AN INDEX OF GEOPHYSICAL WELL LOGGING IN VIRGINIA BY THE U.S. GEOLOGICAL SURVEY

By

M. Patrick Mulheren, J. D. Larson, and H. T. Hopkins

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UNITED STATES DEPARTMENT OF THE INTERIOR

James W. Watt, Secretary

GEOLOGICAL SURVEY

Dallas L. Peck, Director

For additional information write to:

U.S. Geological Survey
200 West Grace Street, Room 304
Richmond, Virginia 23220

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AN INDEX OF GEOPHYSICAL WELL LOGGING IN VIRGINIA BY THE U.S. GEOLOGICAL SURVEY

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ABSTRACT

Geophysical logs have been obtained in more than 170 wells in Virginia by the U.S. Geological Survey since 1968. These logs include natural gamma, electric, caliper, temperature, fluid conductivity, and fluid velocity. Most of the logs are for wells in the Coastal Plain Province of eastern Virginia. Geophysical logs aid in the interpretation of properties of earth materials, including the capacity to store and transmit water in the immediate vicinity of the well bore.

INTRODUCTION

The U.S. Geological Survey uses geophysical logging as an aid to understanding the properties of earth materials, specifically how these materials store and transmit water. Geophysical data are obtained by lowering sensing devices into a well bore and measuring a physical characteristic of the well bore, the material encountered, or the fluids contained in the rocks (fig. 1). The Virginia District has maintained geophysical logging equipment since 1968. More than 170 wells have been logged by this unit throughout the state, with major emphasis on the Coastal Plain Province.

PURPOSE AND SCOPE

The purpose of this report is to list and report the availability of geophysical well logs by the Geological Survey in Virginia. The logs documented in this report are on file at the District Office of the WRD in Richmond, Virginia. The logs are not interpreted.

WELL-NUMBERING SYSTEM

The well-numbering system used by the U.S. Geological Survey in Virginia is based on the "Index to Topographic Maps of Virginia" (U.S. Geological Survey, 1975). Quadrangles (map sheets covering 7½-minutes of latitude and longitude, published at a scale of 1:24,000 or 1 inch = 2000

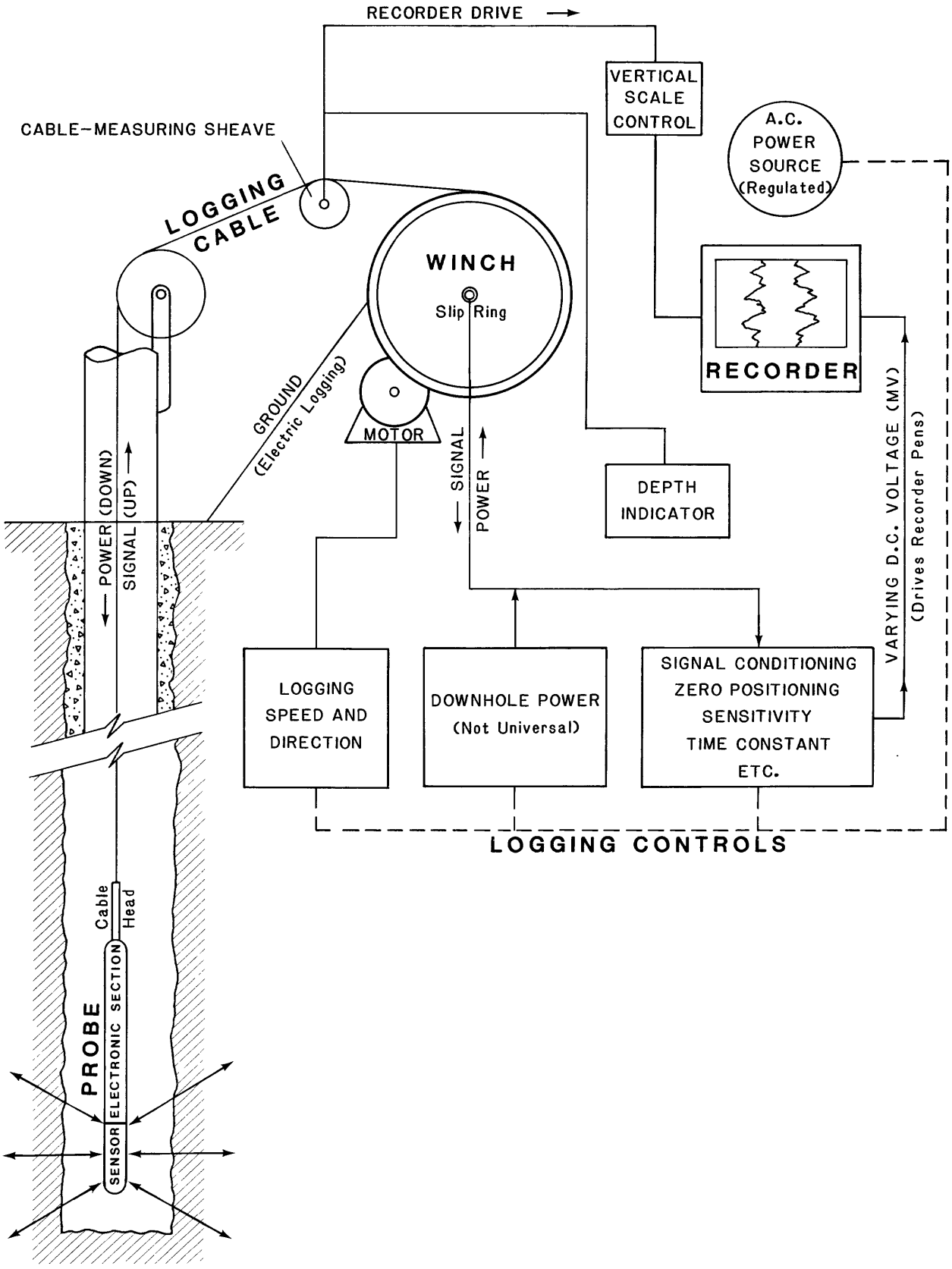

Figure 1. -- Schematic block diagram of geophysical well-logging equipment (from Keys and MacCary, 1971).

feet) are identified by numbers and letters starting in the southwest corner of the State. The quadrangles are numbered 1 through 69 from west to east beginning at longitude 83°45', and lettered A through Z (omitting letters I and O) from south to north, beginning at latitude 36°30'. These numbers and letters are shown in the bottom and left margins of figure 2, which shows a small portion of the state. Wells are numbered serially within each 7½-minute quadrangle. For example, well 53A 2 is in quadrangle 53A and is the second well in that quadrangle for which the location and other data were recorded.

