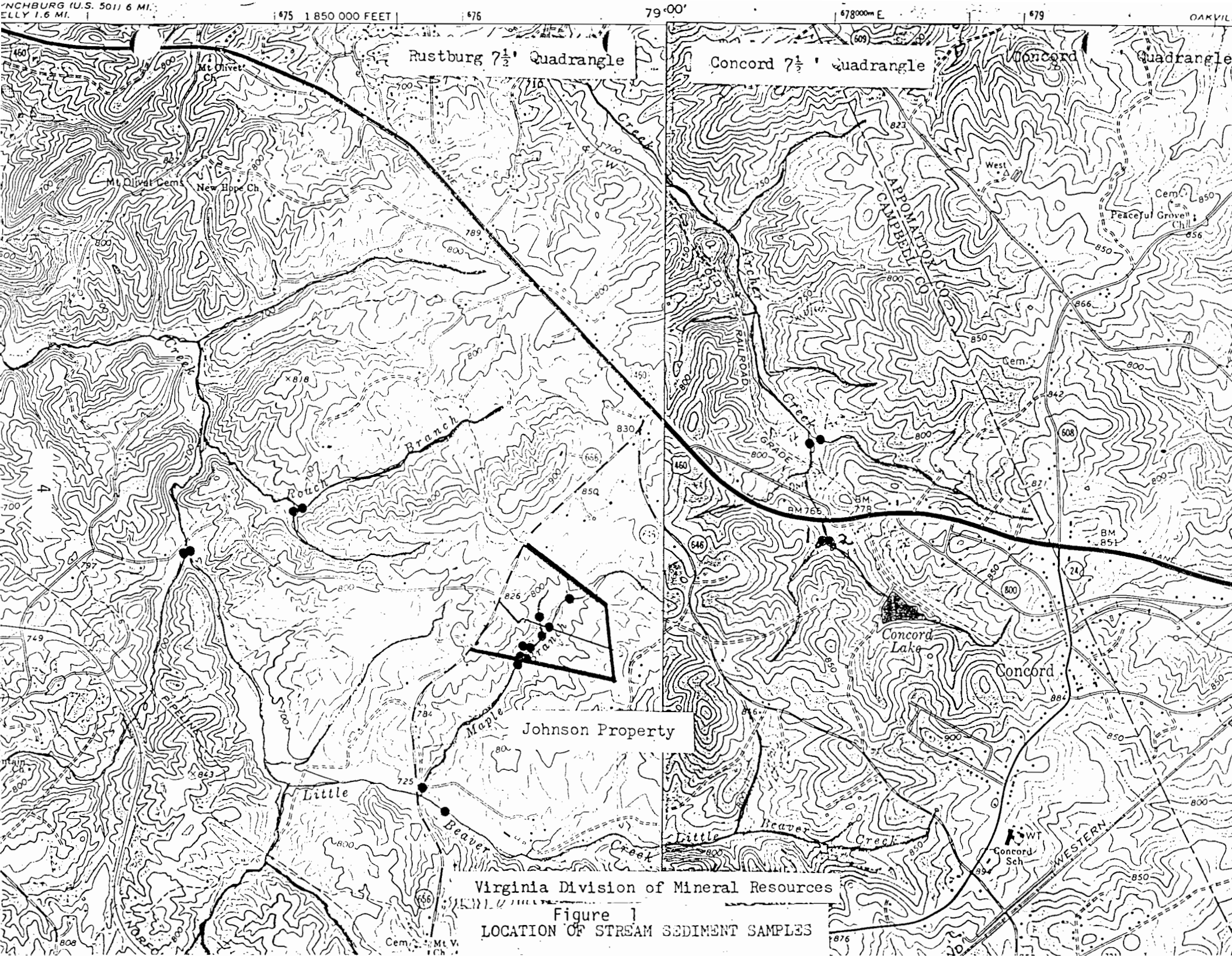

Virginia Division of Mineral Resources

Figure 1
LOCATION OF STREAM SEDIMENT SAMPLES

Figure 2. Location of Geochemical Samples and Gamma Spectrometer Traverse.

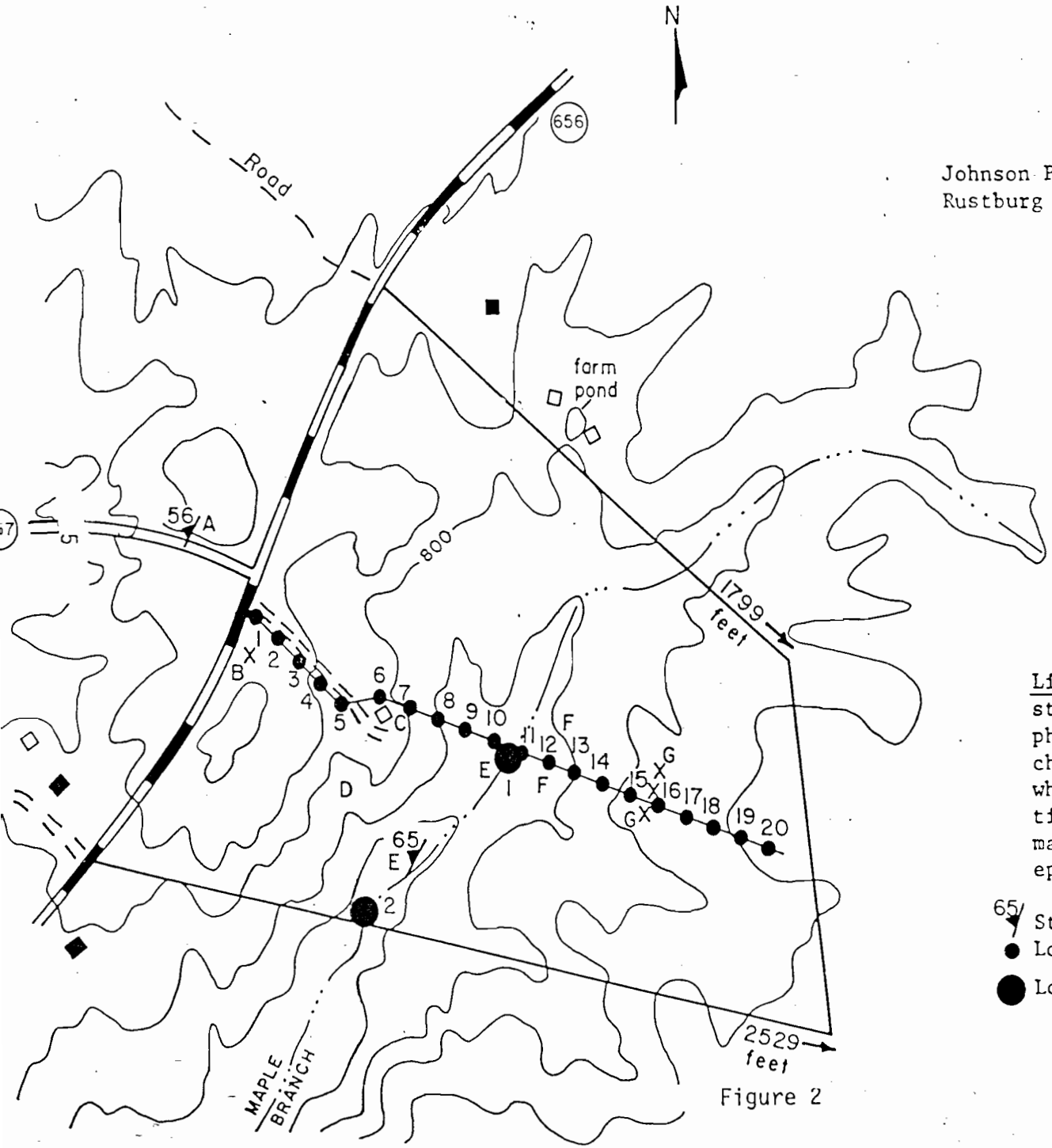

Figure 2

Johnson Property, Campbell County, Va.
Rustburg 7½ Minute Quadrangle.

