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CHEMICAL COMPOSITION OF STREAMS DURING LOW FLOW-- FAIRFAX COUNTY, VIRGINIA

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samples

Abstract

Water samples were collected and stream discharges were measured at 49 sites in Fairfax County, Virginia during a period of low flow in August 1977. In addition, pesticide and metal content of residue on stream-bottom sediments from several major streams in the county were analysed.

Waters from the streams in Fairfax County have generally good chemical quality during low flow. One stream in Vienna, Virginia has a high sodium chloride content, suggesting an upstream discharge of salty water. Higher concentrations of dissolved solids reflect both the effects of geology and urbanization. Streams draining Triassic rocks in the western section of the county are characterized by the greatest natural concentration of dissolved minerals in the water.

The concentrations of pesticide and metal residue associated with bottom sediments suggest a low level of pollution in the streams. One site in western Fairfax County contained above-normal levels of polychlorinated biphenyls (PCB's) in the stream sediments.

Introduction

During periods of low flow, water in the streams of Fairfax County is derived from ground-water discharge. Thus, the chemical quality of stream water during low flow depends on the composition of ground water which, in turn, is controlled by the geology. Pollutants will alter the composition of ground water. To evaluate the current (1977) chemical quality of water in the major streams in Fairfax County, stream discharges and chemical samples were collected during August, 1977. In addition to the chemical analyses of the water, sand and gravel material was collected from the bottom of selected streams. Residue attached to this bottom material was removed and analysed for pesticides and metals content. The analyses are intended to detect natural or man-made changes of water quality in the area. No microbiological sampling was done during this study; therefore, all statements regarding quality refer only to chemical composition of water or bottom sediment. This report presents the data and shows the effects of geology and urbanization on stream quality in the county.

Hydrologic conditions during August 1977

Precipitation either evaporates, transpires, flows overland to streams or infiltrates the ground. This series of events is part of the hydrologic cycle. A diagrammatic representation of the hydrologic cycle during a typical summer period is given in Figure 1. Note that there is no infiltration of water down to the water table. As a result, the water table slowly

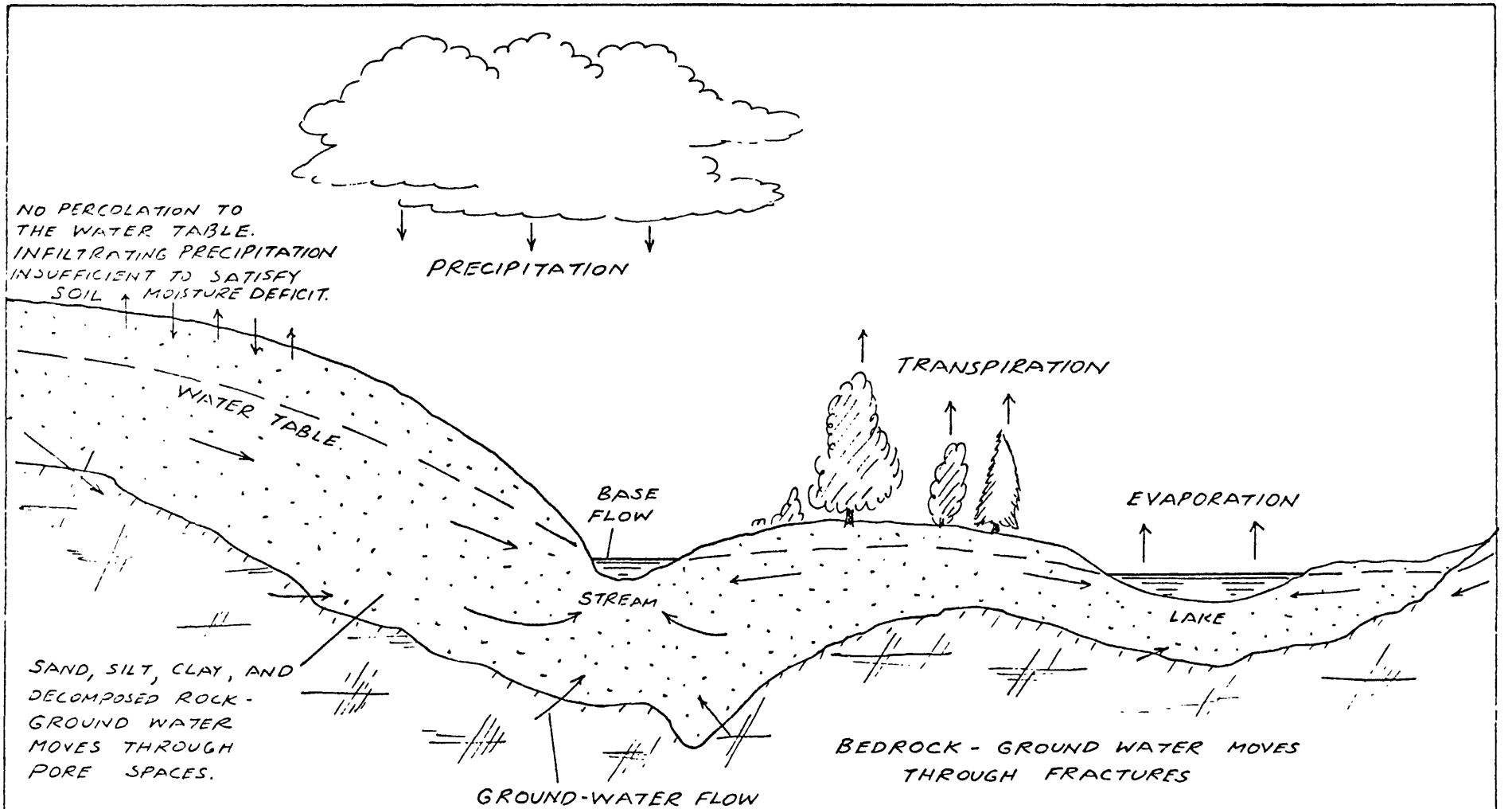


FIGURE 1. DIAGRAMMATIC REPRESENTATION OF THE HYDROLOGIC CYCLE DURING SUMMER PERIOD WITH ALL STREAMFLOW DERIVED FROM GROUND-WATER DISCHARGE

vertical scale exaggerated

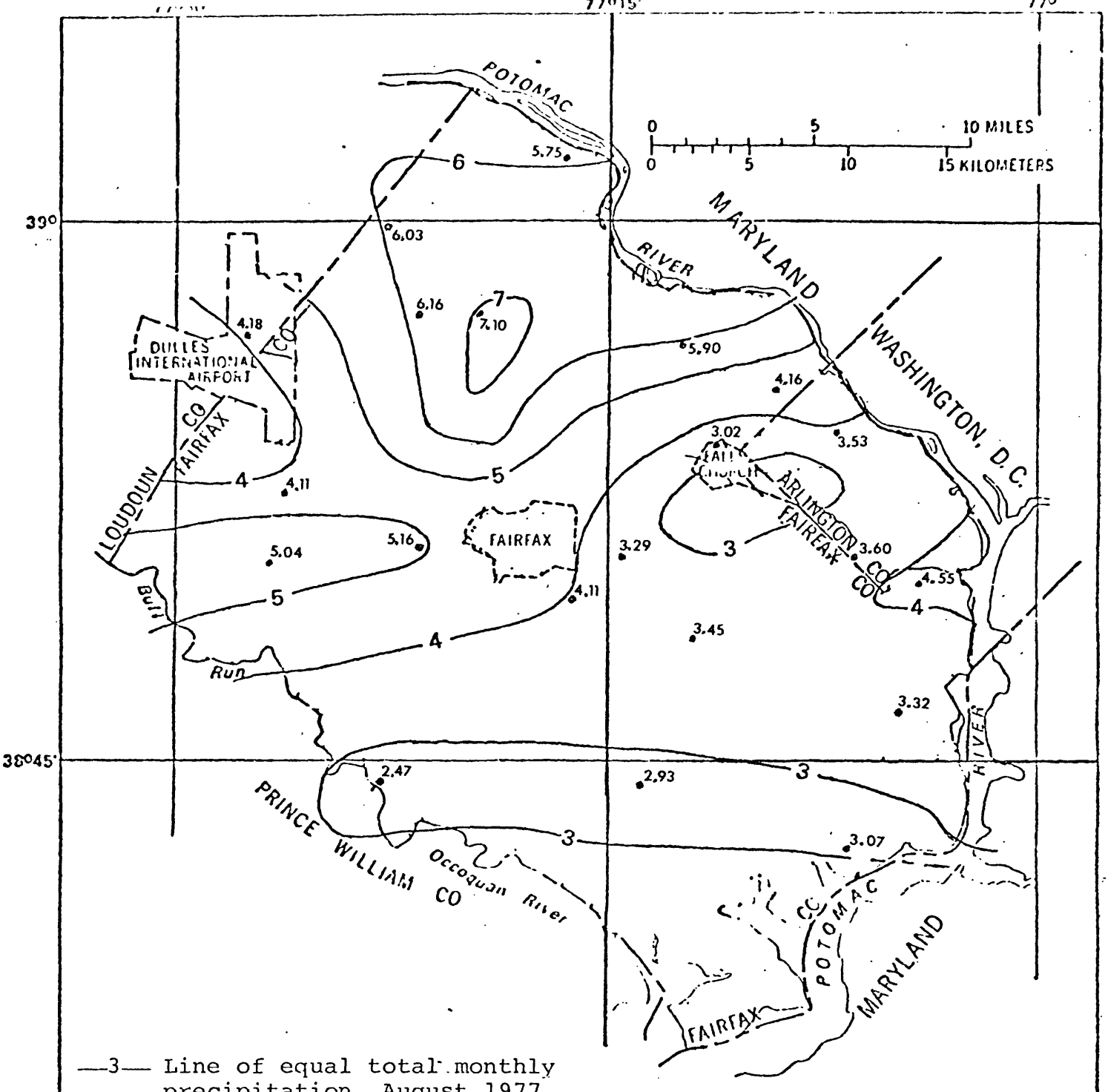
declines. The fair weather or base flow of streams is directly proportional to the height of the water table and accordingly base flow also gradually declines. This was the hydrologic situation in Fairfax County during much of the summer of 1977.