COOPERATION AND ACKNOWLEDGEMENTS

This compilation of logs was made by the U.S. Geological Survey in cooperation with the Virginia State Water Control Board, R. V. Davis, Executive Secretary.

GEOPHYSICAL LOGS

The Virginia District has a vehicle-mounted geophysical logging unit with natural gamma, electric (single point), caliper, temperature and fluid conductivity probes. In addition to these probes, the unit has a downhole velocity meter and a thief sampler. The downhole velocity meter measures water velocities in the bore hole during pumping or injection to determine which zones are yielding or accepting

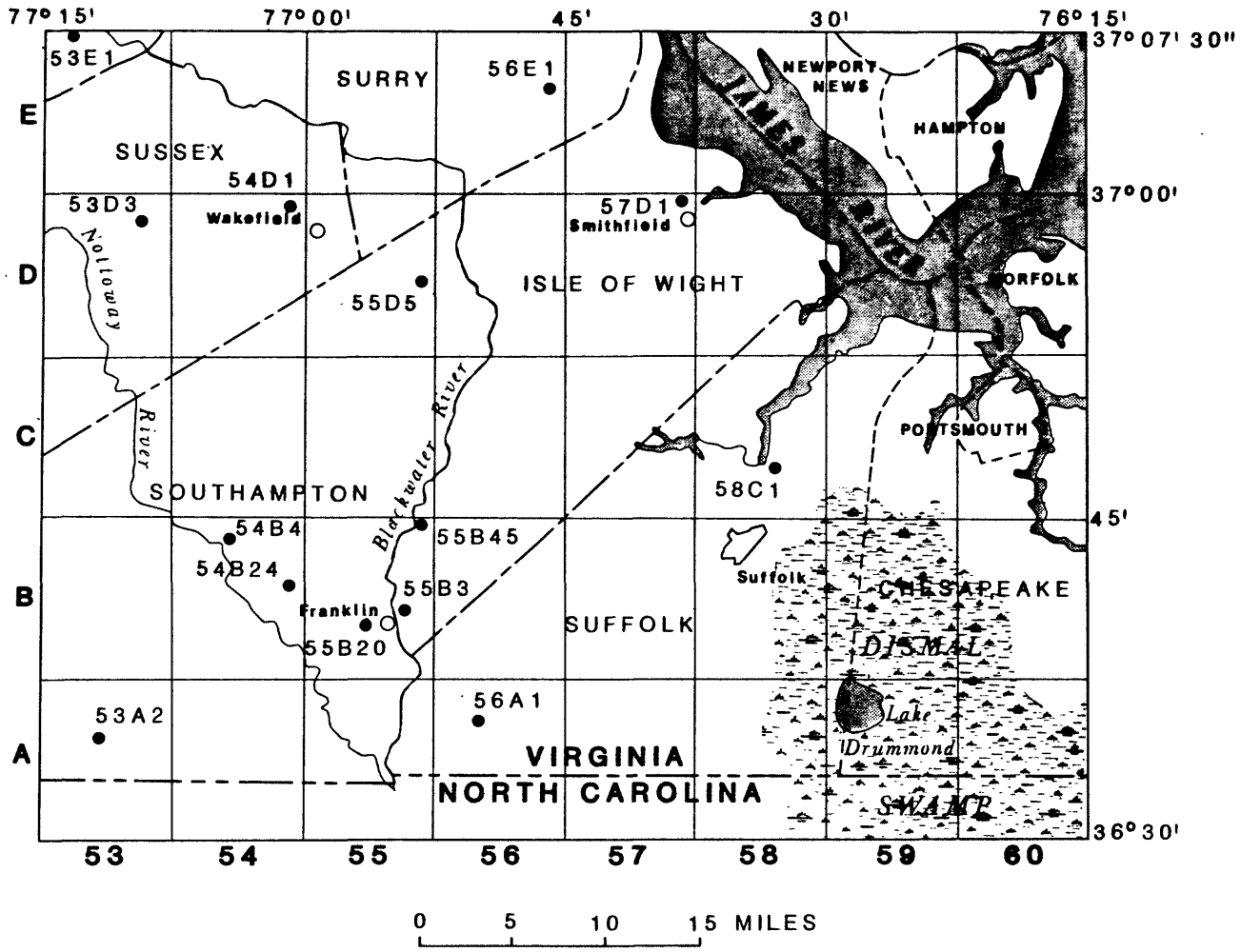

Figure 2. -- Map showing example of Virginia well-numbering system.

water. The thief sampler is used to collect water samples at discrete zones.

Descriptions of the individual logs are given below, as is their use in geologic and water-resources investigations. The principles and applications of each type of log are discussed in detail in "Application of borehole geophysics to water-resources investigations" (Keys and MacCary, 1971). The letter following the name of the log is used in the table to identify the log type.

1) Natural-Gamma Log (J). "Natural-gamma logs are records of the amount of natural-gamma radiation that is emitted by all rocks. The chief use of natural-gamma logs is for the identification of lithology and stratigraphic correlation in open or cased, liquid- or air-filled holes" (Keys and MacCary, 1971, p. 64).

2) Electric Log (E). The electric log combines the spontaneous-potential log and the resistivity log.

    a) Spontaneous-Potential Log. "Spontaneous-potential logs are records of the natural potentials developed between the borehole fluid and the surrounding rock materials. The spontaneous-potential is used chiefly for geologic correlation, determination of bed thickness, and separating non-porous from porous rocks in

shale-sandstone and shale-carbonate sequences" (Keys and MacCary, 1971, p. 23).

b) Resistivity Log. "Resistivity-logging devices measure the electrical resistivity of a known or assumed volume of earth materials under the direct application of an electric current. Depending on the device employed, resistivity logs can be used for geologic correlation, although this is not the most important application. Resistivity devices are generally used to determine the formation resistivity, formation porosity, mud porosity, hydrocarbon and water saturation, fluid resistivity, and formation factor" (Keys and MacCary, 1971, p. 37).

3) Caliper Log (C). "The caliper log is a record of the average diameter of a drill hole. Its major use is to evaluate the environment in which other logs are made in order to correct them for hole-diameter effects and to provide information on lithology" (Keys and MacCary, 1971, p.37).

4) Temperature Log (T). "Temperature logs are continuous records of the temperature of the environment immediately surrounding a sensor in a borehole. They can provide information of the source and movement of water

and the thermal conductivity of rocks" (Keys and MacCary, 1971, p. 99).

