

# Hydrology Section — Land, Water and Conservation Division

South Carolina Department of Natural Resources

www.dnr.sc.gov

803-734-9100



DNR

## PROJECT: Geophysical Logging

**OBJECTIVE: Collect geophysical logs from wells to better understand our ground water resources**

Geophysical logs are continuous records of the electrical, nuclear, physical, and chemical properties of the sediment, rock, borehole, and formation water penetrated by a well. Logs are obtained from water wells for many different reasons, but the primary use of logs is to identify water-bearing zones in the subsurface that can be used as a source of ground water for a given well. Other uses of geophysical logs include:

- identifying the freshwater/saltwater interface in aquifers along the coast;
- determining well and screen depth and diameter in completed wells;
- identifying high-radiation zones and determining geologic contacts;
- quantifying flow rates in open-hole wells and estimating lithology and ground-water salinity.

The South Carolina Department of Natural Resources owns and operates a geophysical logger and provides logging services free of charge in areas where the State requires additional ground water information. The DNR logging system is capable of running the following types of logs: Single-point resistance; spontaneous potential; 16-inch short normal resistivity; 64-inch long normal resistivity; 72-inch lateral resistivity; gamma ray; caliper; temperature; and fluid resistivity.

**A single-point resistance log** measures the electrical resistance of formation water and of sediment and rock penetrated by the borehole, and is used to delineate the depth and thickness of aquifers and confining units of the Coastal Plain and to determine the location of fractures in rock wells in the Piedmont.

**A spontaneous potential (SP) log** records small electrical voltages that occur in the borehole and in the surrounding sediment caused by variations in water chemistry and mineralogy. This log is used primarily to indicate relative permeability and is especially useful in coastal areas where stronger voltages result from more mineralized ground water.

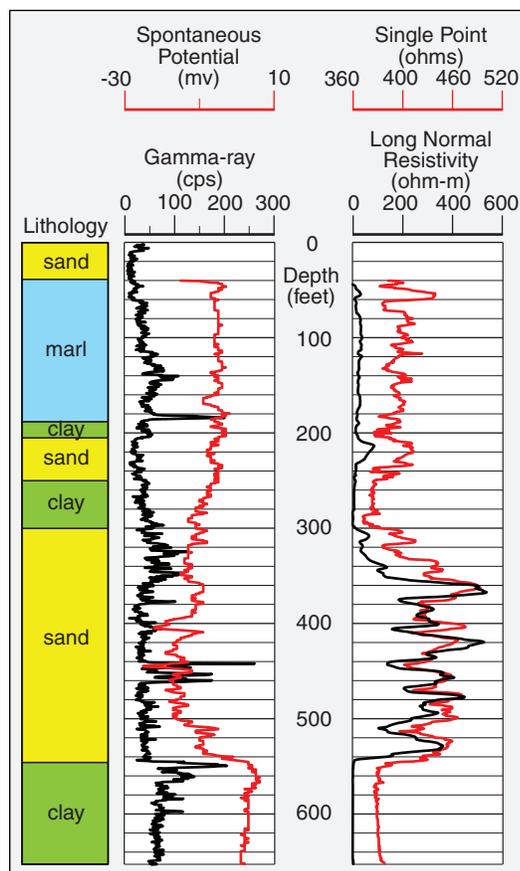
**Resistivity logs**—16-inch short normal, 64-inch long normal, and 72-inch lateral—measure the electrical resistivity of the formation water and of the sediment and rock penetrated by the borehole. The three logs differ in their vertical resolution and in the distance to which the electrical current penetrates the formation, both a function of the spacing of the electrodes. All three logs are used to delineate the aquifers and confining units of the Coastal Plain.

**A gamma-ray log** measures the naturally occurring gamma radiation emitted from the rock and sediment penetrated by a well. It is used to infer different types of lithology, such as clay, marl, sand, and limestone.

**A caliper log** measures the diameter of a cased well or of an open borehole and is used to determine the integrity and length of the well casing, to determine well diameter and screen locations, and to locate fractures in rock wells.

**A temperature log** measures the temperature of water in a well or of drilling fluid in an open borehole. Because ground-water temperature increases with depth, this log can be used to determine the geothermal gradient in an area.

**A fluid resistivity log** measures the electrical resistivity of water in a well or of drilling fluid in an open borehole. Because resistivity is inversely related to the concentration of dissolved solids in water, this log is used to estimate ground-water salinity and dissolved-solids concentration and to determine the depth of the freshwater/saltwater interface in aquifers that have been intruded by saltwater.



Geophysical logs from a well in Orangeburg County, and corresponding lithology.

Some digitized geophysical logs can be found on the DNR Hydrology website at [https://www.dnr.sc.gov/hydro/gl\\_home.html](https://www.dnr.sc.gov/hydro/gl_home.html). Paper copies of all logs are available from the DNR Hydrology Section.

For additional information, contact Joe Gellici ([gellicij@dnr.sc.gov](mailto:gellicij@dnr.sc.gov)) or Andrew Wachob ([wachoba@dnr.sc.gov](mailto:wachoba@dnr.sc.gov)).