Precipitation in Fairfax County is highly variable due to the movement of individual storm centers across the county. Variation in rainfall during August 1977 (NOAA, written commun. 1977) is shown by the rainfall map (fig. 2). Note that monthly rainfall ranged from less than 3 to more than 7 inches and averaged 4.8 inches. Most precipitation fell on 4 days, August 1, 7, 8, and 24. Temperatures were above normal during August with 15 days above 90°F compared with a normal of 6 days.

During the spring and summer months preceding August 1977, precipitation was abnormally low. The water table was near record low in August, and therefore the base flow of streams was also very low. The near-normal precipitation during August had virtually no effect on either the water table or base flow under these conditions.

Relation of geology to base flow of streams

Water in the ground interacts with the rock material and develops a characteristic chemical composition that reflects the material it has passed through. Thus, chemical quality of streams during low flow is directly dependent upon the rock types through which the ground water passes.



—3— Line of equal total monthly precipitation, August 1977, Interval 1 inch.

•2.47 Selected precipitation stations with August 1977 total in inches.

Figure 2.-- Rainfall in August 1977 in Fairfax County, Virginia

Fairfax County is underlain by three distinct rock types (fig. 3). These are the Coastal Plain sediments, Piedmont crystalline rocks, and Triassic sedimentary rocks.

The Coastal Plain sediments in eastern Fairfax County are eastward dipping sand and clay beds of the Potomac Group of Cretaceous age (Force, 1975). Their thickness ranges from a featheredge on the west, near Route I-95, to about 600 feet near the Potomac River. These are nonmarine fluvial deposits and are overlain in many places by beds of upland gravel.

The Piedmont crystalline rocks in the center half of Fairfax County are recrystallized sedimentary and igneous rocks (Drake and Froelich, 1977). These rocks have undergone several periods of recrystallization, with subsequent folding and faulting, to make up a complex of several types of rock. The rocks are mostly schist, gneiss, phyllite, greenstone, and granite.

The Triassic sedimentary rocks are westdipping sandstone, siltstone, and shale (Nelson and Force, 1976) underlying the western quarter of Fairfax County. The basal unit is the Manassas Sandstone which is overlain, in turn, by the Balls Bluff Siltstone and the Bull Run Formation, toward the western border of the county. Locally these units have been intruded by diabase igneous rock. Surrounding each of the diabase bodies is an altered or "baked" zone of hornfels. The altered hornfels zones extend as far as a half mile from the contact of the diabase intrusives.

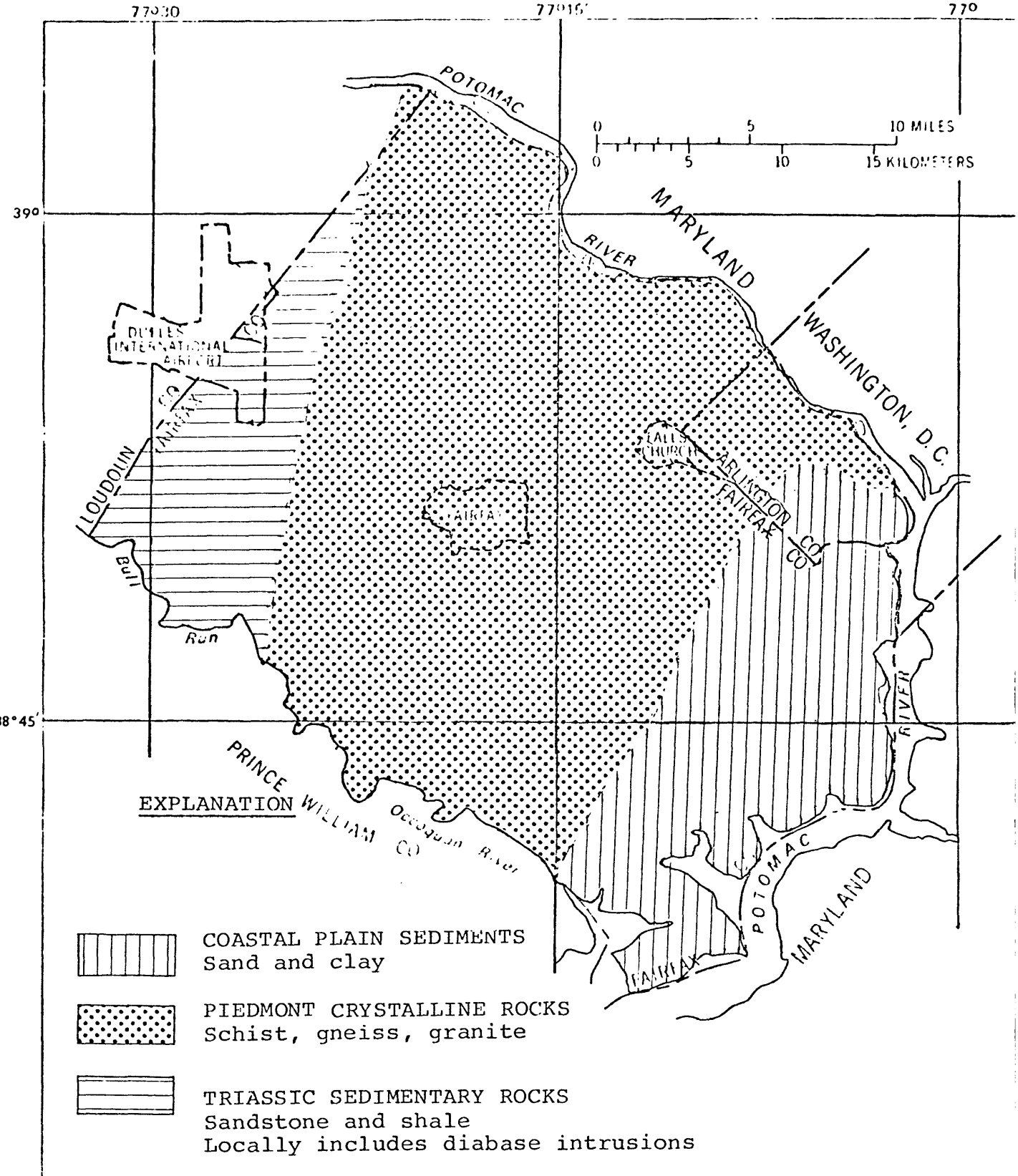


Figure 3.--Generalized geology of Fairfax County, Virginia. (after Drake and Froelich, 1977)

Low-flow measurement and sampling program

Stream discharge was measured and water samples were collected at 49 sites within Fairfax County during August 1977. Plate 1 shows the locations of all measuring-sampling sites and table 1 lists the stations in a downstream order, giving the station location, drainage area, and discharge. A prerequisite for sampling and measurement was a minimum of 2 days of no measurable precipitation to avoid measuring or sampling surface runoff. All streams were considered to be at base flow at the time of measurement. Two locations in the western part of the county showed anomalously high flows owing to upstream discharge from sewage plants. The discharge values and water analyses for these two streams (Cub Run and Big Rocky Run) have little relation to the hydrology or geology but do reflect effects of urbanization.

General chemical composition of surface water

During low flow, waters from the streams in Fairfax County are generally of good chemical quality. Dissolved-solids concentration ranged from 50 to 266 mg/L (milligrams per liter) except for Piney Branch in downtown Vienna, where the value was 1290 mg/L. This sampling site is in the highly urbanized section of Vienna. A high sodium chloride content suggests an upstream source discharging salty water. Except for the Vienna site, hardness ranged between 19 mg/L and 150 mg/L. A comparison of the analyses from the streams, with recommended limits for selected constituents in domestic water supplies

Table 1.--Name, location, and discharge data for streams sampled in Fairfax County, Virginia

Site No. (Plate 1)	Station Number	Station Name	Latitude Deg.	Min.	Sec.	Longitude Deg.	Min.	Sec.	Date Measured	Discharge (ft^3/s)	Drainage Area (mi^2)	Discharge [(ft^3/s) /mi^2]
1 A	01644260	Horsepen Run nr Floris	38	55	27	077	23	56	8-5-77	0.04	1.61	0.025
1 B	01644270	Horsepen Run nr Herndon	38	56	31	077	25	27	8-5-77	<0.01	6.64	<0.001
2 A	01644300	Sugarland Run at Herndon	38	58	00	077	22	17	8-5-77	0.03	3.36	0.009
2 B	01644370	Sugarland Run nr Dranesville	39	00	47	077	22	12	8-5-77	.53	13.4	0.040
3 A	01645160	Nichols Run nr Dranesville	39	01	49	077	18	57	8-5-77	0.47	3.5	0.134
4 A	01645750	S. Fork Little Difficult Run nr Fairfax	38	53	52	077	21	12	8-29-77	0.14	1.59	0.088
4 B	01645800	Piney Branch at Vienna	38	54	06	077	15	57	8-29-77	0.01	0.29	0.034
4 C	01645850	Wolftrap Crk nr Vienna	38	57	02	077	17	06	8-5-77	1.15	6.75	0.170
4 D	01645900	Colvin Run at Reston	38	57	56	077	18	36	8-5-77	0.74	5.09	0.145
4 E	01645950	Piney Run at Reston	38	58	49	077	19	09	8-29-77	.32	2.06	0.155
4 F	01646000	Difficult Run nr Great Falls	38	58	33	077	14	46	8-31-77	16.2	57.9	0.280
5 A	01646200	Scott Run nr McLean	38	57	32	077	12	21	8-5-77	0.92	4.69	0.196
6 A	01646600	Pimmit Run nr Falls Church	38	54	41	077	11	05	8-4-77	0.06	2,87	0.021
6 B	01646700	Pimmit Run at Arlington	38	56	05	077	08	26	8-5-77	1.17	8.12	0.144
6 C	01646750	Little Pimmit Run Trib at Arlington	38	54	18	077	08	17	8-4-77	0.20	0.41	0.486
6 D	01646800	Little Pimmit Run at Arlington	38	55	22	077	08	43	8-4-77	0.25	2.31	0.108
7 A	01652400	Long Branch at Arlington	38	51	31	077	07	37	8-5-77	0.14	0.94	0.149
7 B	01652470	Lucky Run at Arlington	38	50	33	077	06	16	8-4-77	0.03	1.22	0.025
7 C	01652500	Fourmile Run at Alexandria	38	50	36	077	04	46	8-31-77	2.25	13.8	0.163
8 A	01642600	Holmes Run at Merryfield	38	51	57	077	12	45	8-4-77	0.13	2.70	0.048
8 B	01652610	Holmes Run nr Annandale	38	50	47	077	10	28	8-5-77	0.16	7.10	0.023
8 C	01652620	Tripps Run at Falls Church	38	52	46	077	08	14	8-4-77	0.21	1.78	0.118
8 D	01652645	Tripps Run Trib nr Falls Church	38	51	54	077	10	16	8-5-77	0.21	0.50	0.420
8 E	01652650	Tripps Run nr Falls Church	38	51	37	077	09	57	8-5-77	0.47	4.55	0.103
8 F	01652710	Backlick Run at Springfield	38	48	05	077	11	14	8-5-77	0	2.02	0
8 G	01652910	Backlick Run at Alexandria	38	48	11	077	07	41	8-4-77	1.30	13.40	0.097
8 H	01653000	Cameron Run at Alexandria	38	48	23	077	06	35	8-30-77	3.54	33.70	0.105
8 I	01653210	Pike Branch at Alexandria	38	47	35	077	05	02	8-4-77	.16	2.65	0.060