5) Fluid-Conductivity Log (F). "Fluid-conductivity logs provide a measurement of the conductivity of the inhole liquid between electrodes in the probe. After appropriate corrections, the logs provide data on the chemical quality of fluid in a bore-hole" (Keys and MacCary, 1971, p. 106).

Two non-geophysical logs listed in this report are used in conjunction with geophysical logs and are based on cuttings and (or) samples collected during drilling. They are:

(1) Driller's Log (D). This is the driller's description of materials observed during drilling.

(2) Geologist's Log (G). This log, made by a trained geologist or hydrologist, identifies and describes the geologic formation observed during drilling.

Figure 3 shows data from a well drilled at the U.S. Geological Survey's National Headquarters in Fairfax County, Virginia, in which geophysical logs were utilized with rock samples collected to describe the formations (Larson, 1978). A good correlation exists between the lithologic, electric, and caliper logs. The caliper and resistivity logs show sharp peaks to the right in sandy zones, which appear as

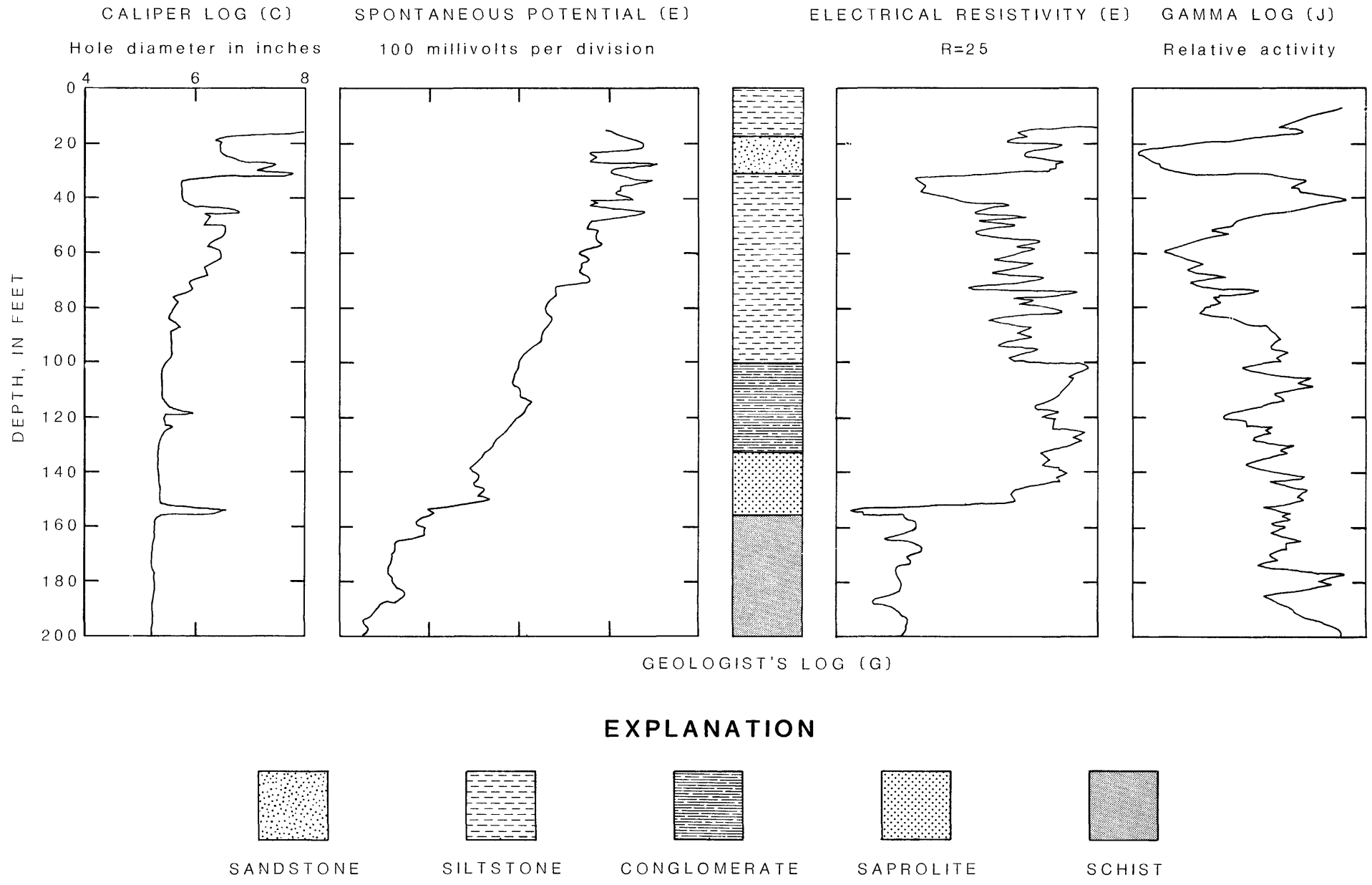

Figure 3. -- Lithologic and geophysical logs of observation well No. 52V-2 at the U.S. Geological Survey's National Center, Fairfax County, Virginia (from Larson, 1978).

large-diameter, washed out zones on the caliper log. The contact between saprolite and unweathered schist is very pronounced on these logs. The peak on the caliper logs shows a wash-out zone at 150 feet; this peak is a thin sand layer commonly found at the base of saprolite. The gamma log shows distinctive drops across sandstone layers and peaks across siltstones.

STATUS OF GEOPHYSICAL LOGGING IN VIRGINIA

Figure 4 is a map of Virginia showing the location of holes logged. The Geological Survey office in Richmond, Virginia has more detailed locations of the sites.

Table 1 is a listing of the geophysical logs obtained by the Virginia District, U.S. Geological Survey. The data are listed by county, the U.S. Geological Survey local well number, latitude, longitude, depth of finished well, log type, and depths to top and bottom of logged interval. An explanation of log type follows:

