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Geol Survey

OFS 2001-3

# The Origin of Weldon Springs

S.V. Panno and K.C. Hackley

**Open File Series 2001-3**



George H. Ryan, Governor

Department of Natural Resources
Brent Manning, Director
ILLINOIS STATE GEOLOGICAL SURVEY
William W. Shilts, Chief

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615 East Peabody Drive
Champaign, IL 61820-6964

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ILLINOIS
DEPARTMENT OF
NATURAL
RESOURCES

# ILLINOIS STATE GEOLOGICAL SURVEY

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Champaign, IL 61820-6964
217/333-4747
FAX 217/244-7004

Ms. Carol Thompson
Weldon Springs
R.R. 2
P.O. Box 87
Clinton, Illinois 61727

Dear Carol:

Enclosed is a copy of the report on Weldon Springs that I promised to send as a replacement for the description you currently have at the park. A cross section of the area was completed using well log descriptions that are available at the Illinois State Geological Survey (attached). Also attached is a summary of our results from the water samples collected this summer. Two water samples were collected, one from Twin Springs (TS) and one from the concrete culvert where water was flowing from the direction of the house (CUL). The combined description and cross section are intended for the display next to Twin Springs. Below is a brief summary of the findings of our study of the Weldon Springs area.

The cross section of the park (A–A′), which is shown with considerable expansion of the vertical scale, shows the origin of of the spring water at the park as it is described in the attached writeup (Figures 1 and 2). The park area is underlain by a layer of silt-rich, sand and gravel deposited by a melting glacier during Wisconsinan time (25,000 to 10,000 years before present). Because of the presence of silt in the sand and gravel, the deposit is probably not productive enough to be considered an aquifer; however, a significant amount of groundwater flows through the deposit toward Salt Creek. The spring water originates from rainwater and snowmelt that fell on areas of higher elevation to the north, flowed through the silt-rich, sand and gravel, and discharges in the low-lying areas of the park (the springs), at the lake, and eventually into the Salt Creek valley. The tritium concentration of the spring water sample (14.1 TU) is relatively high for recent rainfall and snowmelt (usually around 5 TU). This suggests that the groundwater was deposited as rainfall and snowmelt somewhere between 20 and 30 years ago. That is, it took 20 to 30 years for the water to seep into the ground to the north, migrate as groundwater through the silty, sand and gravel deposit, and discharge at the spring.

The chemical data indicate that the groundwater is a calcium-bicarbonate water typical of water flowing through sand and gravel aquifers in the state (Table 1). The groundwater contains effectively little if any dissolved oxygen; that is, most of the oxygen from the atmosphere that was

originally dissolved in the water has been consumed by reactions within the soil zone. As a result, it is possible for the metals iron and manganese, present as oxides within the sand and gravel, to dissolve in the groundwater. When the water with these metals dissolved in it is again exposed to the atmosphere, iron and manganese precipitate out of the water turning the water yellow with suspended iron oxyhydroxide and manganese oxides. The gas bubbling from the fine sediment (silt) within the brick enclosure is nitrogen and probably represents dissolved nitrogen from trapped air bubbles during original recharge to the sand and gravel deposit. The oxygen has been removed from the trapped air and, at the lower pressures at the discharge points of the springs, the nitrogen gas is coming out of solution.

The water flowing through the culvert from the direction of the house to the north (CUL) has been exposed to atmospheric oxygen and has lost its metals. In addition, it is high in sodium and chloride relative to the Twin Springs sample (TS), and both samples fall along a line defined by sodium and chloride (attached). The elevated sodium and chloride concentrations in the culvert water suggest that input from a septic system from a house with a water softener is a likely source (Figure 3).

The well that supplies the park is pumping water from a deeper sand and gravel deposit that lies about 50 to 60 feet below the surface. This aquifer is also used by nearby farms and is probably a fairly clean water source because it is protected by a thick sequence of clay-rich glacial till. We did not sample this water during our visit.

The Mahomet aquifer lies at a depth of about 220 feet below the park and supplies most of the fresh water to cities and towns (including Clinton) across east central Illinois. The aquifer is about 30 to 50 feet thick in this area and is discussed in the writeup. Groundwater from the Mahomet aquifer is in no way related to the springs at Weldon Springs State Park.

If you have any questions concerning this report, please feel free to contact me at the above address, by telephone at (217) 244-2456, by telefax at (217) 244-2785, or by e-mail at panno@isgs.uiuc.edu.