Table 1.--Continued

Site No. (Plate 1)	Station Number	Station Name	Latitude Deg.	Min.	Sec.	Longitude Deg.	Min.	Sec.	Date Measured	Discharge (ft^3/s)	Drainage Area (mi^2)	Discharge [(ft^3/s) /mi^2]
8 J	01653447	Penn Daw Outfall at Alexandria	38	47	19	077	03	54	8-4-77	.10	.82	0.122
9 A	01653700	Little Hunting Crk at Gum Springs	38	44	21	077	05	20	8-4-77	.21	1.78	0.118
10 A	01653800	Dogue Crk nr Accotink	3-	43	08	077	07	44	8-4-77	.48	10.6	0.045
11 A	01653900	Accotink Crk at Fairfax	38	51	39	077	16	17	8-1-77	.22	6.8	0.032
11 B	01653950	Long Branch at Vienna	38	52	23	077	14	34	8-1-77	.02	1.18	0.017
11 C	01654500	Long Branch nr Annandale	38	48	39	077	14	07	8-4-77	.35	3.71	0.094
11 D	01655000	Accotink Crk nr Accotink Station	38	45	15	077	12	09	8-30-77	9.41	37.0	0.254
12 A	01655310	Rabbit Branch nr Burke	38	48	06	077	19	19	8-29-77	.30	3.81	0.079
12 B	01655350	Pohick Crk nr Springfield	38	45	26	077	13	37	8-5-77	.96	15.0	0.064
12 C	01655370	Middle Run nr Lorton	38	45	01	077	14	03	8-5-77	.22	3.56	0.062
12 D	01655380	South Run nr Lorton	38	44	11	077	15	10	8-5-77	.34	6.54	0.052
12 E	01655390	Pohick Crk at Lorton	38	42	14	077	12	52	8-30-77	1.92	31.0	0.062
13 A	01656800	Cub Run nr Chantilly	38	54	30	077	28	01	8-1-77	0	7.13	0
13 B	01656850	Cain Br. nr Chantilly	38	54	08	077	27	06	8-30-77	0	1.67	0
13 C	01656900	Flatlick Br at Chantilly	38	53	21	077	25	12	8-1-77	.03	3.47	0.009
13 D	01656940	Cub Run nr Centreville	38	49	59	077	27	50	8-30-77	* .37	39.6	0.009
13 E	01656950	Big Rocky Run nr Centreville	38	50	11	077	27	00	8-30-77	* .22	8.27	0.027
14 A	01657230	Little Rocky Run at Comptons Corner	38	48	19	077	26	10	8-30-77	.02	6.07	0.003
15 A	01657250	Johnny Moore Crk nr Clifton	38	47	47	077	24	34	8-5-77	.29	3.17	0.091
16 A	01657300	Popes Head Crn nr Fairfax	38	48	57	077	20	16	8-29-77	.39	3.88	0.101
16 B	01657400	Popes Head Crk at Clifton	38	46	54	077	23	18	8-5-77	.84	17.2	0.049
17 A	01657435	Wolf Run nr Clifton	38	44	09	077	21	51	8-5-77	.25	5.39	0.046
18 A	01657600	Sandy Run nr Fairfax Sta	38	44	53	077	19	23	8-5-77	.05	2.35	0.021
19 A	01657800	Giles Run nr Woodbridge	38	40	48	077	13	36	8-4-77	.62	4.54	0.137

* Estimated natural inflow with upstream sewage discharge subtracted out.

recommended by the Environmental Protection Agency (USEPA), 1976, indicates good chemical quality for those constituents measured. The recommended limit for iron is 0.3 mg/L based on staining characteristics whereas the streams ranged between 0.01 and 0.78 mg/L. Fluoride has a recommended limit of between 1.4 and 2.4 mg/L depending on maximum daily air temperature, (National Academy of Science-National Academy of Engineering, 1973), and the streams had a range of 0.1 to 0.8 mg/L. Nitrate concentration (expressed as dissolved N) is restricted to less than 10 mg/L, and the streams had between 0.0 and 9.7 mg/L nitrate. Sulfate limits are recommended at less than 250 mg/L, and the range of sulfate in the streams was 1.2 to 61 mg/L.

The chemical analyses are presented in table 2 for the streams sampled in the county. The site number refers to plate 1, which presents selected chemical constituents in graphical form. The circular diagrams on the maps are useful for making regional comparisons of the analyses. Data are given in milliequivalents per liter, as compared to milligrams per liter on the table. (Note: milliequivalents per liter is milligrams per liter divided by the atomic weight).

Pesticide and metal content in stream-bottom material

Analyses for pesticide concentrations were made on stream-bottom material from seven major streams within the county. Table 3 presents these findings as well as the alert limits suggested by the U. S. Geological Survey for pesticide content in the sediment. Figures 4, 5, and 6, present chlordane, DDT

Table 2.--Chemical Analyses of water from streams in Fairfax County, Virginia
(All values in milligrams per liter unless noted)

Site No. (Plate 1)	Station Number	Stream and Location	Discharge	Date of Collection	Iron (Fe)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Silica (SiO_2)	Dissolved Solids (Residue on evaporation at 180°C.)	Alkalinity as $CaCO_3$	Hardness as $CaCO_3$		Specific conductance micromhos at 25°C
																		Calcium, magnesium	Noncarbonate	
1 A	01644260	Horsepen Run nr Floris	.04	8-5-77	.04	36	7.6	11	3.4	140	8.2	9.3	.1	.8	18	173	110	120	6	270
1 B	01644270	Horsepen Run nr Herndon	.01	8-5-77	.05	43	9.3	11	5.6	190	10	12	.1	.9	13	202	160	150	0	320
2 A	01644300	Sugarland Run at Herndon	.032	8-5-77	.02	24	7.0	15	54	120	55	15	.4	.4	17	266	98	89	0	390
2 B	01644370	Sugarland Run nr Dranesville	.53	8-5-77	.03	32	7.5	70	6.4	120	19	11	.2	1.5	14	178	98	110	12	270
3 A	01645160	Nichols Run nr Dranesville	.47	8-5-77	.17	5	2	4	1.6	34	2.8	3.6	.1	1.3	12	50	28	21	0	65
4 A	01645750	S. Fork Little Difficult Run nr Fairfax	.14	8-29-77	.02	3.4	1.4	4.2	1.4	20	1.2	3.5	.1	4.0	17	44	16	14	0	40
4 B	01645800	Piney Branch at Vienna	.01	8-29-77	.06	83	17	330	4.4	85	27	630	.2	7.0	20	1290	70	280	210	2000
4 C	01645850	Wolftrap Crk nr Vienna	1.15	8-5-77	.13	8.1	2.6	6.4	2.3	40	5.4	8.4	.1	3.1	14	80	33	31	0	100
4 D	01645900	Colvin Run at Reston	.74	8-5-77	.07	7.8	2.8	6.6	2.7	34	3.3	10	.1	1.2	5.9	66	28	31	3	100
4 E	01645950	Piney Run at Reston	.32	8-29-77	.03	5.4	3.1	5.2	3.3	19	2.5	9.4	.1	6.1	15	66	16	26	11	90
4 F	01646000	Difficult Run nr Great Falls	16.2	8-31-77	.07	6.9	2.3	5.4	2.6	32	5.0	7.4	.1	2.3	11	58	26	27	0	85
5 A	01646200	Scott Run nr McLean	.92	8-5-77	.02	18	5.6	9.1	2.5	48	16	17	.2	2.1	11	127	39	68	29	190
6 A	01646600	Pimmit Run nr Falls Church	.06	8-4-77	.26	21	5.1	26	3.3	6.4	14	42	.2	1.8	15	182	53	73	21	220
6 B	01646700	Pimmit Run at Arlington	1.17	8-5-77	.07	13	3.6	7.1	3.4	3.9	10	11	.1	4.0	11	108	32	47	15	140
6 C	01646750	Little Pimmit Run Trib. Arlington	.20	8-4-77	.02	19	5.1	15	3.2	49	13	26	.1	9.7	23	157	40			
6 D	01646800	Little Pimmit Run at Arlington	.25	8-4-77	.02	20	4.3	11	3.4	62	11	21	.1	1.8	13	123	51	68	17	150
7 A	01652400	Long Branch at Arlington	.14	8-5-77	.17	30	5.4	20	4.4	65	37	34	.2	1.3	13	193	53	97	44	280
7 B	01652470	Lucky Run at Arlington	.03	8-4-77	.04	20	3.3	9.0	3.2	54	11	21	.3	0	9.9	122	44	64	19	180
7 C	01652500	Fourmile Run at Alexandria	2.25	8-31-77	.11	32	6.9	25	5.0	82	40	42	.3	.2	12	211	67	110	41	345
8 A	01652600	Holmes Run at Merrifield	.13	8-4-77	.07	20	4.2	12	3.9	44	25	20	.3	.5	6.6	132	36	67	31	200
8 B	01652610	Holmes Run nr Annandale	.16	8-5-77	.20	16	3.8	11	3.5	59	11	16	.1	.5	7.2	117	48	56	7	165
8 C	01652620	Tripps Run at Falls Church	.21	8-4-77	.06	29	3.8	16	4.2	90	13	26	.1	2.7	22	170	74	88	14	200
8 D	01652645	Tripps Run Trib nr Falls Church	.21	8-5-77	.02	42	8.8	25	3.9	98	61	35	.8	1.0	7.1	260	80	140	61	400
8 E	01652650	Tripps Run nr Falls Church	.47	8-5-77	.14	31	5.3	18	3.8	100	24	21	.2	1.2	16	195	82	99	17	280
8 F	01652710	Backlick Run at Springfield	0	8-5-77	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
8 G	01652910	Backlick Run at Alexandria	1.30	8-5-77	.32	18	4.3	12	4.2	52	12	27	.2	.1	8.7	142	43	63	20	160
8 H	01653000	Cameron Run at Alexandria	3.54	8-30-77	.07	20	4.8	15	4.3	49	18	27	.3	0	12	127	40	70	30	210
8 I	01653210	Pike Branch at Alexandria	.16	8-4-77	.03	16	4.3	13	4.5	42	15	24	.2	1.2	8.3	145	34	58	23	200
8 J	01653447	Penn Daw Outfall at Alexandria	.10	8-4-77	.12	19	4.7	18	4.3	42	19	31	.3	1.4	14	145	34	67	32	220
9 A	01653700	Little Hunting Creek at Gum Springs	.21	8-4-77	.60	26	3.6	20	4.7	53	19	39	.3	.8	13	176	43	80	36	270
10 A	01653800	Dogue Ck nr Accotink	.43	8-4-77	.03	6.5	2.4	5.6	3.2	22	7.9	9.0	.1	.2	9.6	64	18	26	8	80
11 A	01653900	Accotink Crk at Fairfax	.22	8-1-77	.23	15	4.3	12	2.9	61	9.1	14	.1	.1	11	122	50	55	5	170
11 B	01653950	Long Branch at Vienna	.02	8-1-77	.09	13	4.2	9.2	2.4	47	7.3	15	.1	2.3	12	109	39	50	11	158
11 C	01654500	Long Branch nr Annandale	.35	8-4-77	.11	10	2.8	7.1	2.8	37	6.2	9.8	.1	1.3	11	79	30	37	6	115
11 D	01655000	Accotink Crn nr Accotink Station	9.41	8-30-77	.17	10	2.2	6.2	3.4	21	9.3	9.4	.1	2.0	4.3	66	17	34	17	105
12 A	01655310	Rabbit Branch nr Burke	.30	8-29-77	.20	6.5	2.5	7.7	1.9	37	2.3	8.4	.1	.2	15	60	30	27	0	90
B	01655350	Pohick Crk nr Springfield	.96	8-5-77	.03	8.8	2.4	5.8	3.1	30	7.8	7.5	.1	1.2	6.6	69	25	32	7	100