Lithology: Tan, polydeformed, garnet-staurolite-chlorite schists (A), grey phyllites, phyllonites greenish garnet chlorite staurolite schists, silvery white micaceous quartzites (E), mylonitized and brecciated quartz veins; magnetite, limonite and Mn stains (B,G); epidosite float, floodplain near E.

65 Strike and dip of foliation

● Location of soil sample

● Location of stream sediment sample

0 1000 feet

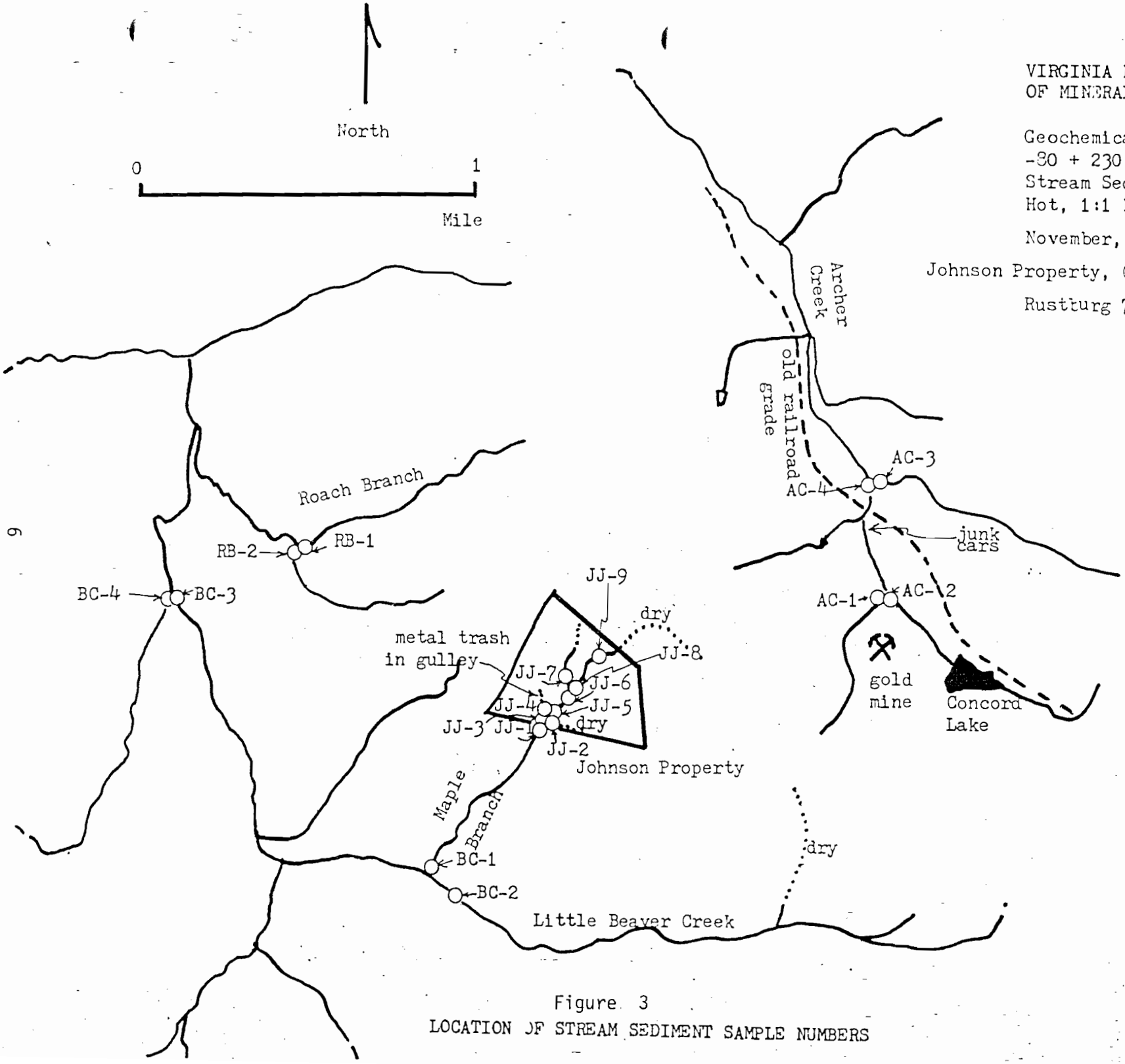

Figure 3
LOCATION OF STREAM SEDIMENT SAMPLE NUMBERS

was noted in the floodplain of Maple Branch near a trash-filled gully (Fig. 2, D).

Some of the quartz float and schist (more correctly polydeformed schist or phyllonite rather than phyllite) is stained black with amorphous manganese oxides, or contains small shows of magnetite, hematite, or occasionally boxy limonite (Fig. 2, B and G).

A large (2x3x2) quartz boulder (Fig. 2, B), 105 feet south of the intersection of 656 with the lane to the house, shows black, wad-type staining. X-ray analysis indicates only magnetite and hematite with no crystallized manganese mineralization. These shows are sparse and common in this part of the Piedmont. No area that could be characterized as gossan-like was noted. Wad-type staining was also noted in foundation rock of the farmhouse.

About 2½ miles northwest of the Johnson property there is a narrow, mineralized belt containing manganese, iron, and barite mines and prospects. Barite occurs within this belt about 4 to 4½ miles west-southwest of the property (Fig. 4). Brown (1958), taking much of his information on mineralization from Espenshade (1954), mapped these stratabound deposits within lower Paleozoic carbonates (Mount Athos marble), felsic tuffs, felsic flows, and pelitic sediments, quartzites, and conglomerates. Barite and manganese are apparently found exclusively within the Mount Athos marble. The Mount Athos Formation is also composed of quartzite, conglomerates, and mica schist. Mafic schists, some amygdaloidal, were mapped by Brown as Slippery Creek greenstones, because he was not certain that these mafic schists were Catoctin age volcanics.