Samuel V. Panno
Senior Geochemist
Groundwater Geology Section

## Groundwater Report on the Weldon Springs Area

*S.V. Panno and K.C. Hackley, Illinois State Geological Survey*

Over 2,000 years ago, Greek philosophers suggested that springs originated from underground lakes and rivers located deep within the earth. Although they were wrong, the idea persists today that groundwater flows in underground rivers, and water seeping from the ground is often assumed to be sterile and free of manmade contaminants because it has been "filtered" by passing through the soil and rock before bubbling out at a spring. The truth is, spring water flowing from rocks or soil, at the rates of gallons per minute to thousands of gallons per minute, can be contaminated with bacteria from human and animal wastes, pesticides, spilled petroleum products, etc. Only bacterial and chemical analyses can tell you if spring water is safe to drink.

Where does the cool, clear water of Weldon Springs come from? A drawing of a slice through the earth in the area of Weldon Spring can reveal the source of the spring water much like slicing a layer cake reveals the icing layers hidden within (Figures 1 and 2). Because the vertical scale on the slice (or cross section) is about 60 times greater than the horizontal scale, the hills in the area appear taller than they really are. From our slice, we can see layers of clay rich till through which water does not flow easily capping two layers of sand and gravel through which water flows quickly. The spring water has a very shallow source located a few tens of feet above the elevation of the springs. Rainfall and snowmelt that seeped into the ground around 20 to 30 years ago has migrated about one mile or less before emerging at the springs. The rain and snow melt seeped into and migrated through a relatively thick deposit of silty sand and gravel left by a continental-size glacier that covered the Clinton area, and much of the northern part of Illinois, between 10,000 and 25,000 years ago.

Groundwater moves in open spaces (pores) between grains in the sand and gravel. For example, if you have ever poured water into a sand box, the water disappeared into the sand very quickly. The water flowed into and through the connected pores adjacent to the sand grains. Groundwater does the same thing, moving through sediment from a higher elevation to a lower elevation. At this site, the higher elevation is to the north and the lower elevation is the stream valley to the south. Near the springs of Weldon Springs State Park, the groundwater moving through the silty sand and gravel in this area has intersected open fractures, probably filled with fine sand and discharges near the base of the hills within the park complex.

Additional groundwater is discharging to the park's lake and Salt Creek farther south; thus, the water in the lake and creek are constantly fed by groundwater that was originally rainwater and snowmelt 20 to 30 years ago. These water bodies are also fed by a deeper, more productive aquifer of sand and gravel that lies below the silt-rich, sand and gravel (at a depth of about 50 feet). The deeper aquifer is about 5 to 10 feet thick and is relied upon for fresh water by the park and nearby farms.

The much larger Mahomet aquifer, which supplies most of the fresh water to cities and towns (including Clinton) across east central Illinois, is located at a depth of about 220 feet below land surface and, in this area, is about 30 to 50 feet thick. The Mahomet aquifer is an ancient, sand and gravel-filled, stream valley that stretches from western Indiana to the Illinois River south of Peoria. The aquifer is over 125 miles long and 8 miles wide; it supplies water to over 800,000 people. The water in the aquifer is much older than that of Weldon Springs, having fallen on Illinois as rainwater and snowmelt between 3,000 and 10,000 years ago.