Table 2.--Continued

Site No. (Plate 1)	Station Number	Stream and Location	Discharge	Date of Collection	Iron (Fe)	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Silica (SiO_2)	Dissolved Solids (Residue on evaporation at 180°C.)	Alkalinity as $CaCO_3$	Hardness as $CaCO_3$		Specific conductance micromhos at 25°C
																		Calcium,magnesium	Noncarbonate	
12 C	01655370	Middle Run nr Lorton	.22	8-5-77	.39	11	2.2	7.6	3.4	46	6.2	8.3	.1	.2	9.2	82	38	37	0	110
12 D	01655380	South Run nr Lorton	.34	8-5-77	.34	5.0	1.5	5.3	1.7	27	3.0	3.1	.1	.3	14	59	22	19	0	65
12 E	01655390	Pohick Crk at Lorton	1.92	8-30-77	.14	10	2.5	6.3	3.4	34	7.2	9.1	.1	.2	5.2	60	28	35	7	110
13 A	01656800	Cub Run nr Chantilly	0	8-1-77	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
13 B	01656850	Cain Br nr Chantilly	00	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
13 C	01656900	Flatlick Br at Chantilly	.03	8-1-77	.02	35	7.8	16	3.2	120	21	28	.2	.1	11	209	98	120	21	310
13 D	01656940	Cub Run nr Centreville	net=.37cfs	8-30-77	.10	27	6.4	22	7.0	34	29	50	.3	2.3	8.8	238	28	94	66	355
13 E	01656950	Big Rocky Run nr Centreville	.68	8-30-77	.07	16	4.0	18	5.8	46	17	30	.3	3.8	9.3	127	38	56	19	200
14 A	01657230	Little Rocky Run at Comptons Corner	.02	8-30-77	.07	19	6.9	33	2.9	32	9.2	76	.1	.1	9.9	205	26	76	50	310
15 A	01657250	Johnny Moore Crk nr Clifton	.29	8-5-77	.01	6.6	3.4	5.6	1.7	36	5.7	2.7	.1	1.0	13	57	30	30	1	90
16 A	01657300	Popes Head Crk nr Fairfax	.39	8-29-77	.120	7.6	3.5	7.2	3.2	33	5.5	10.0	.1	2.0	11	70	27	33	6	105
16 B	01657400	Popes Head Crk at Clifton	.84	8-5-77	.03	6.8	3.0	5.1	3.0	37	5.4	6.6	.1	1.5	8.1	63	30	29	0	80
17 A	01657435	Wolf Run at Clifton	.25	8-5-77	.16	8.3	2.6	5.6	2.0	47	3.8	4.2	.1	.3	13	58	39	31	0	90
18 A	01657600	Sandy Run nr Fairfax Sta.	.05	8-5-77	.78	8.1	3.0	5.5	2.5	48	4.7	4.3	.1	0	13	80	39	33	0	80
19 A	01657800	Giles Run nr Woodbridge	.62	8-4-77	.11	12	3.5	13	5.2	38	15	22	.1	1.5	11	108	31	44	13	170

Table 3.--Pesticide residue on stream-bottom samples in selected sites in Fairfax County, Virginia (all values in micrograms per kilogram)

Site No. (Plate 1)	Stream and Location	Date Collected	Aldrin	Chlordane	DDD	DDE	DDT	Dieldrin	Endrin	Heptachlor Epoxide	Lindane	PCB's	PCN	Endosulfan	Heptachlor	Perthane	Toxaphene
2 B	Sugraland Run nr Dranesville, Va.	8-29-77	.2	0	0	0	0	.3	0	0	0	4	0	0	0	0	0
7 C	Fourmile Run at Alexandria, Va.	8-31-77	.1	4	.5	0	.3	.6	0	0	0	0	0	0	0	0	0
8 H	Cameron Run at Alexandria, Va.	8-30-77	.3	1	0	0	0	0	0	0	0	0	0	0	0	0	0
10 A	Dogue Creek near Accotink, Va.	8-30-77	0	12	0	0	2.1	.5	0	0	0	15	0	0	0	0	0
11 D	Accotink Creek nr Accotink Sta., Va.	8-30-77	.2	2	0	0	0	0	0	0	0	0	0	0	0	0	0
12 E	Pohick Creek at Lorton, Va.	8-30-77	0	9	.3	0	.3	.2	0	.3	0	16	0	0	0	0	0
13 D	Cub Run nr Centreville, Va.	8-30-77	.3	0	0	0	3.0	1.1	0	.4	0	31	0	0	.2	0	0
	Alert limits for possible contamination:		20	20			20	20	20	20	20	20			20		20

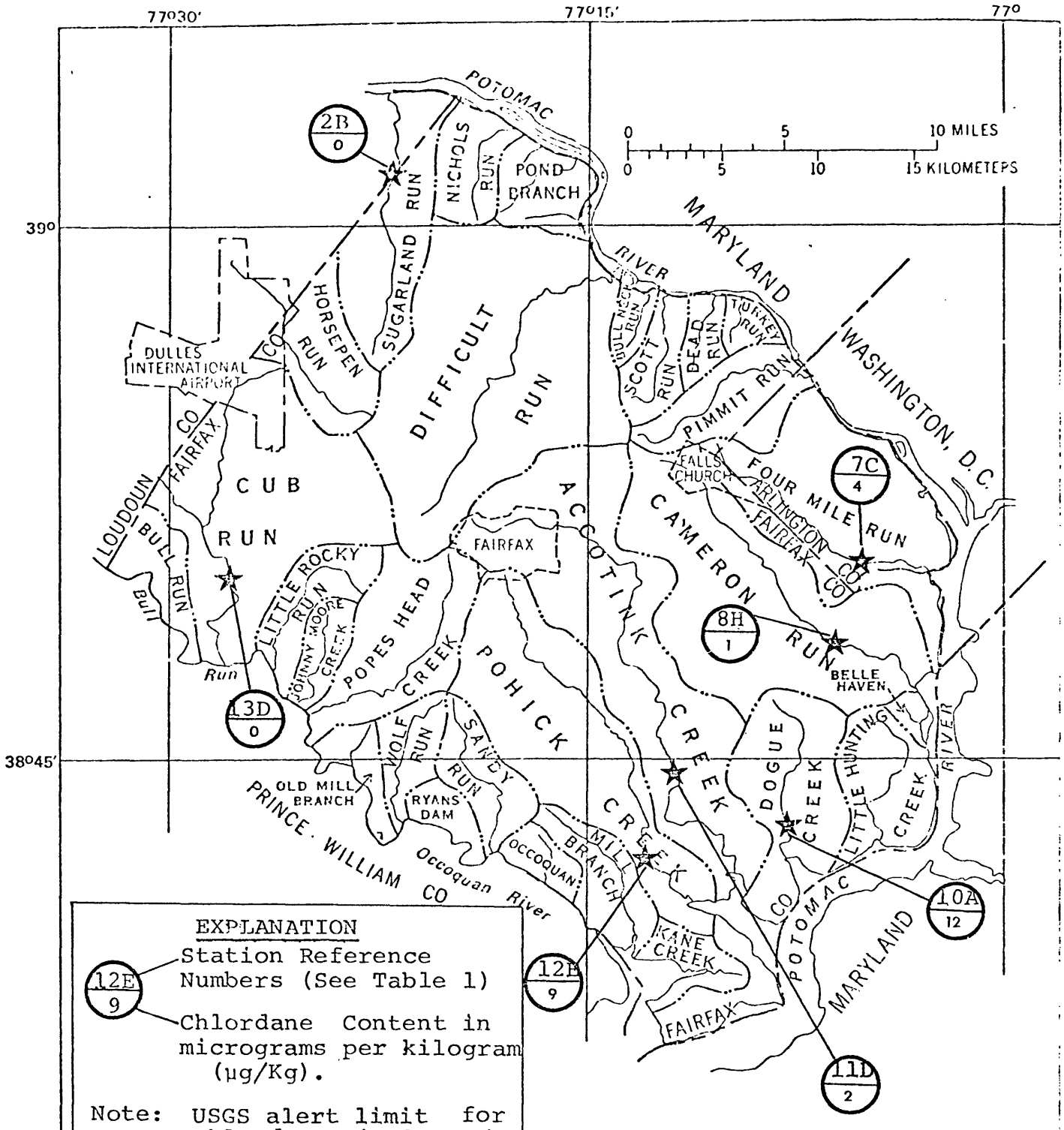


Figure 4 . - Chlordane content of stream-bottom samples in Fairfax County, Virginia