51. Iron mine (limonite)
52. Ryan manganese prospects
53. Oxford or Ross iron mine (limonite)
54. Piedmont iron mine (limonite)
55. Piedmont iron mine (limonite)
56. Piedmont (Lerner or Myers) manganese mine
57. Piedmont (Lerner or Myers) manganese mine
58. Quartzite quarry
59. Manganese prospect
60. Harvey manganese mine
61. Manganese prospect
62. Manganese prospect
63. Lindsay manganese prospects
64. Iron prospects (limonite)
65. Lindsay manganese prospects
66. Lindsay marble pit (Mount Athos fm.)
67. Lindsay marble pit (Arch fm.)
68. Lindsay barite prospect
69. Carson barite mine
70. Carson barite mine
71. Neighbours barite mine
72. Iron prospect (limonite)
73. Iron prospect (limonite)
74. Quartzite quarry
75. Quartzite quarry
76. Quartzite quarry
77. Jack Mountain manganese prospect
78. Bethel (Stevens) manganese prospect
79. Blue Ridge Stone Corp. marble quarry (Arch fm.)
80. Neighbours manganese mine
81. Manganese prospect
82. Iron prospect (limonite)
83. Dodson iron mine (limonite)

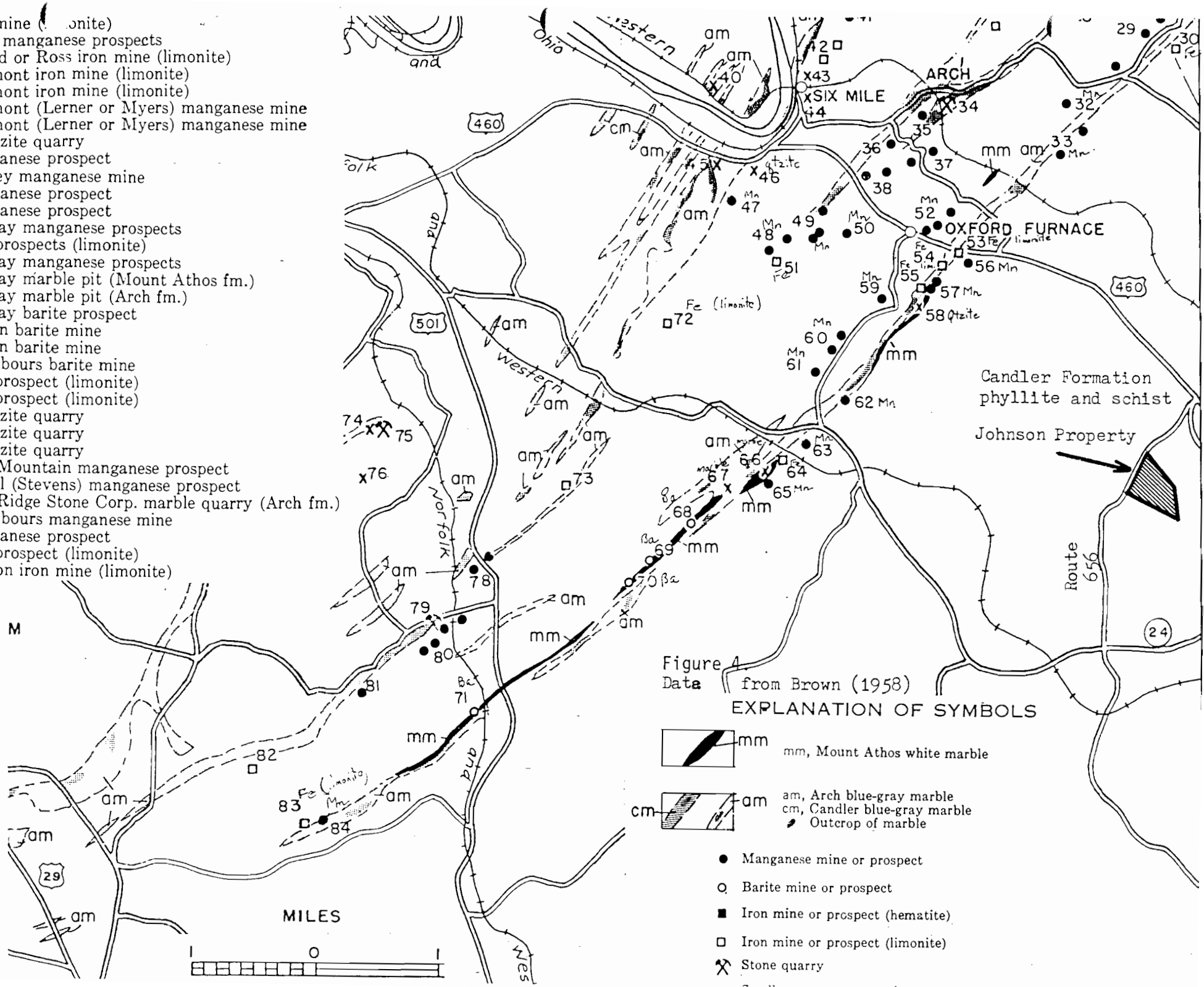

Figure 4
Data from Brown (1958)

Rocks cropping out on the Johnson property were mapped by Brown (1958) as the Candler Formation (Fig. 4). However, the garnet and staurolite schists and quartzites which the writer observed on the Johnson property (Fig. 2) seem more likely to be part of the Fork Mountain Formation, according to J. F. Conley (personal communication). The Fork Mountain Formation in Virginia and North Carolina contains both precious metals and base metal occurrences, a few of which were mined in the past. In the writer's opinion another stratigraphic interpretation could be that the mica schists, greenstones, and quartzites are equivalent to Cambrian Chopawamsic sediments and volcanics. The Chopawamsic and Candler Formation lie on strike to the northeast in the central and northern Piedmont and contain gold and volcanogenic massive sulfides which have been mined in the past. The results of the stream sediment geochemistry suggest the presence of copper and zinc-bearing volcanogenic massive sulfides (pyrite or pyrrhotite) within or close to the Johnson property. Some quartzite float (recrystallized chert?) contains boxy limonite which could represent disseminated pyrite or chalcopyrite.

No gold was noted in the few pan concentrates that were examined. Chemical examination of panned concentrates and of some of the highly crushed vein quartz would be needed for further assessment for gold. Gold mineralization is reported 3/4 of a mile due east of the Johnson property line, just west of Concord Lake (Concord 7½' Quadrangle, Figures 1 and 5). Conversations with local residents by D. Trimble in 1980 helped locate old workings 2000 feet north-northeast of Route 646 and 700 and 900 feet west of Concord Lake. Inspection of the wooded area west of Concord Lake in September, 1983 showed three small test