J Natural-gamma log

E Electric log

C Caliper log

T Temperature log

F Fluid conductivity log

D Driller's log

G Geologist's log

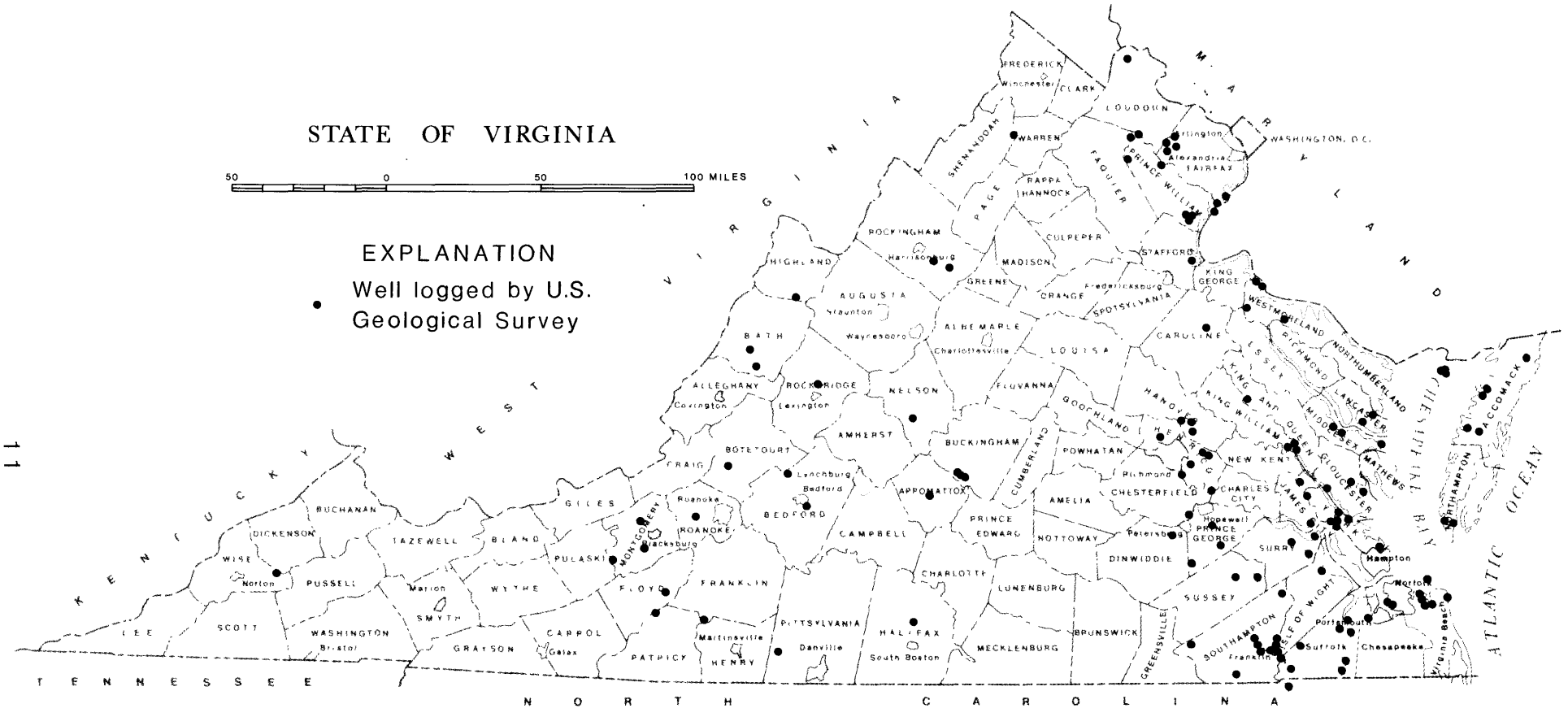

Figure 4. -- Map of Virginia showing general location of wells logged by U.S. Geological Survey.

LOCAL-NUMBER	LONGITUDE	LATITUDE	COUNTY	HOLE-DEPTH (FT)	LOG-TYPE	LOG-TOP (FT BELOW LAND SURFACE)	LOG-BOTTOM (FT BELOW LAND SURFACE)
63L 1	755947	374948	Accomack	991.00	J	3.00	987.00
					G	.00	990.00
63L 4	755945	374940		1033.00	J	.00	1033.00
63L 5	755931	374921		920.00	J	.00	920.00
64J 1	754638	373600		460.00	E		
					J	2.00	420.00
					D	.00	460.00
64K 7	755225	373845		400.00	C	4.40	371.00
					D	.00	340.00
					E	5.40	385.00
					J	3.70	374.00
					E		
65K 2	754432	374324		350.00	D	.00	350.00
					J	6.00	184.00
65K 23	754328	374438		400.00	C	8.70	292.00
					D	.00	400.00
					E	9.90	260.00
					J	11.30	292.00
66L 1	753217	375225		390.00	C	4.00	377.00
					D	.00	390.00
					E	4.00	380.00
					J	2.60	382.00
40G 1 SOW 12	784937	372133	Appomattox	288.00	C	3.40	272.00
					E	88.00	270.00
					J	2.20	272.00

Table 1.--Listing of Geophysical Logs in Virginia by the U.S. Geological Survey, WRD

LOCAL-NUMBER	LONGITUDE	LATITUDE	COUNTY	HOLE-DEPTH (FT)	LOG-TYPE	LOG-TOP (FT BELOW LAND SURFACE)	LOG-BOTTOM (FT BELOW LAND SURFACE)
41H 2	783943	372514		73.00	D	.00	55.50
					J	4.70	69.30
41H 7	783840	372454		45.00	G	.00	45.00
					J	5.00	36.00
					Z	.00	45.00
32M 1 SOW 13	794730	375455	Bath	336.00	C	3.70	311.00
					D	.00	336.00
					E	49.00	332.00
					J	.00	332.00
32M 2	794921	375956		756.00	C	4.70	732.00
					E	126.50	700.00
					F	130.00	755.00
					J	4.60	750.00
					T	40.00	755.00
34G 1 SOW 7	793058	371809	Bedford	241.00	C	4.80	240.00
					E	61.00	240.00
					J	3.40	240.00
31H 1 SOW 14	795841	372744	Botetourt	399.00	C	5.00	372.00
					E	18.00	372.00
					J	3.00	372.00
41H 1	783921	372541	Buckingham	88.00	J	4.00	85.00
41H 3	784046	372608		54.00	D	.00	55.50
					J	3.70	49.30
41H 4	783740	372519		77.00	J	4.00	70.80

Table 1.--Listing of Geophysical Logs in Virginia by the U.S. Geological Survey, WRD--Continued

LOCAL-NUMBER	LONGITUDE	LATITUDE	COUNTY	HOLE-DEPTH (FT)	LOG-TYPE	LOG-TOP (FT BELOW LAND SURFACE)	LOG-BOTTOM (FT BELOW LAND SURFACE)
52N 1 SOW 32	771829	380249	Caroline	278.00	C	5.00	278.00
					E	102.00	278.00
					J	4.00	278.00
54G 10 SOW 66A	770552	371956	Charles City	600.00	C	5.50	596.00
					E	20.00	600.00
					J	6.30	597.40
54G 11 SOW 66	770552	371956		594.00	C	8.80	532.00
					D	.00	591.00
					G	.00	550.00
59C 7	762451	364703	Chesapeake	1540.00			
					F	6.10	1234.00
					T	6.10	1234.00
					G	.00	1510.00
51H 6	772531	372516	Chesterfield	205.00	D	.00	205.00
					E	20.00	120.00
					J	10.00	120.00
52G 2	771728	372054		286.00	E	70.00	284.00
51G 1 OW	772446	371644	Colonial Heights	100.00	C	9.80	99.20
					E	.00	100.00
					J	6.00	99.20
					D	.00	100.00
50F 1	773051	370954	Dinwiddie	310.00	C	8.00	304.00
					E	40.20	310.00
					J	8.00	308.00
					T	10.00	306.00