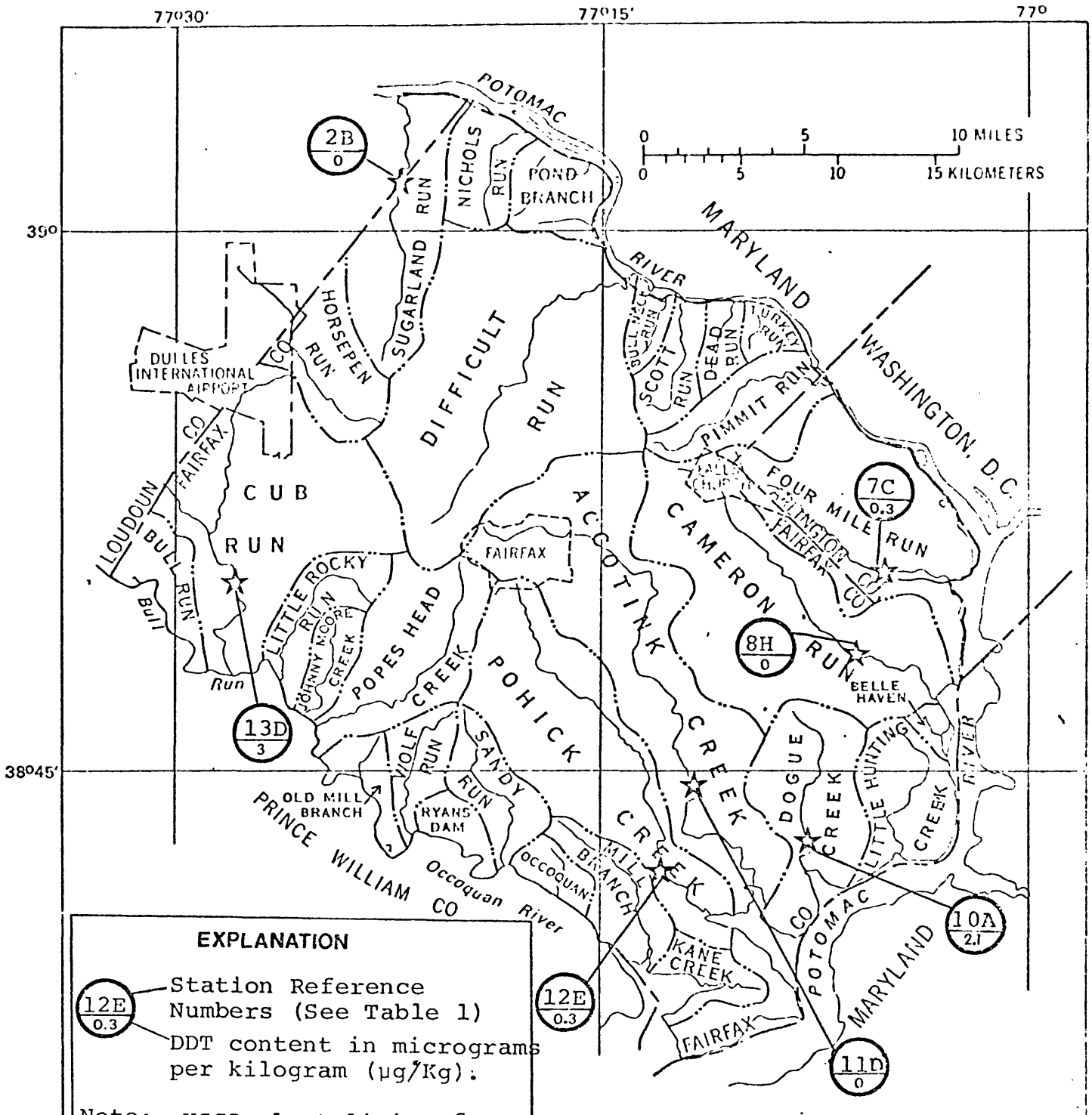


Figure 5. - DDT content of stream-bottom samples in Fairfax County, Virginia

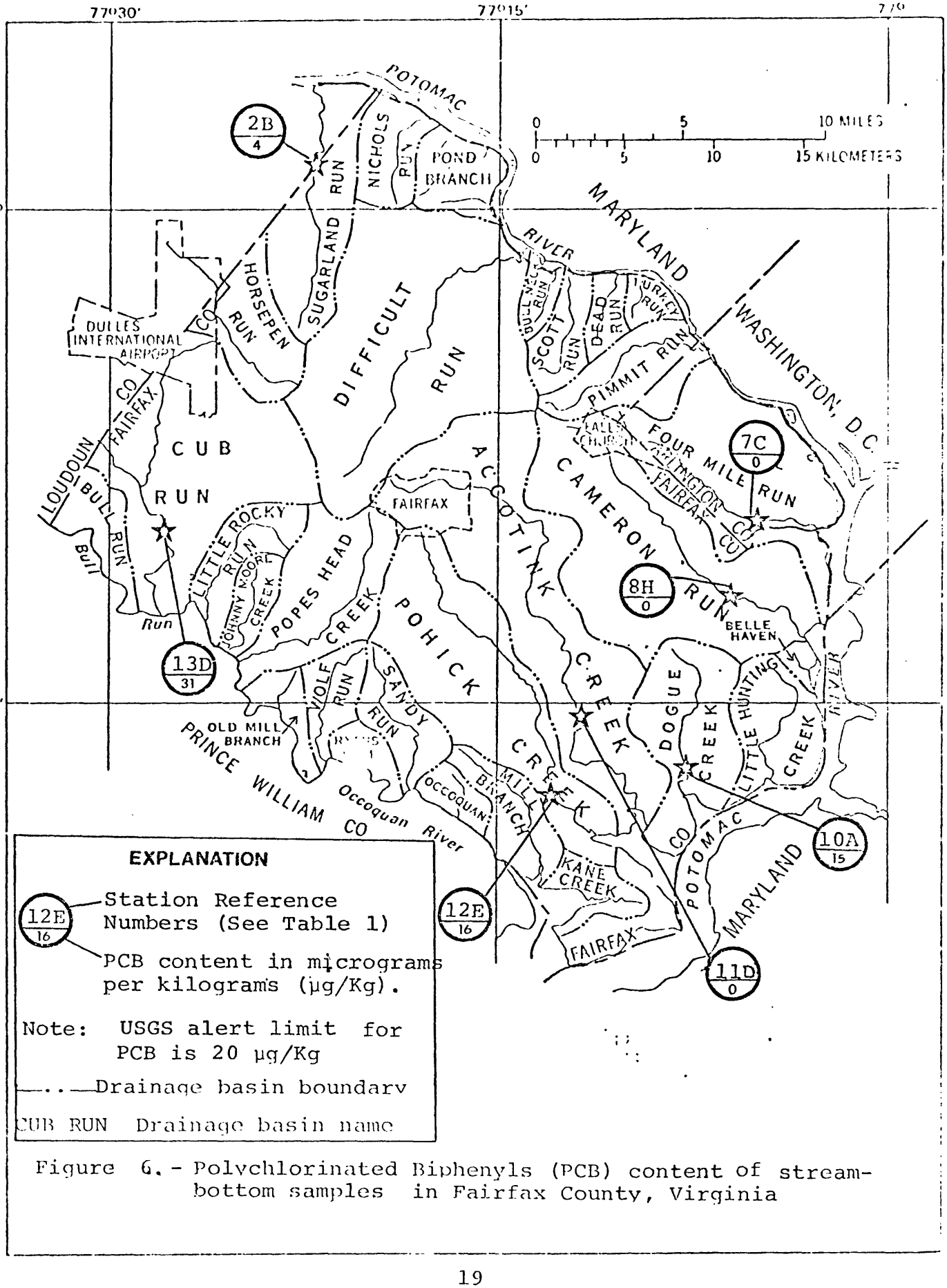


Figure 6. - Polychlorinated Biphenyls (PCB) content of stream-bottom samples in Fairfax County, Virginia

and PCB content in map form. The analyses show that the pesticide residues are below suggested upper limits in the streams, except for Cub Run which has an above-normal PCB content. The source for this material is not known. Note particularly that DDT contents are very low in all streams.

Analyses for selected metals were made on bottom sediments from eight major streams within the county. Table 4 presents the values for each metal and the corresponding alert level. Lead, zinc, and chromium concentrations are shown in figures 7, 8, and 9, respectively. The source of the relatively high values of lead and zinc in Dogue Creek (although below the alert limits) is unknown.