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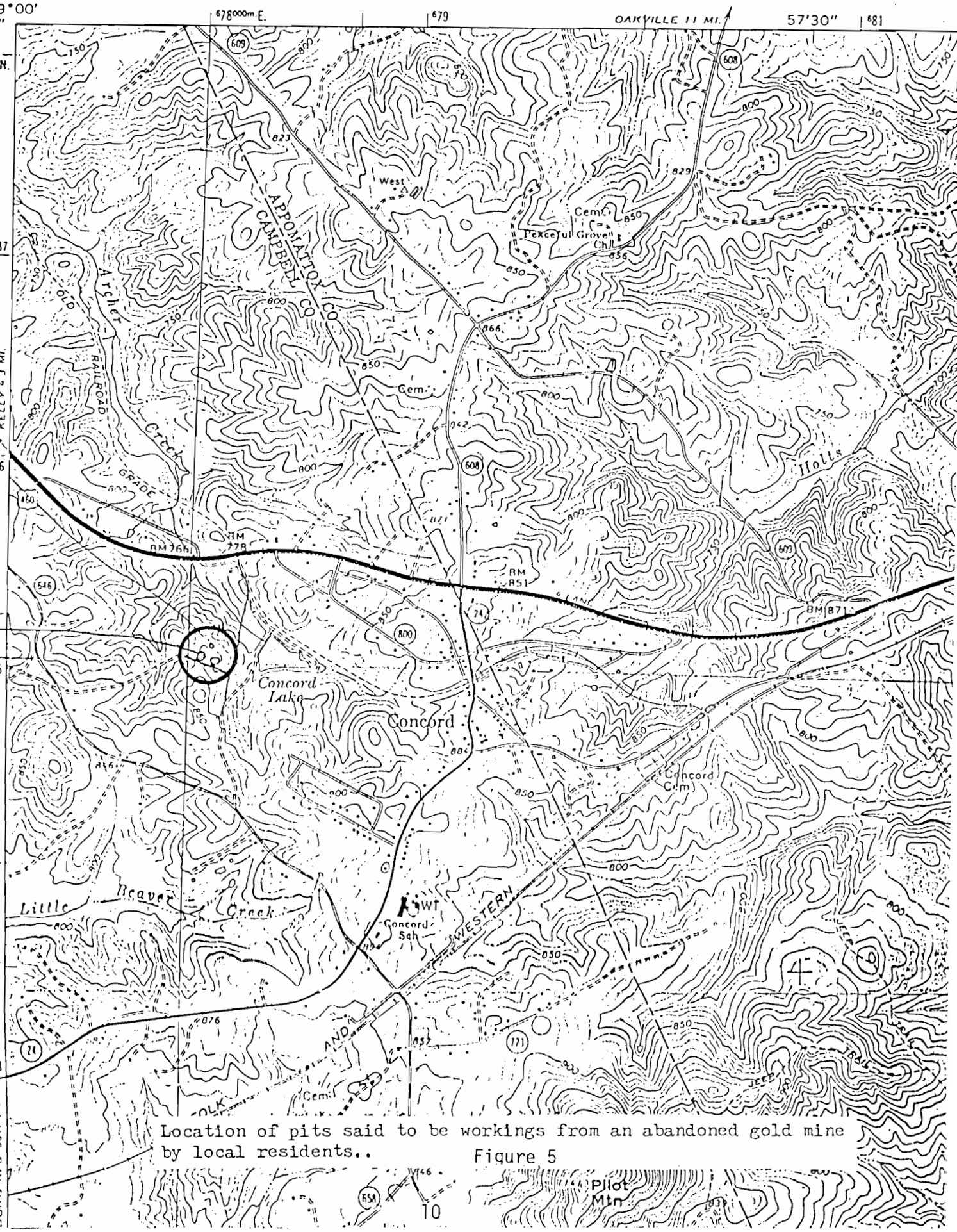
GEOLOGICAL SURVEY



Location of pits said to be workings from an abandoned gold mine by local residents..

Figure 5

pits with quartz float on the dumps. One 8' x 8' x 3' area was apparently a shaft which was said to be 40-50 feet deep and filled in recently by bulldozer. According to local residents the "Concord Mine" was worked before the Civil War and again in the 1920's and 1930's and early 1940's. Gold and pyrite were apparently mined and the mine was said to have been shut down because of water problems.

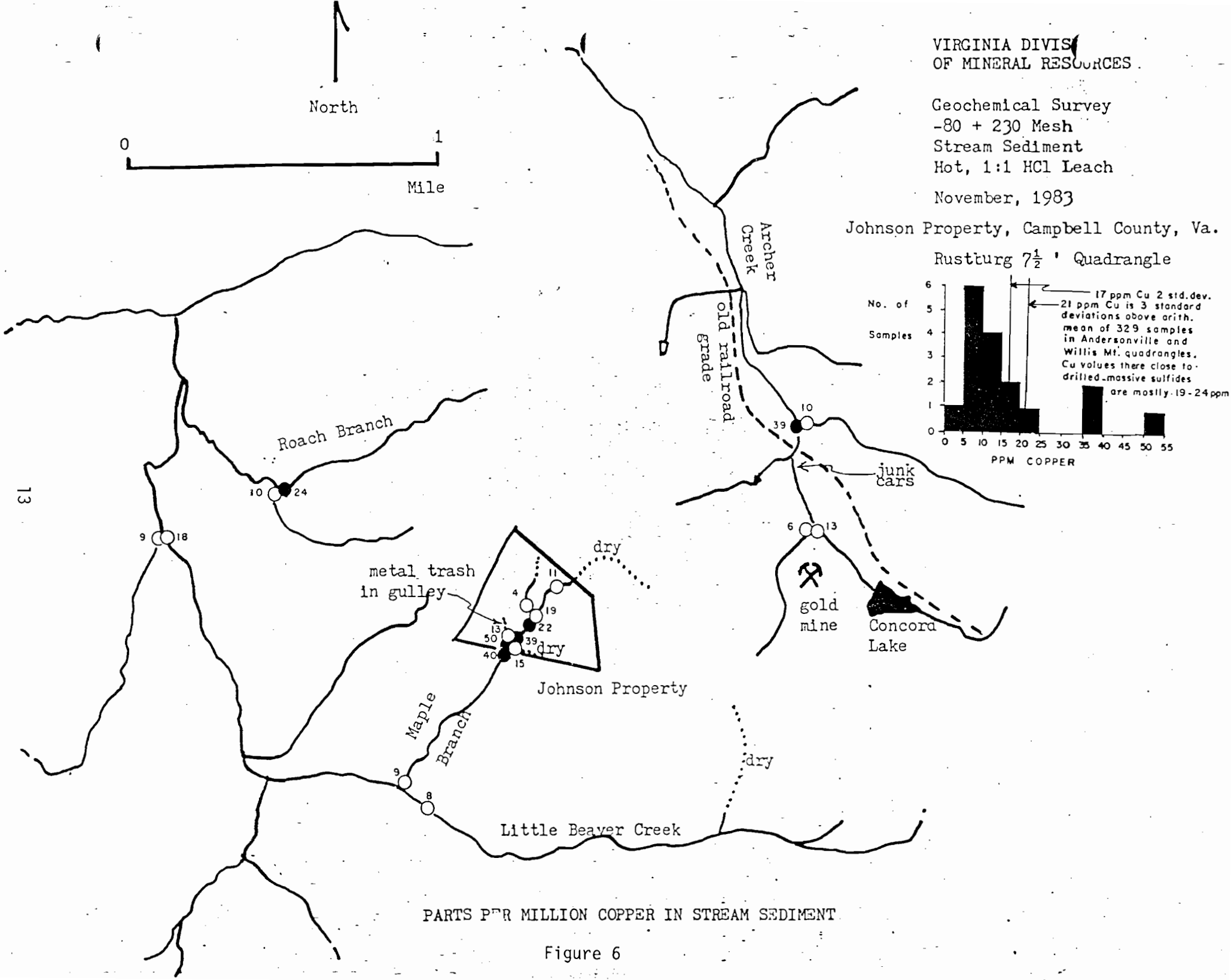
Geochemical Results

Based on previous experience in geochemical exploration in the Virginia Piedmont (Fordham and Good, 1976; Good and Fordham, 1977a Good and Fordham, 1977b; Good, 1981), evaluation of the two stream sediment samples taken during the initial examination of the Johnson property would be considered anomalous for copper. The values of 40 and 50 parts per million (Fig. 2; Table 1) are larger than 3 standard deviations above the arithmetic means of large populations of stream sediment taken from similar lithologies elsewhere. Statistics with standard deviations less than two above the mean can be subjected to a variety of procedures which may either mask or enhance anomalies. These procedures may involve use of geometric means, logarithmic means, reiterated means with extreme or outlier values removed to avoid distortion by a few high values (because the deviation is a square function), and the use of nonparametric statistical techniques. However, it has been found from experience in Piedmont exploration that, although some valid geochemical anomalies are as low as between one and two standard deviations above the mean, near documented mineralization anomalies more than 3 standard deviations above the mean are virtually independent of statistical

approach and clearly indicate definite mineralization, or the occurrence of very unusual rocks within the drainage.