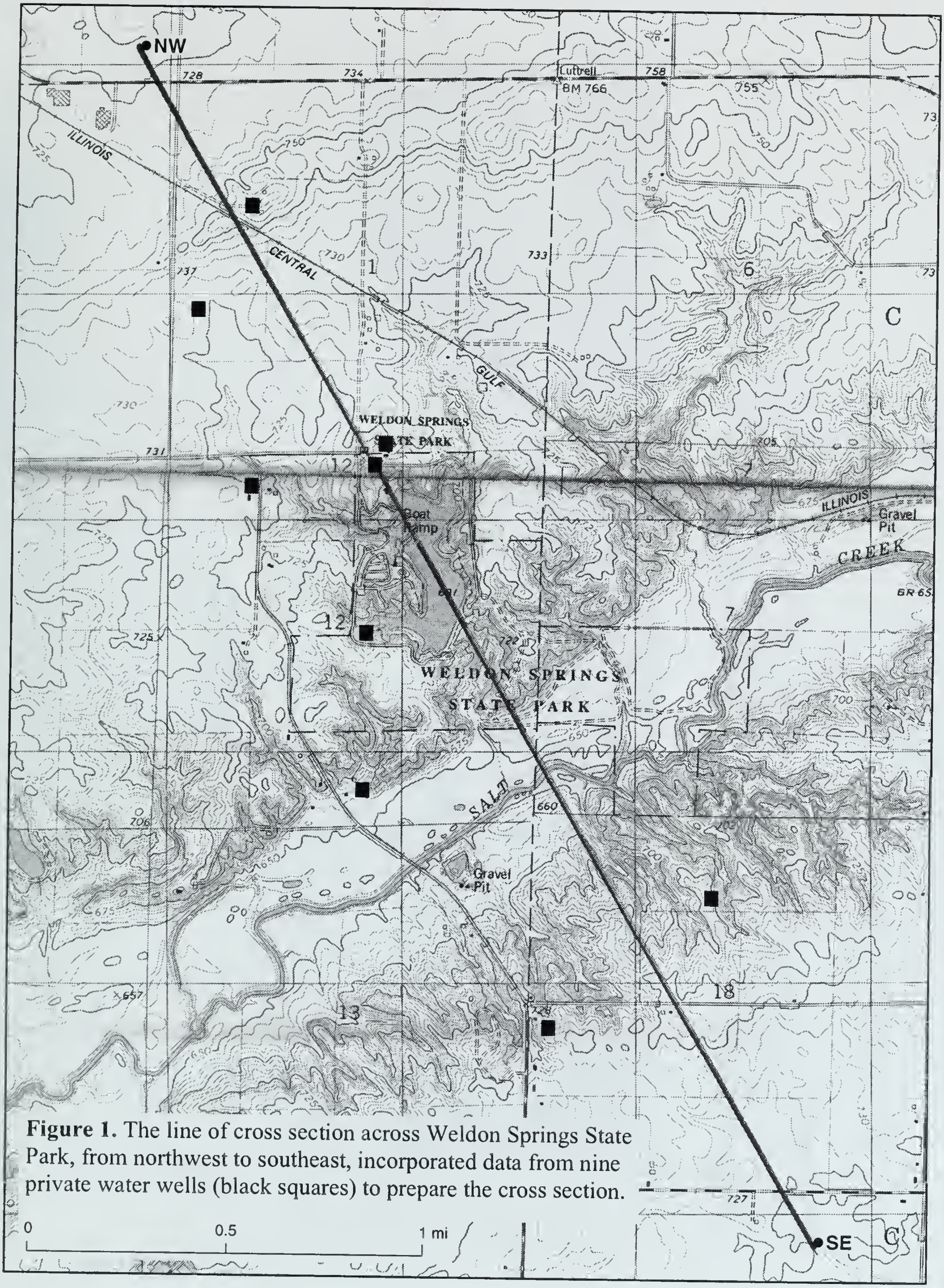


**Figure 1.** The line of cross section across Weldon Springs State Park, from northwest to southeast, incorporated data from nine private water wells (black squares) to prepare the cross section.