Table 1.--Listing of Geophysical Logs in Virginia by the U.S. Geological Survey, WRD--Continued

LOCAL-NUMBER	LONGITUDE	LATITUDE	COUNTY	HOLE-DEPTH (FT)	LOG-TYPE	LOG-TOP (FT BELOW	LOG-BOTTOM LAND SURFACE)
51U 13	772755	385205	Fairfax	650.00	C	.00	650.00
					G	.00	650.00
51V 4J	772340	385321		309.00	C	10.00	309.00
					E	90.00	309.00
					C	8.00	204.00
52V 2	772201	385658		204.00	E	14.00	204.00
					J	7.00	204.00
					C	14.00	204.00
					G	0.00	204.00
52V 18	772155	385651		205.00	C	1.90	205.00
					F	2.00	205.00
					G	.00	205.00
					J	2.20	203.00
					T	5.30	205.00
53T 51	770934	383956		506.50	D	.00	506.00
					E	30.00	400.00
					J	4.00	410.00
49V 40	774127	385551	Fauquier	500.00	C	8.00	164.00
					E	10.00	165.00
					J	4.00	164.00
28D 1 SOW 20	801904	365436	Floyd	89.50	C	3.90	88.50
					E	60.00	89.50
					J	2.00	88.50
55B 20	765618	364014	Franklin	604.00	D	17.00	604.00
					E	24.00	596.00

Table 1.--Listing of Geophysical Logs in Virginia by the U.S. Geological Survey, WRD--Continued

LOCAL-NUMBER	LONGITUDE	LATITUDE	COUNTY	HOLE-DEPTH (FT)	LOG-TYPE	LOG-TOP (FT BELOW LAND SURFACE)	LOG-BOTTOM (FT BELOW LAND SURFACE)
58G 7	763042	371856	Gloucester	40.07	J	1.60	40.00
					D	.00	56.00
58G 8	763042	371856		41.00	J	.60	38.50
58G 9	763042	371856		40.71	J	.00	40.10
58G 10	763039	371854		38.68	J	.10	38.30
58G 11	763043	371854		33.77	J	.00	33.80
59G 3	762414	371800		130.00	E	6.00	126.50
					J	7.00	127.00
39C 1 SOW 11	785623	364550	Halifax	302.00	C	4.00	299.00
					E	4.50	301.00
					J	1.70	302.00
51K 1	772513	374123	Hanover	300.00	J	4.90	203.00
51K 6	772530	374134		632.00	C	6.60	548.00
					D	.00	632.00
					J	4.70	552.00
52J 17	772030	373644		369.50	D	.00	368.00
					E	5.00	368.50
					J	7.00	369.50
52K 8	772000	373859		390.00	C	2.00	388.00
					D	.00	380.00
					E	9.20	388.00
					J	5.00	388.00

Table 1.--Listing of Geophysical Logs in Virginia by the U.S. Geological Survey, WRD--Continued

LOCAL-NUMBER	LONGITUDE	LATITUDE	COUNTY	HOLE-DEPTH (FT)	LOG-TYPE	LOG-TOP (FT BELOW LAND SURFACE)	LOG-BOTTOM (FT BELOW LAND SURFACE)
50J 1 SOW 23	773314	373607	Henrico	300.00	C	3.50	296.00
					E	6.00	300.00
					J	2.00	300.00
52H 3	772111	372936		345.00	C	10.00	299.00
					D	.00	340.00
					E	2.00	298.80
					J	2.50	304.40
52J 4	771843	373151		316.00	C	164.00	312.00
					D	.00	310.00
					E	14.00	312.00
					J	2.10	312.00
52J 12 SOW 71	771637	373112		610.00	C	3.80	584.00
					D	.00	610.00
					J	2.20	586.00
34P 1 SOW 26	793540	381250	Highland	200.00	C	6.80	132.00
					D	.00	200.00
					E	64.00	106.00
					J	5.20	132.00
55B 3	765419	364046	Isle of Wight	755.00	D	.00	755.00
					J	.00	608.00
55B 16	765449	364059		311.00	C	5.00	300.00
					D	.00	311.00
					E	120.00	301.00
					J	5.00	301.00
55B 24	765357	364138		180.00	D	.00	180.00
					J	4.00	180.00

Table 1.--Listing of Geophysical Logs in Virginia by the U.S. Geological Survey, WRD--Continued

LOCAL-NUMBER	LONGITUDE	LATITUDE	COUNTY	HOLE-DEPTH (FT)	LOG-TYPE	LOG-TOP (FT BELOW LAND SURFACE)	LOG-BOTTOM
55B 26	765429	364353		849.00	C	15.00	748.00
					D	.00	849.00
					E	41.00	825.00
					J	10.00	823.00
55B 27	765422	364404		832.00	C	7.50	656.00
					E	320.00	656.00
					J	5.60	590.00
					D	.00	832.00
55B 28	765414	364415		833.00	C	5.00	800.00
					E	41.00	814.00
					J	3.00	814.00
					D	.00	832.00
55B 35	765450	364116		628.00	C	4.00	620.00
					E	180.00	622.40
					J	1.00	620.00
55B 36	765448	364125		860.00	C	3.30	848.00
					E	176.00	848.00
					J	1.80	848.00
55B 45 SOW 33	765327	364425		348.00	C	2.00	343.00
					E	4.00	368.00
					J	6.00	345.00
55B 59	765340	363846		822.00	A	.00	822.00
					D	.00	822.00
					E	365.00	818.00
					J	4.70	741.00
					C	38.00	811.00

Table 1.--Listing of Geophysical Logs in Virginia by the U.S. Geological Survey, WRD--Continued