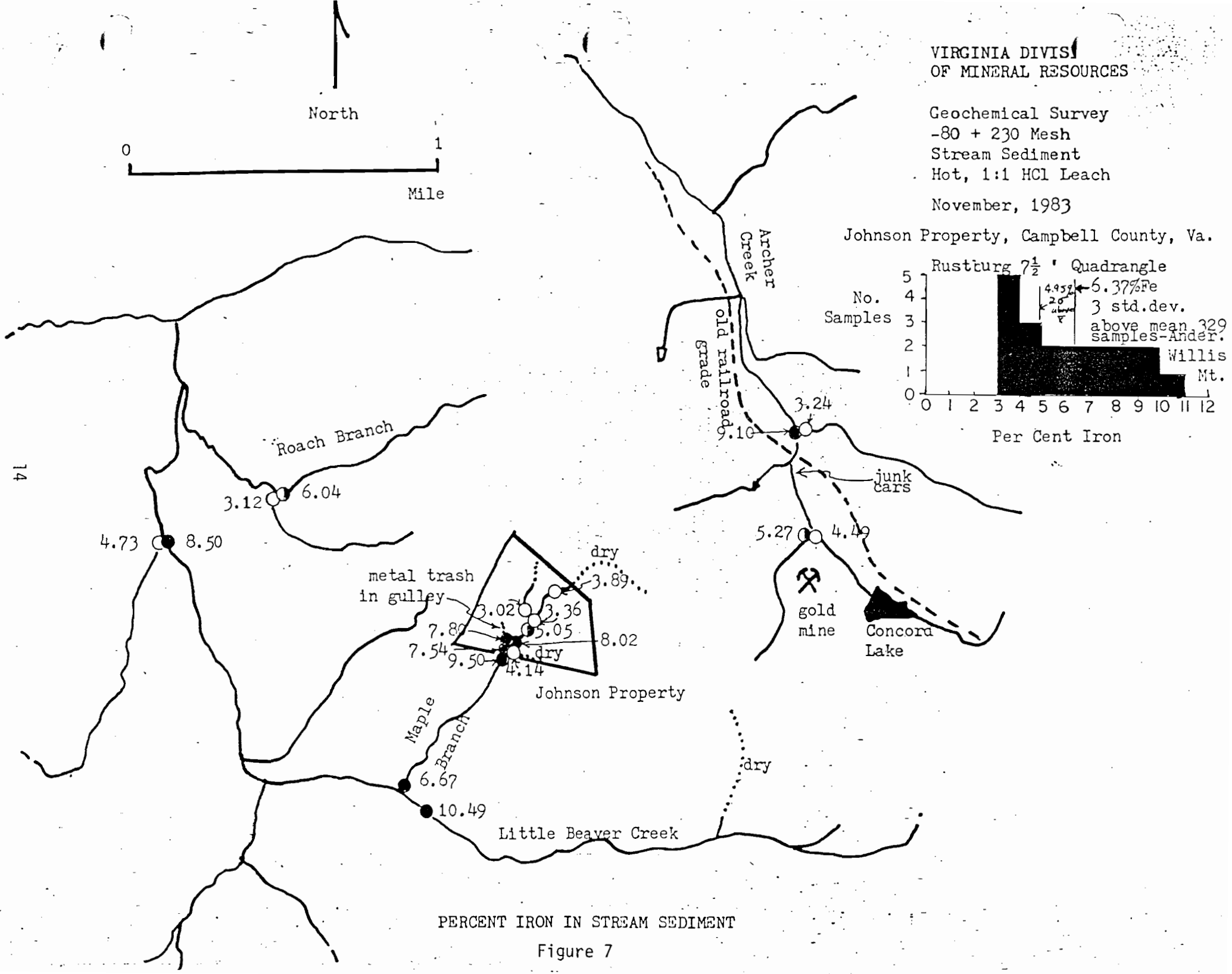
Pollution from chemical dumping, metal trash (galvanized storm pipes), poultry and orchard sprays (copper, arsenic), lead shot, copper whiskey stills or sewage is usually not multielement and has a distinct signature that is different from that generated by mineralization.

On the Johnson property, four samples out of nine are in the 22-50 ppm range. Three of these samples are each three standard deviations above the arithmetic mean of 329 samples analyzed in the Andersonville and Willis Mountain quadrangles, an area containing similar Piedmont rocks (Fig.6; Table 1). Similar anomalous distributions of slightly less than two to more than three standard deviations above the mean can be seen for iron, zinc, cobalt, barium, and nickel (Figs. 7, 8, 9, 10, 11; Tables 4, 5, 6). The four anomalous samples along Maple Branch, Samples JJ-1, JJ-3, JJ-5, and JJ-6 (Fig. 3) are all in the lower parts of the main steam on the property. Samples near the headwaters (JJ-6, JJ-7, JJ-8, and JJ-9) are not anomalous. One sample, JJ-4, from a nearly dry gully filled with metal trash, was not anomalous except for iron. Another drainage to the east of the anomalous samples (JJ-2) from an almost dry depression, was also not anomalous, In the Andersonville Quadrangle, Buckingham County, stream sediments very close to an extensively drilled copper-and zinc bearing massive sulfide are mostly in the 19-24 ppm copper range. These values are slightly below, to slightly greater than, three standard deviations above the mean. Because of the lack of anomalous values from a stream sediment sample taken from drainage downstream from a trash-filled gully, it seems probable that the multi-element in the southern part of the Johnson