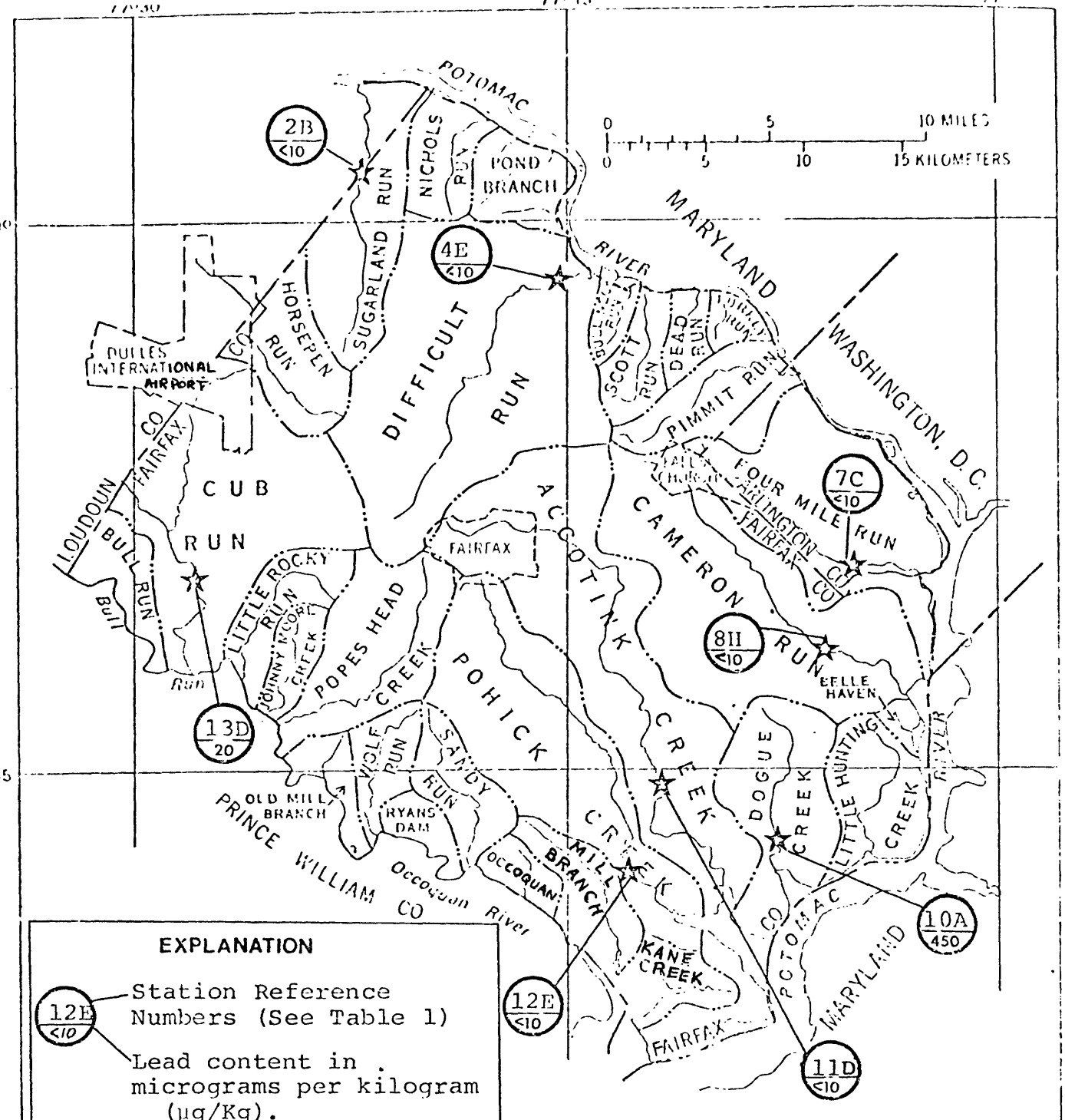
Relation of geology and urbanization to water chemistry

The chemical analysis diagrams on plate 1 show a wide range in the concentrations of the various constituents; this is in part due to the varying rock types within the drainage basins and in part to the effects of urbanization. The circular diagrams on plate 1 show major constituents in pairs, for example, calcium and magnesium, sulfate and chloride, etc.

Four streams are located entirely within the area of Coastal Plain sediments. Of these, Dogue Creek shows the lowest concentration of chemical constituents; it also has the lowest population density within its drainage area. All the constituent pairs are nearly equal in concentration. Little Hunting Creek, Penn Daw Outfall, and Pike Branch are characterized by higher concentrations of all constituents and correspondingly

TABLE 4: Metal Content of stream-bottom samples from selected streams, Fairfax County, Virginia (all values in micrograms per kilogram)

Site No. (Plate 1)	Stream and Location	Date	Barium	Copper	Lead	Zinc	Cadmium	Chromium	Mercury
2 B	Sugarland Run Dran esville, Va.	8-29-77	20	< 10	< 10	70	< 10	40	0
4 E	Difficult Run nr Great Falls, Va.	8-31-77	20	< 10	< 10	50	10	20	0
7 C	Fourmile Run at Alexandria, Va.	8-31-77	20	< 10	< 10	40	10	20	0
8 H	Cameron Run at Alexandria, Va.	8-30-77	20	< 10	< 10	30	< 10	< 10	0
10 A	Dogue Creek nr Accotink, Va.	8-30-77	20	10	450	260	< 10	20	0
11 D	Accotink Creek nr Accotink Station, Va.	8-30-77	20	< 10	< 10	30	10	30	0
12 E	Pohick Creek at Lorton, Va.	8-30-77	20	< 10	< 10	90	< 10	10	0
13 D	Cub Run nr Centreville, Va.	8-30-77	20	20	20	80	10	40	0
Alert limits for possible contamination			2000	2000	500	5000	20	200	20



EXPLANATION

12E <10 — Station Reference Numbers (See Table 1)

Lead content in micrograms per kilogram (µg/Kg).

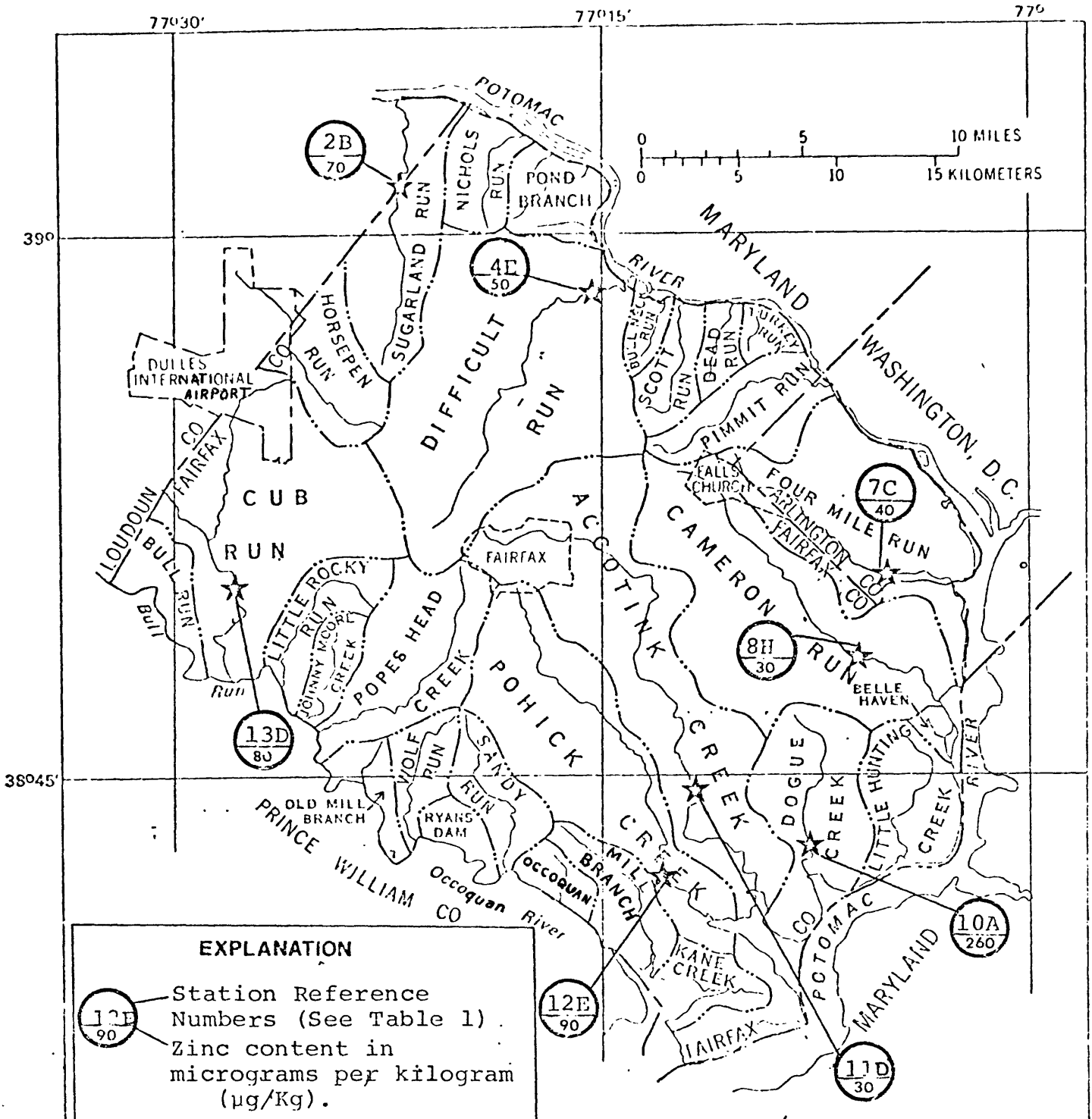
< = less than

Note: USGS alert limit for Lead is 500 µg/Kg

_._._ Drainage basin boundary

CUB RUN Drainage basin name

Figure 7. - Lead content of stream-bottom samples in Fairfax County, Virginia



EXPLANATION

12E 90 — Station Reference Numbers (See Table 1). Zinc content in micrograms per kilogram (µg/Kg).