LOCAL-NUMBER	LONGITUDE	LATITUDE	COUNTY	HOLE-DEPTH (FT)	LOG-TYPE	LOG-TOP (FT BELOW LAND SURFACE)	LOG-BOTTOM (FT BELOW LAND SURFACE)
57D 1 SOW 5	763753	365942		800.00	C	8.00	448.00
					D	.00	800.00
					E	80.00	454.00
					J	8.00	450.00
56F 1 SOW 18	764636	371311	James City	346.00	C	10.00	337.00
					E	44.00	337.00
					J	10.00	337.00
					D	.00	346.00
56H 20 OW	764804	372313		660.00	C	20.00	648.00
					E	.00	649.00
					D	.00	660.00
					J	4.00	650.00
57G 1 SOW 1	764418	371749		605.00	D	.00	605.00
					E	2.00	550.00
					G	.00	591.00
					C	10.00	550.00
					J	8.00	553.00
					F	150.00	549.00
58F 15	763638	371151		563.00	D	.00	563.00
					C	4.20	410.00
					F	97.00	414.00
					J	2.00	414.00
					T	5.60	414.00
58F 23	763628	371122		530.00	D	.00	530.00
					C	4.20	420.00
					F	80.00	420.00
					J	2.00	420.00
					T	5.60	420.00

Table 1.--Listing of Geophysical Logs in Virginia by the U.S. Geological Survey, WRD--Continued

LOCAL-NUMBER	LONGITUDE	LATITUDE	COUNTY	HOLE-DEPTH (FT)	LOG-TYPE	LOG-TOP (FT BELOW	LOG-BOTTOM LAND SURFACE)
54K 6 SOW 64	770128	374328	King and Queen	390.00	C	.00	348.00
					J	.00	349.00
					D	.00	377.00
56J 1	764819	373238	King William	852.00	C	8.00	850.00
					D	.00	852.00
					E	123.00	844.00
					J	2.00	850.00
56J 2	764812	373226		667.50	D	.00	667.50
					J	8.00	268.00
56J 3	764757	373232		763.00	D	.00	763.00
					J	3.00	267.00
56J 4	764845	373303		811.00	D	.00	811.00
					E	180.00	805.00
					F	140.00	696.00
					J	4.00	700.00
					T	8.00	700.00
56J 5	764830	373246		1689.00	D	.00	1689.00
					F	80.00	1228.00
					J	5.80	1228.00
					T	4.10	1228.00
56J 8	764820	373234		640.00	C	40.00	620.00
					D	.00	640.00
					E	136.00	612.00
					J	2.10	616.00
56J 12	764832	373249		900.00	D	.00	900.00
					F	126.72	698.00

Table 1.--Listing of Geophysical Logs in Virginia by the U.S. Geological Survey, WRD--Continued

LOCAL-NUMBER	LONGITUDE	LATITUDE	COUNTY	HOLE-DEPTH (FT)	LOG-TYPE	LOG-TOP (FT BELOW	LOG-BOTTOM LAND SURFACE)
					J	1.00	750.00
					T	2.00	750.00
					C	1.30	696.00
56J 13	764904	373317		1315.00	C	.00	1292.00
					E	4.00	1306.00
					J	.00	1313.00
56J 15	764817	373216		709.00	D	.00	709.00
					J	.00	662.00
56J 19	764812	373206		450.00	C	3.40	395.00
					D	.00	450.00
					F	113.00	395.00
					J	7.60	400.10
					T	100.00	395.00
56J 20	764812	373206		163.00	C	4.70	159.00
					D	.00	163.00
					F	20.00	159.40
					J	3.30	160.00
					T	20.00	159.40
56J 21	764824	373224		338.00	D	.00	335.00
					C	4.70	337.20
					F	113.00	337.00
					J	2.70	333.00
					T	10.00	337.80
59K 1 SOW 15	762301	374249	Lancaster	727.00	D	.00	716.00
					E	5.10	726.00
					J	6.00	727.00

Table 1.--Listing of Geophysical Logs in Virginia by the U.S. Geological Survey, WRD--Continued

LOCAL-NUMBER	LONGITUDE	LATITUDE	COUNTY	HOLE-DEPTH (FT)	LOG-TYPE	LOG-TOP (FT BELOW LAND SURFACE)	LOG-BOTTOM
59K 8	762614	374035		677.00	J	.00	673.00
49Y 1 SOW 22	774238	391542	Loudoun	516.00	E	44.00	476.00
					D	.00	516.00
51V 3E	772712	385617		1020.00	C	6.00	1000.00
					E	36.00	894.00
					J	8.00	1014.00
					T	20.00	960.00
58J 5	763126	373630	Middlesex	742.00	D	.00	742.00
					E	.00	742.00
58K 1 SOW 31	763425	373809		552.00	C	4.00	552.00
					J	8.00	552.00
60J 2	761759	373324		792.00	J	8.10	224.00
27F 1	802536	371346	Montgomery	486.00	C	8.00	486.00
					E	16.00	486.00
					J	3.30	486.00
27F 2 SOW 19	802619	370812		450.00	C	5.20	440.00
					E	39.00	445.60
					J	4.50	444.00
39K 1 SOW 6	785556	374224	Nelson	275.00	C	7.00	268.00
					G	.00	275.00
					J	2.50	270.00
54H 1	770210	372739	New Kent	367.00	E	146.00	310.00
					J	3.10	310.00

Table 1.--Listing of Geophysical Logs in Virginia by the U.S. Geological Survey, WRD--Continued

LOCAL-NUMBER	LONGITUDE	LATITUDE	COUNTY	HOLE-DEPTH (FT)	LOG-TYPE	LOG-TOP (FT BELOW LAND SURFACE)	LOG-BOTTOM (FT BELOW LAND SURFACE)
55H 1 SOW 17	765615	372428		778.00	C	8.00	622.00
					D	.00	717.00
					E	5.00	778.00
					J	3.00	642.00
58F 1 SOW 2	763356	371027	Newport News	443.00	C	9.40	440.00
					J	5.00	425.00
58F 2	763500	371154		526.00	C	5.00	500.00
					D	.00	526.00
					J	3.50	508.00
59E 5	762243	370538		2092.00	D	.00	2091.00
					E	.00	2091.00
					I	.00	2091.00
					J	.00	2091.00
60C 1	761725	365046	Norfolk	780.00	C	6.00	400.00
					E	16.00	680.00
					J	.00	780.00
60C 2	761725	365046		763.00	J	6.00	738.00
60C 3	761725	365046		822.00	J	10.00	818.00
60C 4	761725	365046		783.00	C	214.00	540.00
					E	230.00	781.00
					J	3.00	783.00
60C 5	761730	365051		765.00	J	2.00	740.00
61C 1 OW	761221	365223		2587.50	C	256.00	2220.00
					D	.00	2587.00

Table 1.--Listing of Geophysical Logs in Virginia by the U.S. Geological Survey, WRD--Continued