PARTS PER MILLION COPPER IN STREAM SEDIMENT

Figure 6



PERCENT IRON IN STREAM SEDIMENT

Figure 7

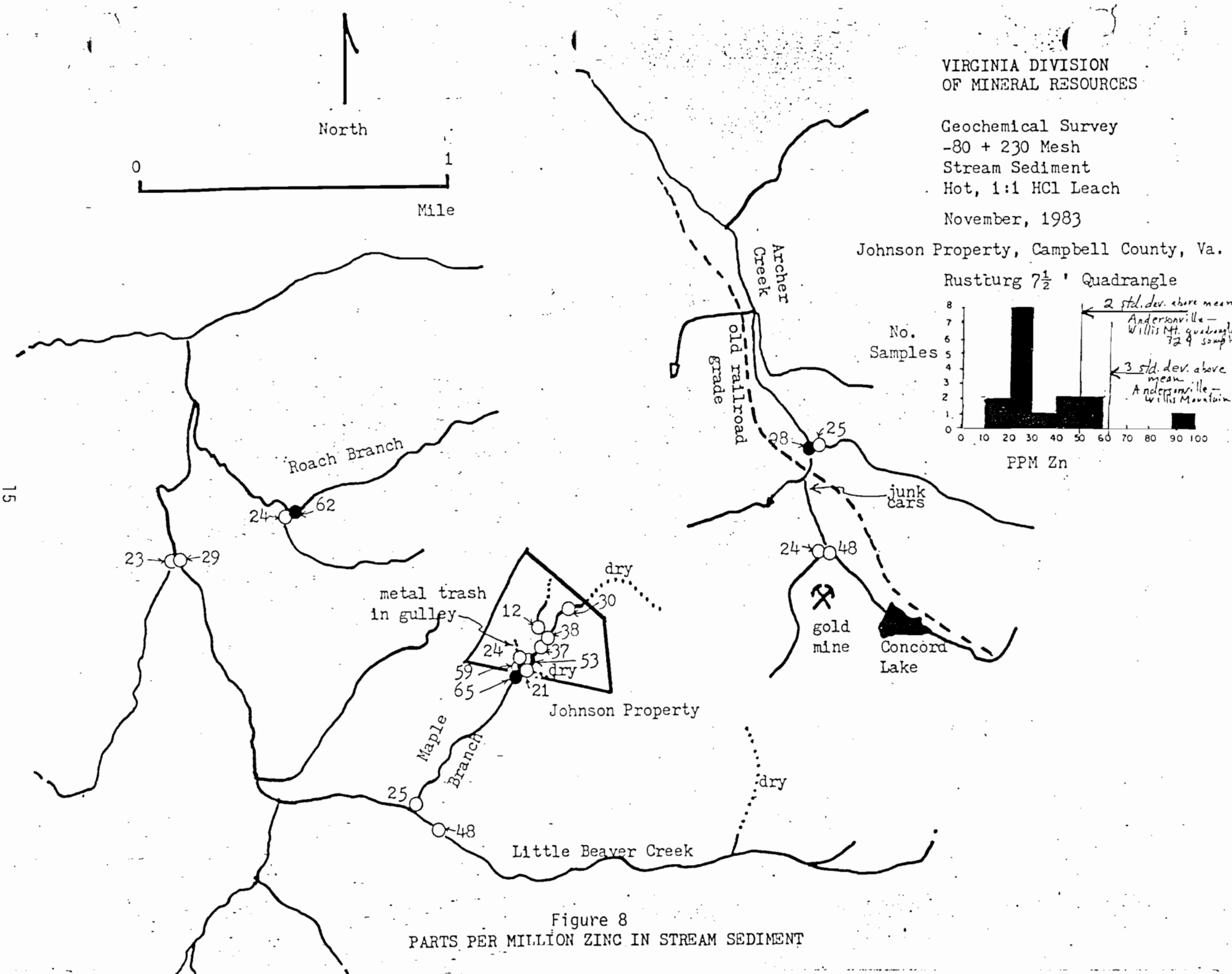
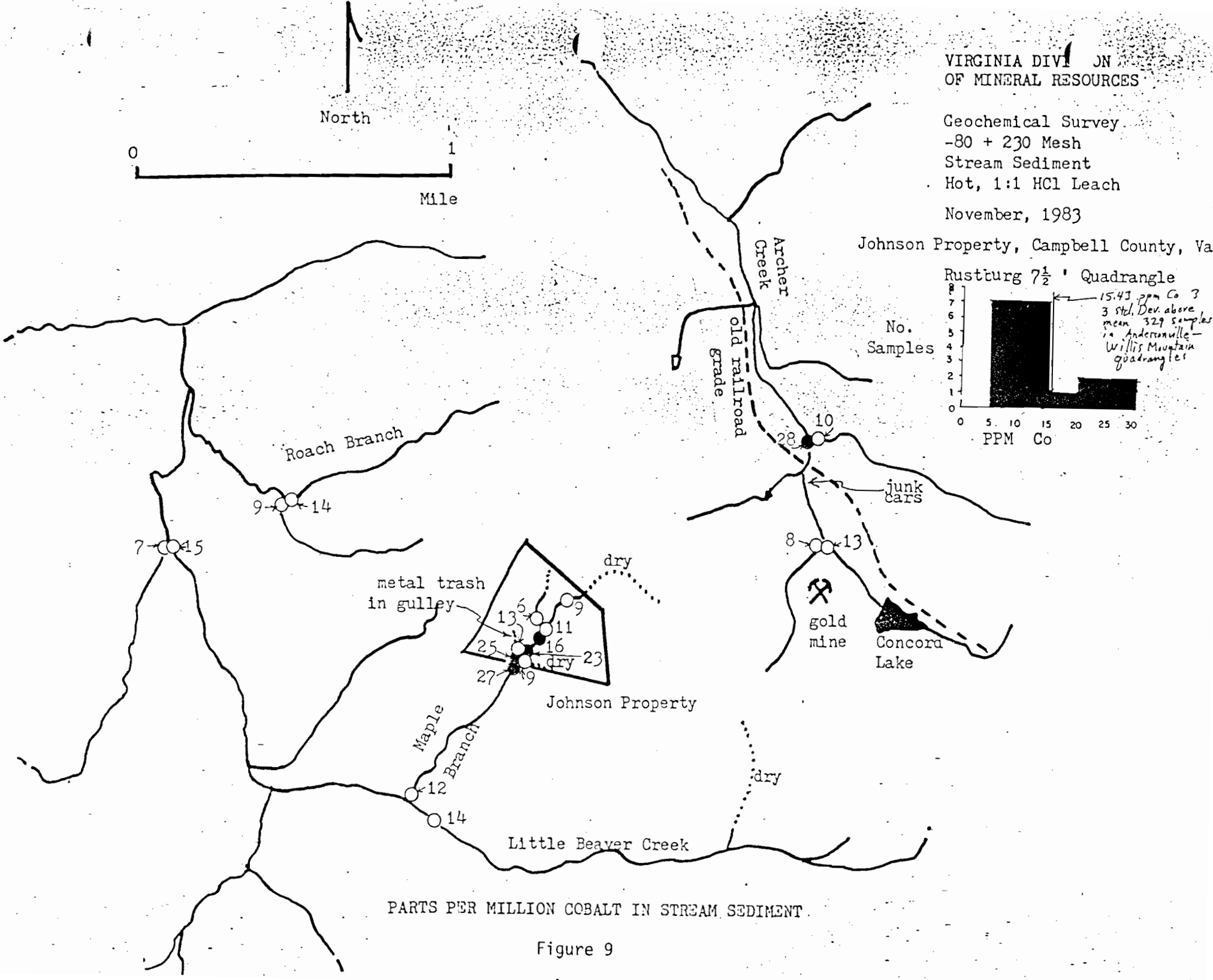
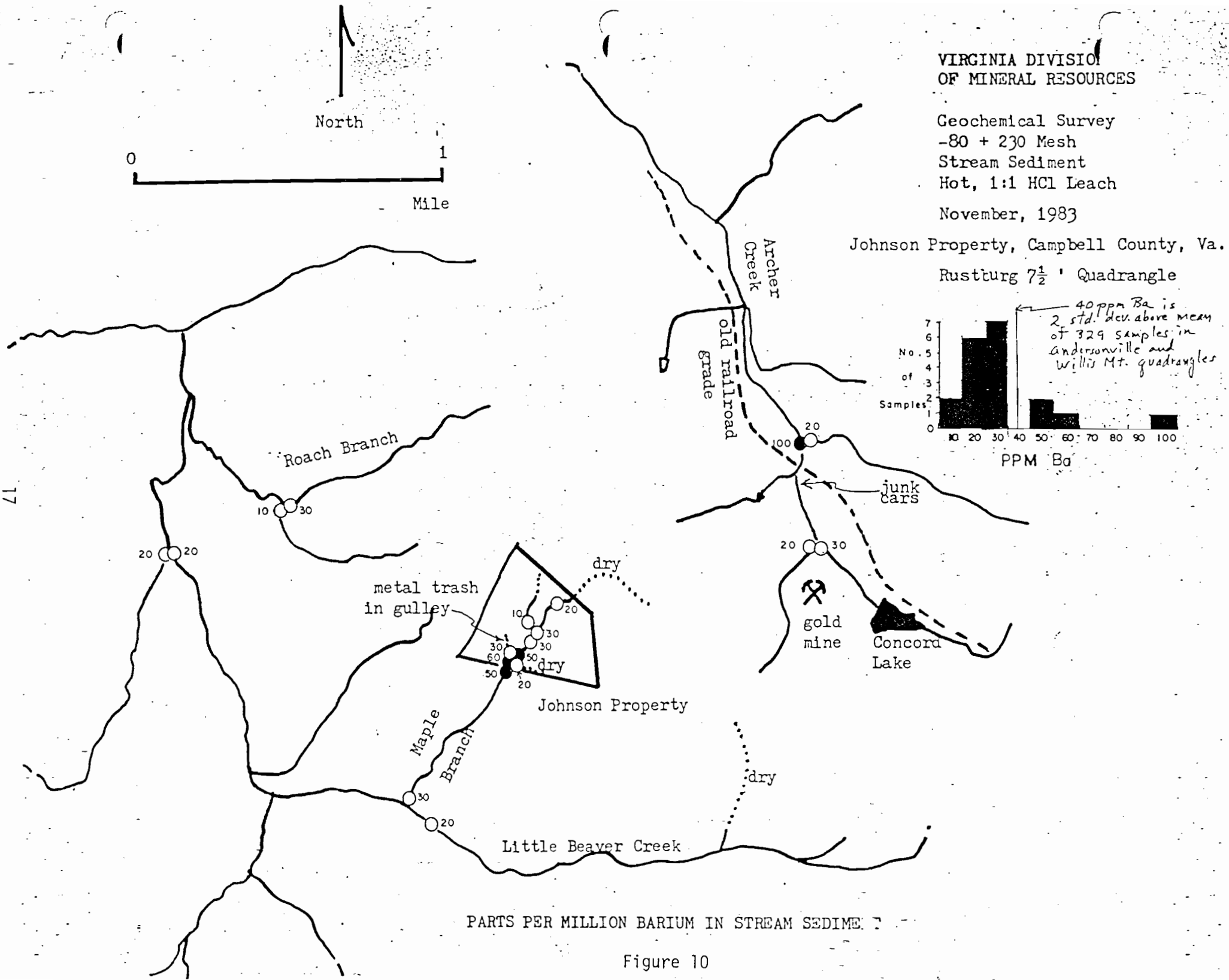