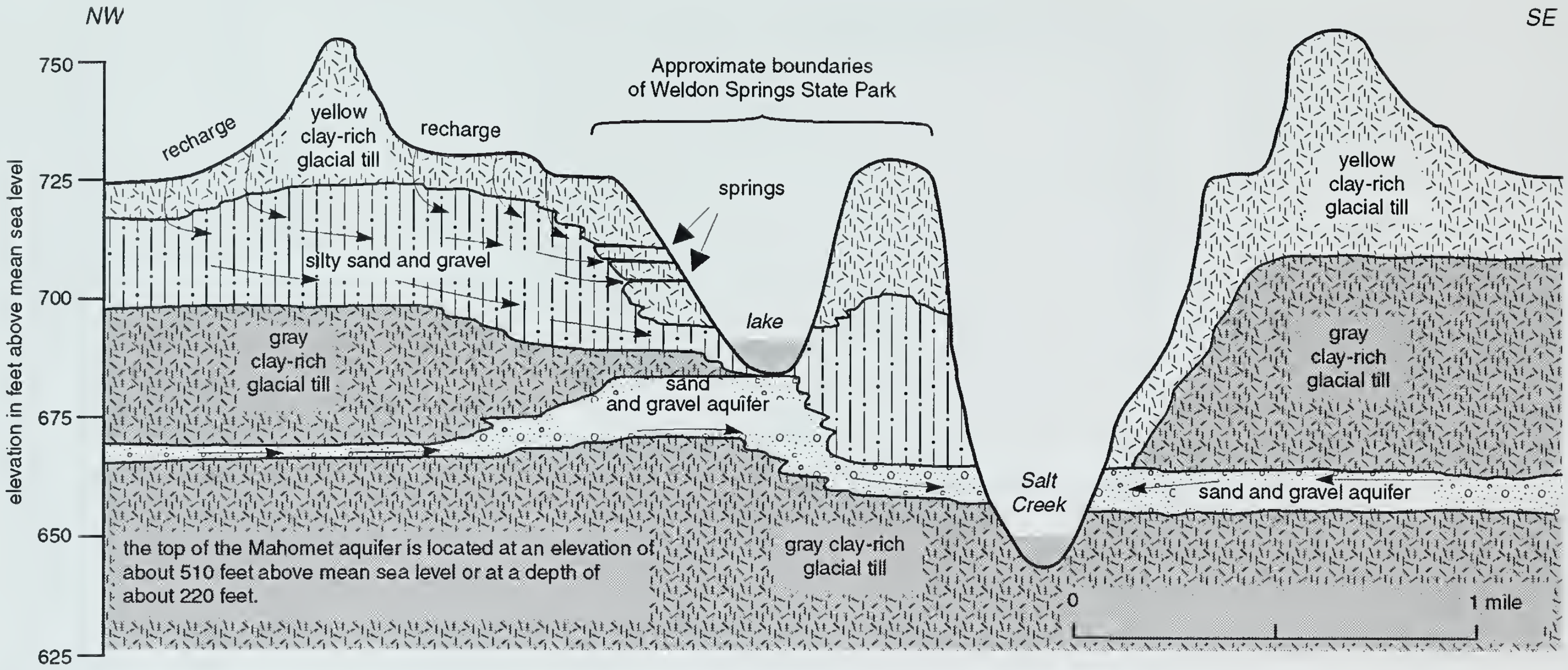


**Figure 2.** Generalized cross section across Weldon Springs State Park, its springs, lake, and Salt Creek. The springs originate as surface recharge becomes groundwater flowing through a relatively shallow silty sand and gravel deposit. After a relatively short trip, the groundwater discharges in the low-lying areas of the park, forming the springs and providing the lake with a constant water supply.

**Table 1.** Chemical analysis completed by the Illinois State Geological Survey (all chemical data are reported in milligrams per liter unless units are indicated). Samples were collected on October 3, 2000. ND, net determined.

| | Groundwater Samples | |
|---|---|---|
| Parameter | TS | CUL |
| Tritium, tritium units or TU | 14.1 | ND |
| Dissolved gas | $N_2$ only | ND |
| Discharge, gpm | 15.9 | ND |
| Temperature, °C | 12.4 | 14.5 |
| pH | 7.33 | 7.42 |
| Eh, mV | +101 | +139 |
| Specific conductance, µS/cm | 606 | 848 |
| Alkalinity, as mg/L $CaCO_3$ | 305 | 313 |
| Na | 8.1 | 57 |
| K | <1 | <1 |
| Ca | 91 | 92 |
| Sr | 0.22 | 0.22 |
| Mg | 40 | 40 |
| $SiO_2$ | 15 | 15 |
| $NO_3$ | 0.08 | 0.06 |
| $NH_3$ | 0.52 | 0.92 |
| $SO_4$ | 63 | 60 |
| Cl | 16 | 78 |
| F | 0.1 | 0.1 |
| Fe | 2.7 | 0.01 |
| Mn | 0.07 | 0.07 |
| Zn | <0.05 | 0.09 |

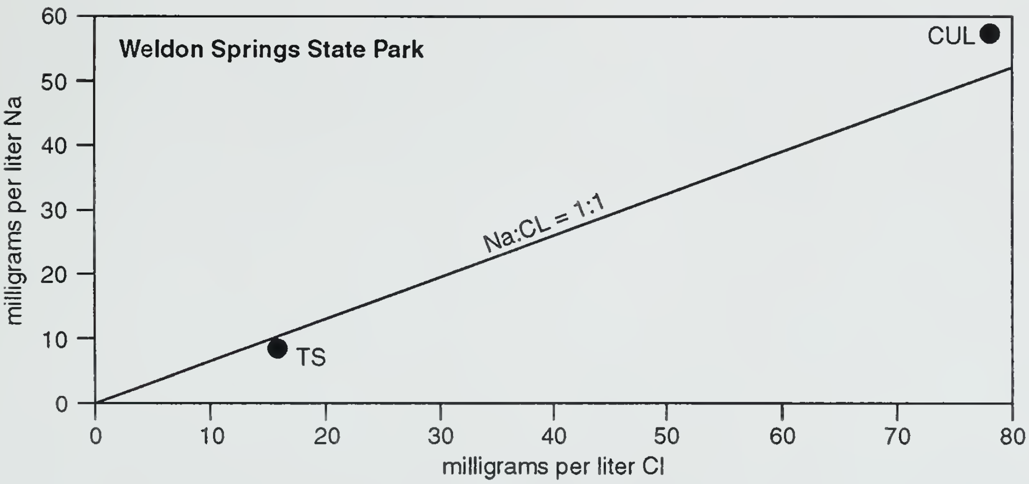


**Figure 3.** Water samples collected from Twin Springs (TS) and the culvert (CUL) that collects the spring water are compared with a 1:1 line for sodium and chloride. The samples fall very close to the 1:1 line suggesting the spring water and culvert water have received sodium and chloride from road salt (TS) and possibly septic effluent from a house using a water softener (CUL).