Evangeline aquifer.
—Map showing location of wells, Jasper aquifer.