Figure 8
PARTS PER MILLION ZINC IN STREAM SEDIMENT



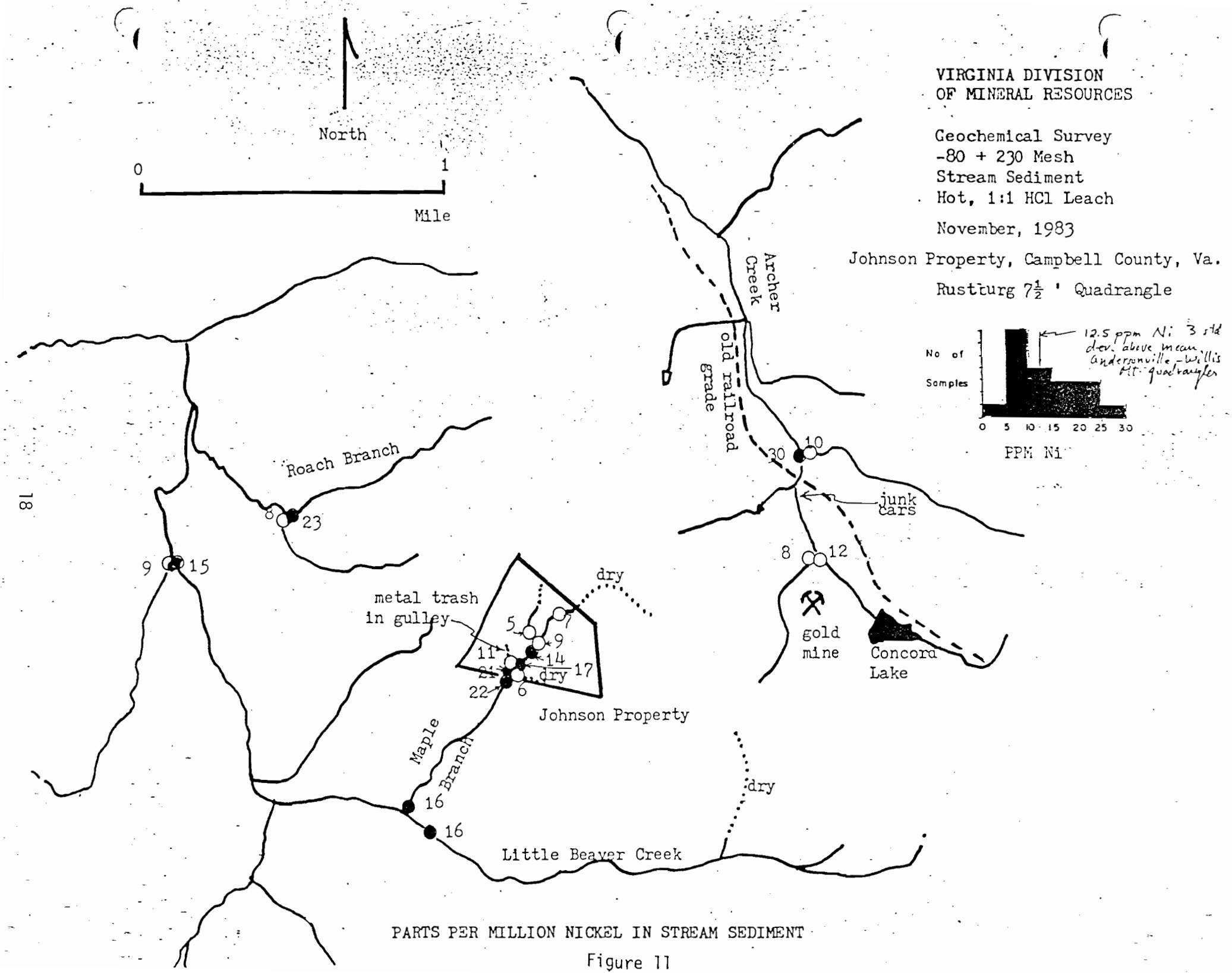
PARTS PER MILLION COBALT IN STREAM SEDIMENT