LOCAL-NUMBER	LONGITUDE	LATITUDE	COUNTY	HOLE-DEPTH (FT)	LOG-TYPE	LOG-TOP (FT BELOW LAND SURFACE)	LOG-BOTTOM
					E	242.00	2470.00
					G	100.00	2587.00
					J	4.00	2582.00
					L	100.00	2580.00
					N	32.00	2582.00
					U	.00	2584.00
61C 2	761215	365221		1019.00	C	14.00	1002.00
					E	90.00	1015.00
					J	.00	1016.00
					G	.00	1019.00
61C 3	761215	365221		1002.00	C	22.00	1000.00
					E	75.00	996.00
					J	10.00	1002.00
					G	.00	995.00
61C 4	761215	365221		1016.00	E	14.00	998.00
					J	.00	1016.00
61C 5	761213	365221		1762.00	D	.00	1762.00
					J	.00	1016.00
					E	119.00	1016.00
61C 8	761128	365038		1065.00	J	3.00	1027.00
63F 1	755732	371159	Northampton	470.00	D	.00	470.00
					J	3.00	460.00
63F 16	755835	371307		301.00	C	3.00	282.00
					D	.00	301.00
					E	1.60	291.00
					J	1.50	287.00

Table 1.--Listing of Geophysical Logs in Virginia by the U.S. Geological Survey, WRD--Continued

LOCAL-NUMBER			LONGITUDE	LATITUDE	COUNTY	HOLE-DEPTH (FT)	LOG-TYPE	LOG-TOP (FT BELOW LAND SURFACE)	LOG-BOTTOM
28C	3		802159	364801	Patrick	200.00	G	.00	200.00
30C	1	SOW 10	800703	364732		250.00	C	4.50	247.00
							E	12.00	250.00
							G	.00	250.00
							J	3.00	250.00
33B	1		793954	363843	Pittsylvania	658.00	C	9.20	656.00
							D	.00	650.00
							E	46.60	658.00
							J	7.50	657.20
60C	7		761917	365115	Portsmouth	1459.00	D	.00	1459.00
							G	.00	1372.00
							E	2.00	1454.00
							J	.00	1450.00
51E	1	SOW 41	772341	370221	Prince George	127.00	C	7.00	127.00
							J	6.00	126.00
52F	1	SOW 38	771719	371315		180.00	C	8.00	180.00
							E	70.00	179.00
							J	3.00	180.00
53E	1	SOW 37	771346	370730		146.00	C	5.00	145.00
							E	51.00	145.00
							J	3.00	145.00
49U	1		774208	384930	Prince William	345.00	C	4.00	330.00
							D	.00	345.00
							E	6.00	344.00
							J	3.00	342.00

Table 1.--Listing of Geophysical Logs in Virginia by the U.S. Geological Survey, WRD--Continued

LOCAL-NUMBER	LONGITUDE	LATITUDE	COUNTY	HOLE-DEPTH (FT)	LOG-TYPE	LOG-TOP (FT BELOW	LOG-BOTTOM LAND SURFACE)
49V 1	773811	385607		165.00	C	8.00	164.00
					D	.00	165.00
					E	8.00	165.00
					J	4.00	164.00
50U 1F	773206	384904		402.30	C	6.00	402.00
					D	.00	402.00
					E	60.00	402.00
					J	3.20	402.00
					T	84.00	402.00
51S 2	772506	383441		101.00	C	8.00	100.70
					D	.00	100.00
					E	7.20	101.00
					J	5.00	101.00
51S 4	772457	383500		199.50	C	5.00	196.00
					E	25.80	197.70
					J	2.70	199.00
51S 7	772459	383423		490.00	C	4.00	489.70
					D	.00	490.00
					J	2.00	489.30
					E	2.00	488.00
					T	4.00	488.90
51S 8	772250	383453		250.00	C	5.00	247.40
					J	3.90	248.30
51S 9	772251	383506		190.00	C	6.00	187.60
					E	37.00	189.00
					J	4.00	189.30
					T	5.00	189.20

Table 1.--Listing of Geophysical Logs in Virginia by the U.S. Geological Survey, WRD--Continued

LOCAL-NUMBER	LONGITUDE	LATITUDE	COUNTY	HOLE-DEPTH (FT)	LOG-TYPE	LOG-TOP (FT BELOW LAND SURFACE)	LOG-BOTTOM (FT BELOW LAND SURFACE)
52S 1	772131	383624		200.00	C	6.00	200.00
					E	95.00	200.00
					J	5.70	200.00
					E	9.80	200.00
					J	9.90	202.00
52S 3	772206	383343		103.00	C	4.75	101.20
					E	6.90	103.00
					J	7.00	101.30
52S 4	771513	383634		242.00	C	8.00	232.00
					E	5.30	240.00
					G	.00	242.00
					J	5.40	236.00
52S 5	771513	383634			E	21.00	116.00
52S 16 OW	772109	383535		550.00	C	3.50	43.60
					J	2.80	45.80
52S 17	772056	383356		108.00	C	5.80	70.70
					E	40.00	71.10
					J	3.90	71.10
52S 29	772216	383551		350.00	C	.00	350.00
					D	.00	350.00
					E	.20	350.00
					F	4.00	350.50
					J	2.00	350.50
52S 30	772048	383330		310.00	C	7.00	159.50
					E	5.00	160.00
					J	6.00	160.20

Table 1.--Listing of Geophysical Logs in Virginia by the U.S. Geological Survey, WRD--Continued

LOCAL-NUMBER	LONGITUDE	LATITUDE	COUNTY	HOLE-DEPTH (FT)	LOG-TYPE	LOG-TOP (FT BELOW	LOG-BOTTOM LAND SURFACE)
53T 2 SOW 29	771355	383830		162.00	C	.00	156.00
					D	.00	160.00
					E	.00	160.00
					J	.00	160.00
25E 1 SOW 9	803744	370254	Pulaski	319.00	C	6.00	318.00
					E	56.00	318.00
					G	.00	319.00
					D	.00	319.00
					J	4.00	318.00
29G 1	800818	371706	Roanoke	408.00	C	5.50	360.00
					D	.00	408.00
					E	160.50	360.00
					F	56.50	364.20
					J	6.80	360.00
					T	40.00	364.20
35L 1	792613	374946	Rockbridge	612.00	C	5.00	612.00
					E	292.00	612.00
					J	5.00	612.00
40R 1	784900	382339	Rockingham	392.00	C	5.50	390.00
					D	.00	300.00
					E	69.50	392.00
					J	6.00	392.00
41Q 1	784240	382150		310.00	C	4.00	309.00
					E	82.00	309.40
					J	4.00	309.50
43V 1	781955	385540	Shenandoah	1124.00	C	60.00	1124.00
					E	36.00	1124.00
					J	20.00	1124.00