Note: USGS alert limit for Zinc is 5000 µg/Kg

__.__.__ Drainage basin boundary

CUB RUN Drainage basin name

Figure 8. - Zinc content of stream-bottom samples in Fairfax County, Virginia

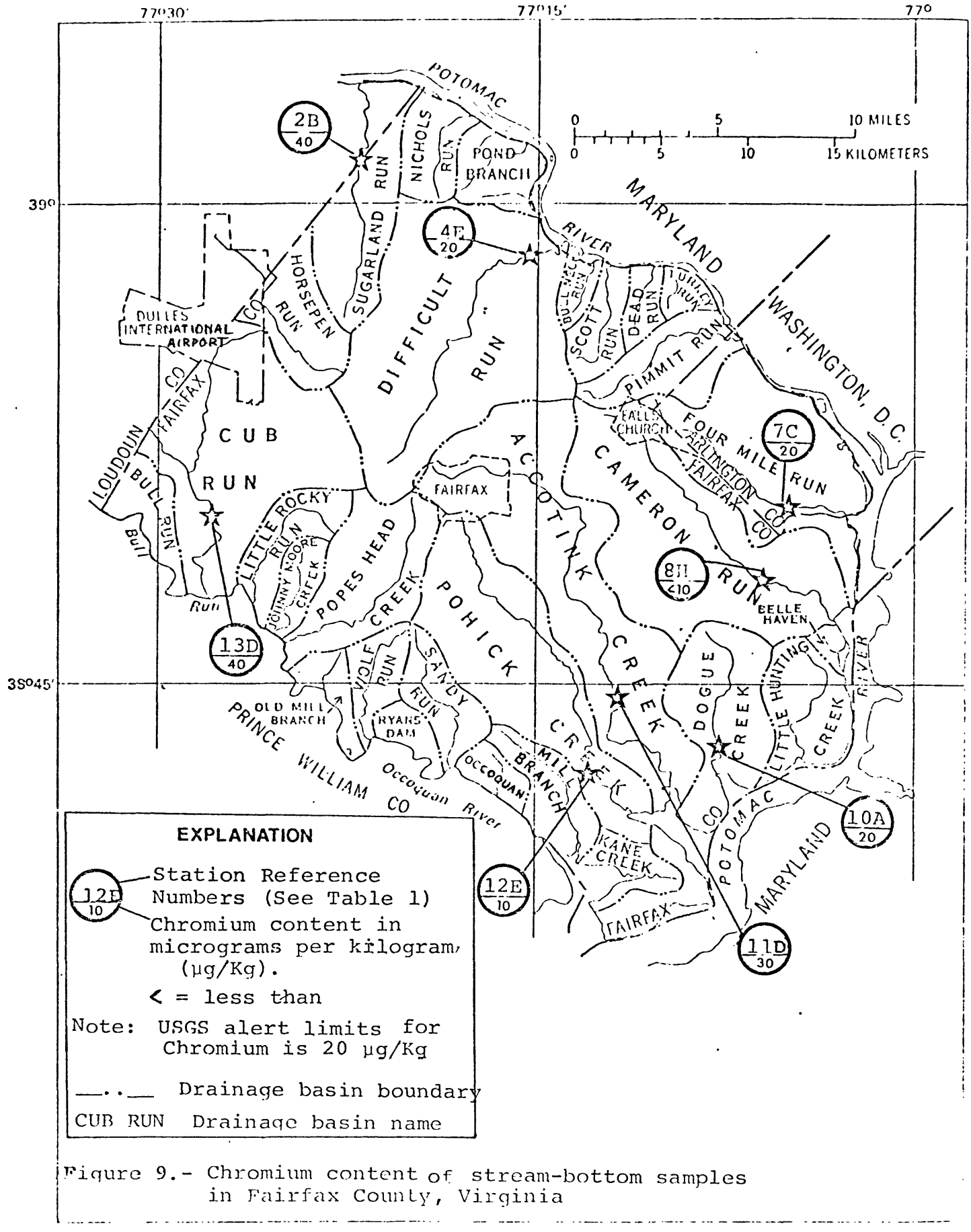


Figure 9.- Chromium content of stream-bottom samples in Fairfax County, Virginia

high urbanization. Water in the three streams has higher concentrations of calcium, magnesium, sulfate, and chloride.

Streams draining Piedmont crystalline rocks show the widest range of chemical constituents. The larger diagrams (more mineralized water) occur in the heavily urbanized Falls Church area. Relatively high concentrations of magnesium, sulfate, and chloride characterize this urbanized area. The remainder of the crystalline rock terrane is characterized by low concentrations of constituents and a fairly even balance between the different ion pairs, as shown on plate 1. No diagram is shown for Piney Branch at Vienna, which had very high sodium chloride concentration and would require an excessively large diagram to be shown on the map.

Streams draining areas of Triassic rocks are Sugarland Run, Horsepen Run, Little Rocky Run, and Cub Run. These areas are not heavily populated, but the water has the highest concentrations of dissolved solids in the county (largest diagrams on plate 1). This is due to the fact that the ground water discharging from the Triassic rocks is the most mineralized in the county--typically a hard, high sulfate water in deep wells. In turn, the more mineralized water in the Triassic rocks reflects the presence of more soluble minerals (calcite and possibly gypsum) plus longer transit time for the circulating ground water. The northern section of the Triassic area is typified by calcium magnesium bicarbonate waters in the streams, whereas the southern section shows more of a calcium magnesium sulfate chloride water.

The diagrams on plate 1 show the effects of urbanization on stream quality and in conjunction with maps of the chemical quality of ground water in Fairfax County (Larson 1978), show the similarity of ground-water chemistry to the surface-water chemistry in the less populated areas.

A further comparison was made using reacting values of cations (Ca, Mg, Na, K) and anions (HCO_3, CO_3, SO_4, Cl) in order to compare these ions on an equivalent base. Table 5 shows the percentages of the constituents and their chemical balance. These percentages are plotted on trilinear diagrams of Piper (1944), which facilitate comparisons of the different waters, as shown in figure 10. The figure shows a good grouping of the cations (lower left triangle). Projecting these points into the upper diagram along parallel lines give the overall chemical balance for each sample. Most of the samples plot within a thirty percent range. The waters from the Triassic drainage areas show the greatest variation in composition (Nos. 1, 2, 3, 41, and 43). Higher concentrations of sulfate plus chloride typify waters of the southern Traissic basins, and higher concentrations of bicarbonate plus carbonate typify waters of the northern Triassic basins.

The water from Piney Branch near Vienna (No. 7) is the only other sample that lies an appreciable distance from the main grouping. As mentioned previously this water has a high sodium chloride content probably owing to upstream pollution. The other variations seen in figure 10 reflect variations in geology and degree of urbanization.

Table 5.-- Chemical balance of cations and anions in waters from streams in Fairfax County, Virginia

***NOTE: ANALYSES WERE CHECKED FOR CHEMICAL BALANCE AND RETAINED FOR PLOTTING (THOSE THAT DO NOT BALANCE ARE DENOTED BY A -)

IDENT.NO.	SAMPLE IDENTIFICATION DATE/T/P/D TIME	DEPTH OR DISCHARGE	PERCENTAGES NA+K	CA+MG	CA	MG	HCO3+ CO3	CL+SO4 +NO3	CL	SO4	NO3	BALANCE
1.	HORSEPEN RUN NR FLORIS VA 1977 8 5 1320	-1.0	18.93	81.07	60.14	20.93	84.13	15.87	9.60	6.25	-1.00	-0.91
2.	HORSEPEN RN NR HERNDON VA 1977 8 5 1255	-1.0	17.60	82.40	60.75	21.65	85.07	14.93	9.23	5.68	-1.00	1.04
3.	SUGARLAND RUN AT HERNDON VA 1977 8 5 1105	-1.0	53.42	46.58	31.46	15.12	55.64	44.36	11.90	32.28	-1.00	-0.93
4.	SUGARLAND RUN NEAR DRANESVILLE, VA. 1977 8 5 1215	-1.0	21.29	78.71	56.78	21.93	73.59	26.41	11.56	14.74	-1.00	0.95
5.	NICHOLS RUN NEAR DRANESVILLE VA 1977 8 5 1115	-1.0	34.17	65.83	39.67	26.15	77.71	22.29	14.05	8.07	-1.00	-1.15
6.	SF LITTLE DIFFICULT RUN NEAR FAIRFAX VA 1977 8 29 1215	-1.0	43.42	56.58	33.71	22.88	72.60	27.40	21.61	5.47	-1.00	0.91
7.	PINEY BRANCH AT VIENNA VA 1977 8 29 1300	-1.0	72.31	27.69	20.70	6.99	7.06	92.94	90.04	2.85	-1.00	0.99
8.	WOLFTRAP CR NR VIENNA VA 1977 8 [illegible] 1207	-1.0	35.30	64.70	42.31	22.38	65.24	34.76	23.45	11.11	-1.00	1.04
9.	COLVIN RUN AT RESTON, VA. 1977 8 5 1420	-1.0	36.51	63.49	39.89	23.60	61.37	38.63	30.88	7.52	-1.00	0.94
10.	PINEY RUN AT RESTON, VA. 1977 8 29 1400	-1.0	37.20	62.80	32.27	30.53	49.54	50.46	41.82	8.21	-1.00	-0.76
11.	DIFFICULT RUN NEAR GREAT FALLS VA 1977 8 31 815	-1.0	36.10	63.90	41.24	22.66	62.64	37.36	24.77	12.10	-1.00	1.01
12.	SCOTT RUN NEAR MCLEAN VA 1977 8 5 1000	-1.0	25.28	74.72	49.39	25.32	49.19	50.81	29.78	20.89	-1.00	-0.89
13.	PIMMIT RUN NEAR FALLS CHURCH VA 1977 8 4 1415	-1.0	45.30	54.70	39.06	15.63	41.55	58.45	46.72	11.90	-1.00	0.95
14.	PIMMIT RUN AT ARLINGTON, VA. 1977 8 5 900	-1.0	29.53	70.47	48.39	22.08	55.22	44.78	26.68	17.90	-1.00	-0.87
15.	LITTLE PIMMIT RUN TRIBUTARY AT ARLINGTON VA 1977 8 4 1510	-1.0	34.94	65.06	45.11	19.95	44.45	55.55	40.46	14.94	-1.00	-0.85
16.	LITTLE PIMMIT RUN AT ARLINGTON VA 1977 8 4 1600	-1.0	29.50	70.50	52.06	18.45	55.31	44.69	32.14	12.43	-1.00	0.96
17.	LONE BRANCH AT ARLINGTON VA 1977 8 5 855	-1.0	33.61	66.39	51.20	15.19	38.12	61.88	34.18	27.46	-1.00	0.96
18.	LUCKY RUN AT ARLINGTON, VA. 1977 8 4 1420	-1.0	27.16	72.84	57.27	15.57	51.87	48.13	34.39	13.30	-1.00	0.99
19.	FOURMILE RUN AT ALEXANDRIA VA 1977 8 31 950	-1.0	35.96	64.04	47.25	16.79	39.99	60.01	35.07	24.88	-1.00	1.00
20.	HOLMES RUN AT BEARFIELD VA 1977 8 4 1130	-1.0	31.64	68.36	50.78	17.58	39.94	60.06	30.96	28.58	-1.00	-0.93
21.	HOLMES RUN NEAR ANNANDALE VA 1977 8 5 945	-1.0	33.83	66.17	47.55	18.61	58.71	41.29	27.30	13.88	-1.00	0.98

Table 5.--Continued

22.	TRIPPS RUN AT FALLS CHURCH VA 1977 A 4 1300	-1.0	31.35	69.65	56.46	12.19	59.50	40.50	24.51	10.90	-1.00	0.97
23.	TRIPPS RUN TRIBUTARY NEAR FALLS CHURCH VA 1977 A 5 1040	-1.0	29.63	70.37	52.31	18.06	41.58	58.42	25.27	32.52	-1.00	0.97
24.	TRIPPS RUN NEAR FALLS CHURCH VA 1977 B 5 1012	-1.0	30.74	69.26	54.03	15.22	60.02	39.98	21.60	18.23	-1.00	0.96
25.	BACKLICK RUN AT ALEXANDRIA VA 1977 A 5 1000	-1.0	33.46	66.54	47.74	18.80	45.73	54.27	40.63	13.64	-1.00	1.00
26.	CAMERON RUN AT ALEXANDRIA, VA. 1977 A 30 1315	-1.0	35.38	64.62	46.31	18.32	41.41	58.59	38.95	19.17	-1.00	0.91
27.	PIKE BRANCH AT ALEXANDRIA VA 1977 B 4 1200	-1.0	37.14	62.86	43.57	19.30	41.04	58.96	40.09	18.50	-1.00	-0.92
28.	PEN DAW OUTFALL AT ALEXANDRIA, VA. 1977 B 4 1230	-1.0	40.09	59.91	42.56	17.35	35.15	64.85	44.29	20.06	-1.00	-0.89
29.	LITTLE HUNTING CREEK AT GUM SPRINGS VA 1977 B 4 1300	-1.0	38.33	61.67	50.21	11.46	36.75	63.25	46.21	16.62	-1.00	-0.92
30.	DOGUE CREEK NEAR ACCOTINK, VA. 1977 B 4 1345	-1.0	38.42	61.58	38.29	23.30	46.30	53.70	32.37	20.98	-1.00	0.93
31.	ACCOTINK CREEK AT FAIRFAX VA 1977 B 1 1330	-1.0	35.10	64.90	44.07	20.82	63.12	36.88	24.84	11.92	-1.00	-0.94
32.	LONG BRANCH AT VIENNA VA 1977 A 1 1415	-1.0	31.71	68.29	44.56	23.73	57.26	42.74	31.32	11.25	-1.00	-0.93
33.	LONG BRANCH NEAR ANNANDALE, VA. 1977 B 4 945	-1.0	34.28	65.72	44.97	20.75	59.93	40.07	27.17	12.89	-1.00	0.92
34.	ACCOTINK C BY ACCOTINK STATION VA 1977 A 30 1145	-1.0	34.41	65.59	48.14	17.45	42.87	57.13	32.80	23.98	-1.00	-0.78
35.	RABBIT BRANCH NEAR BURKE VA 1977 A 29 1900	-1.0	41.99	58.01	35.51	22.51	68.05	31.95	26.42	5.54	-1.00	0.99
36.	POHICK CREEK NEAR SPRINGFIELD VA 1977 A 5 845	-1.0	34.25	65.75	45.36	20.39	56.80	43.20	24.29	18.85	-1.00	-0.90
37.	MIDDLE RUN NEAR LORTON, VA. 1977 A 5 945	-1.0	36.39	63.61	47.84	15.77	67.49	32.51	20.85	11.58	-1.00	0.99
38.	SOUTH RUN NEAR LORTON VA 1977 A 5 1045	-1.0	42.36	57.64	38.57	19.07	74.70	25.30	14.63	10.45	-1.00	0.92
39.	POHICK CREEK AT LORTON VA 1977 A 30 1100	-1.0	33.66	66.12	46.43	19.29	57.82	42.18	26.48	15.47	-1.00	0.91
40.	FLATLICK RN AT CHANTILLY VA 1977 A 1 1345	-1.0	24.57	75.43	55.17	20.26	61.59	38.41	24.64	13.85	-1.00	1.01
41.	CUB RUN NEAR CENTREVILLE, VA. 1977 A 30 815	-1.0	37.75	62.25	44.77	17.49	21.67	78.33	54.51	23.84	-1.00	-0.86
42.	BIG ROCKY RUN NR CENTERVILLE VA 1977 B 30 730	-1.0	45.24	54.76	38.78	15.98	38.59	61.41	42.95	17.47	-1.00	0.96
43.	LITTLE ROCKY RUN AT COMPTONS COR VA 1977 A 30 900	-1.0	49.90	50.10	31.34	18.76	18.34	81.66	74.82	6.84	-1.00	0.95
44.	JOHNNY MOORE CR NR CLIFTON VA 1977 A 5 1440	-1.0	32.04	67.96	36.75	31.21	75.18	24.82	9.64	15.02	-1.00	-0.88
45.	ROPES RD CR NR FAIRFAX VA 1977 A 29 1100	-1.0	37.19	62.81	35.71	27.10	57.70	42.30	29.92	12.15	-1.00	-0.89
46.	ROPES RD CR AT CLIFTON VA 1977 A 5 1340	-1.0	33.75	66.25	38.36	27.89	67.01	32.99	20.45	12.45	-1.00	1.03
47.	WOLF RUN RN CLIFTON VA 1977 A 5 1230	-1.0	31.94	68.06	44.88	23.17	79.59	20.41	12.17	8.14	-1.00	1.05
48.	SANDY RUN NEAR FAIRFAX STATION VA 1977 A 5 1145	-1.0	31.78	68.22	42.36	25.86	78.22	21.78	11.99	9.88	-1.00	1.06
49.	GILES RUN NEAR OCCOQUAN VA 1977 A 4 1445	-1.0	44.07	55.93	37.78	18.16	40.04	59.96	39.75	20.01	-1.00	0.98

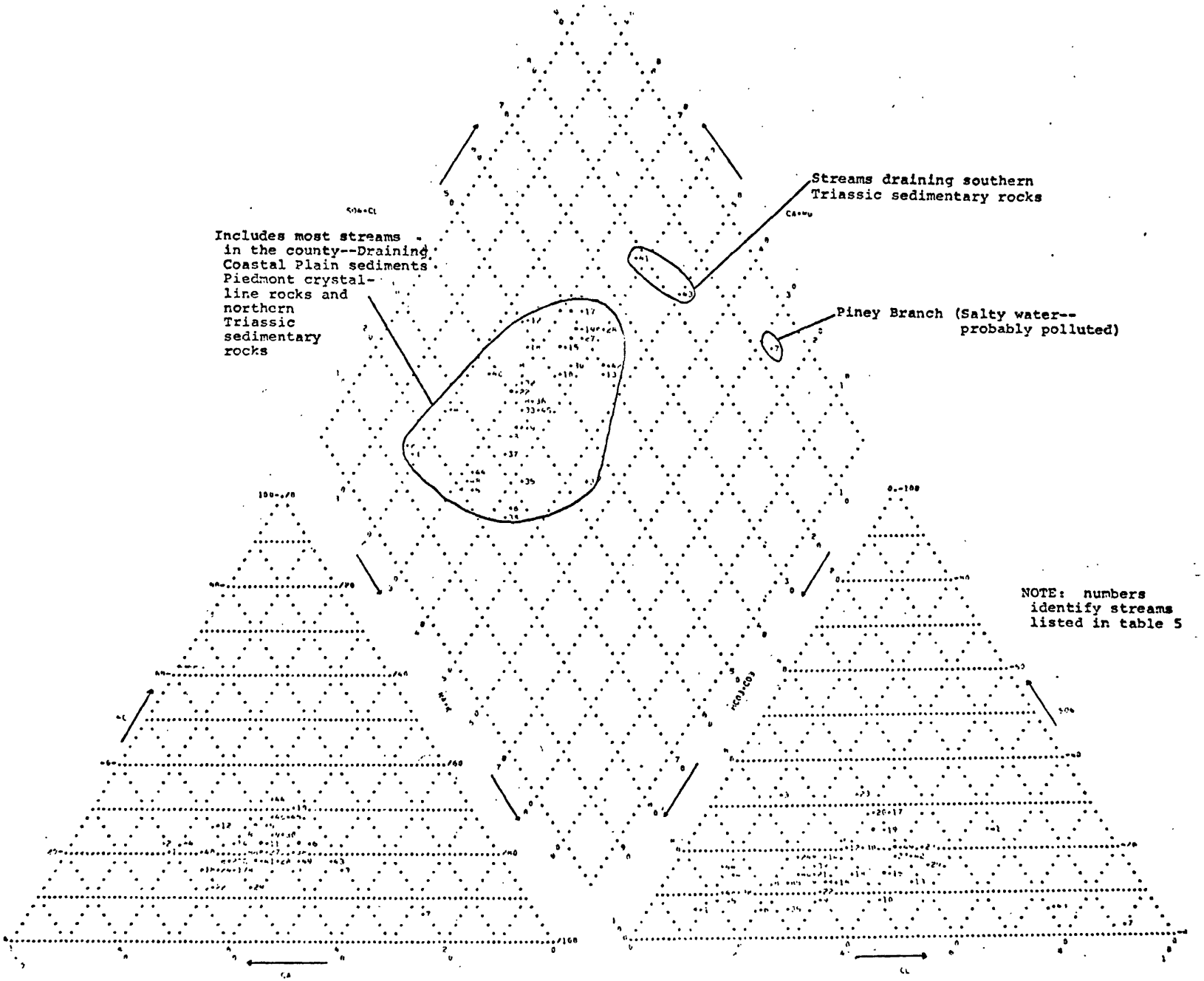


Figure 10.--Chemical analyses of stream waters in Fairfax County represented by three points in trilinear diagram

Conclusions

The water and stream-bed material collected from streams in Fairfax County during this study was found to be of generally excellent chemical quality. No pollutants were identified except for high sodium chloride in Piney Branch and high PCB content in Cub Run. A comparison of streams draining urbanized and unurbanized areas in the same geologic terrane indicated higher dissolved solids concentration in the waters of the urbanized areas. The greatest influence of geology on water quality is observed in streams draining the Triassic rocks. This is caused by the greater solubility of carbonate material in the Traissic sandstone and shale as compared to the less soluble minerals in granite, gneiss, schist, etc. Plate 1 indicates the effects of geology and urbanization on stream quality in addition to providing a baseline against which future stream-quality may be compared.

The generally low pesticide and metal concentrations in the stream sediments suggest a lack of adverse effects due to industry or agriculture on stream environments in the county.

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