Table 1.--Listing of Geophysical Logs in Virginia by the U.S. Geological Survey, WRD--Continued

LOCAL-NUMBER		LONGITUDE	LATITUDE	COUNTY	HOLE-DEPTH (FT)	LOG-TYPE	LOG-TOP (FT BELOW LAND SURFACE)	LOG-BOTTOM
51B 3		772307	364109	Southampton	253.00	C	2.00	250.00
						E	2.00	252.00
						J	2.40	252.00
53A 2		771149	363457		269.80	C	10.00	269.00
						E	5.00	269.80
						J	3.60	269.80
54B 4		770410	364307		238.00	C	2.80	225.00
						E	78.00	226.00
						J	2.30	225.00
54B 6		770013	363915		760.00	D	.00	760.00
						E	6.00	760.00
						J	6.50	677.70
54B 24	SOW 34	770137	364121		224.00			
						J	2.30	224.00
55D 5		765320	365415		516.00	C	5.00	442.00
						D	.00	516.00
						E	.00	508.00
						J	.00	445.00
51Q 1		772232	382220	Stafford	332.00	C	.00	332.00
						D	.00	330.00
						E	.00	330.00
						J	.00	331.00
56A 1	SOW 47	764929	363511	Suffolk	1149.50	D	.00	1149.60
						E	12.30	1148.00
						F	9.00	1149.60
						J	6.00	1156.00
						T	3.70	1154.00

Table 1.--Listing of Geophysical Logs in Virginia by the U.S. Geological Survey, WRD--Continued

LOCAL-NUMBER	LONGITUDE	LATITUDE	COUNTY	HOLE-DEPTH (FT)	LOG-TYPE	LOG-TOP (FT BELOW LAND SURFACE)	LOG-BOTTOM (FT BELOW LAND SURFACE)
56A 9 SOW 76	765226	363625		1063.40	C	2.50	1063.00
					D	.00	1063.00
					E	.20	1063.40
					J	6.00	1063.00
					T	6.00	1014.00
56B 7	764556	364051		511.00	C	6.00	480.00
					D	.00	511.00
					E	18.00	485.00
					J	4.00	480.00
58A 1 SOW 36	763345	363702		420.00	C	6.00	395.00
					J	4.00	410.00
					D	.00	380.00
58A 2 SOW 42	763500	363409		2017.00	D	.00	2017.00
					E	2.00	1840.00
					F	200.00	1800.00
					G	2.00	2017.00
					J	1.00	1833.00
					T	22.00	1800.00
58B 4	763451	364333		604.00	D	.00	603.50
58B114	763148	364301		569.90	J	3.30	568.00
58B238 OW	763039	363803		6.06	D	.00	6.06
58C 1 SOW 4	763232	364635		1024.00	C	6.00	876.00
					E	47.70	877.00
					J	4.00	876.00
					D	.00	1024.00

Table 1.--Listing of Geophysical Logs in Virginia by the U.S. Geological Survey, WRD--Continued

LOCAL-NUMBER	LONGITUDE	LATITUDE	COUNTY	HOLE-DEPTH (FT)	LOG-TYPE	LOG-TOP (FT BELOW LAND SURFACE)	LOG-BOTTOM (FT BELOW LAND SURFACE)
56E 1 OW	764601	370408	Surry	799.00	C	9.00	702.00
					D	.00	798.00
					E	333.00	700.00
					G	291.00	411.00
					J	7.00	700.00
56F 2 SOW 39	765007	370800		367.00	C	6.00	367.00
					J	9.00	367.00
57F 1 SOW 40	764349	370839		288.00	C	10.00	288.00
					E	40.00	288.00
					J	2.00	288.00
53D 3 SOW 48	770902	365843	Sussex	554.00	C	5.00	550.00
					D	.00	554.00
					E	4.80	554.00
					J	.00	554.00
54D 1	770021	365845		840.00	C	10.00	784.00
					E	10.00	832.00
					J	10.00	838.00
54D 3 SOW 43	770133	365928		218.00	C	4.00	218.00
					J	3.00	218.00
61C 12	760757	365050	Virginia Beach	125.00	D	.00	125.00
					J	2.90	121.20
61C 20	760757	365050		200.00	J	2.00	194.70
61D 2	761117	365333		1142.00	D	.00	1142.00
					E	70.00	1140.80
					J	3.90	1121.50

Table 1.--Listing of Geophysical Logs in Virginia by the U.S. Geological Survey, WRD--Continued

LOCAL-NUMBER	LONGITUDE	LATITUDE	COUNTY	HOLE-DEPTH (FT)	LOG-TYPE	LOG-TOP (FT BELOW	LOG-BOTTOM LAND SURFACE)
62D 2	760647	365759		1502.00	D	.00	1502.00
					J	120.00	1389.00
					E	11.00	586.00
63C 1	755851	365200		1593.00	D	.00	1593.00
					J	.00	1307.00
54P 3	770219	381010	Westmoreland	1385.50	C	.00	1352.00
					N	.00	1352.00
					E	70.00	1346.00
					D	80.00	1385.50
					J	.00	1356.00
					T	.00	1356.00
					U	.00	1352.00
55P 3	765531	381122		814.00	E	40.00	814.00
					J	8.00	814.00
					D	.00	814.00
55P 10	765720	381211		975.00	D	.00	975.00
					E	180.00	560.00
					J	3.90	731.00
11D 3	822720	365808	Wise	605.80	C	8.00	600.00
					E	28.00	601.00
					F	5.50	604.00
					J	6.00	604.00
					T	7.00	605.80
56N 1 SOW 16	764908	380538		646.00	C	6.00	646.00
					E	140.00	641.00
					J	3.30	646.00

Table 1.--Listing of Geophysical Logs in Virginia by the U.S. Geological Survey, WRD--Continued

LOCAL-NUMBER	LONGITUDE	LATITUDE	COUNTY	HOLE-DEPTH (FT)	LOG-TYPE	LOG-TOP (FT BELOW LAND SURFACE)	LOG-BOTTOM (FT BELOW LAND SURFACE)
57G 2 SOW 3	763759	371916	York	387.00	C	10.70	378.00
					J	10.00	380.00
58F 48	763257	371349		180.00	C	2.80	180.00
					D	.00	180.00
					E	4.00	180.00
					J	2.70	180.00
59F 1 SOW 27	762919	371304		446.00	C	.00	440.00
					J	4.00	446.00

Table 1.--Listing of Geophysical Logs in Virginia by the U.S. Geological Survey, WRD--Continued

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