Figure 9



PARTS PER MILLION BARIUM IN STREAM SEDIME

Figure 10



PARTS PER MILLION NICKEL IN STREAM SEDIMENT

Figure 11

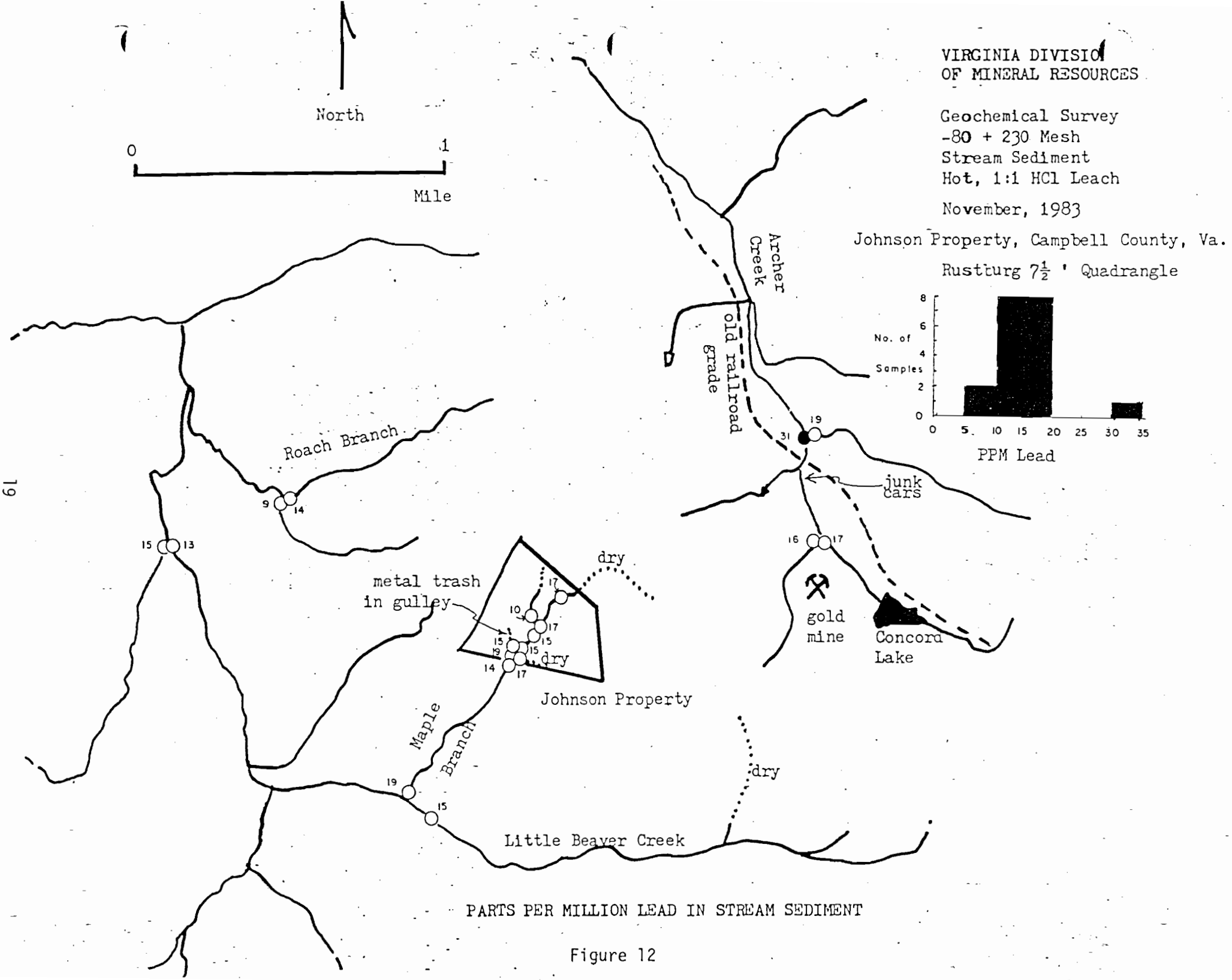
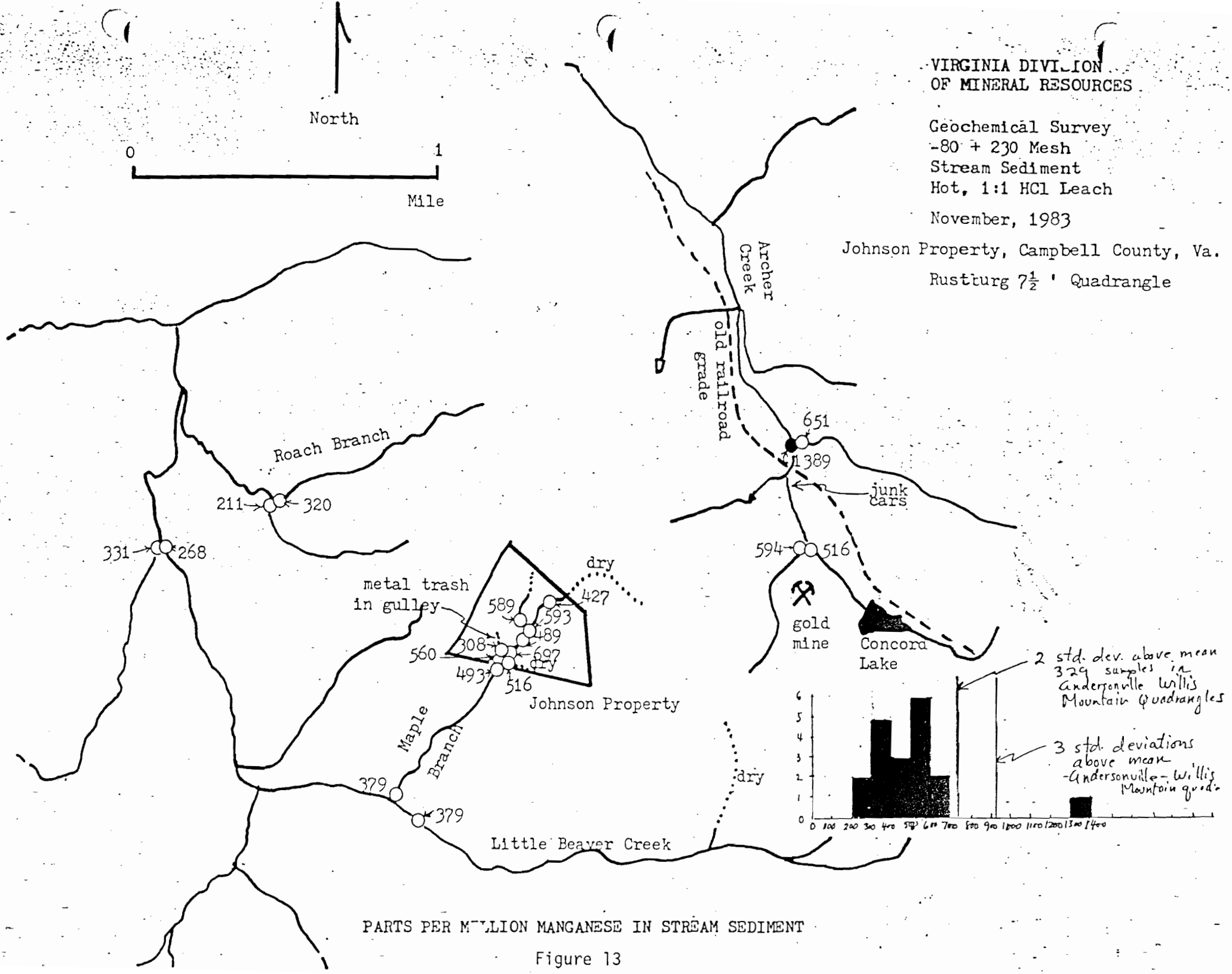
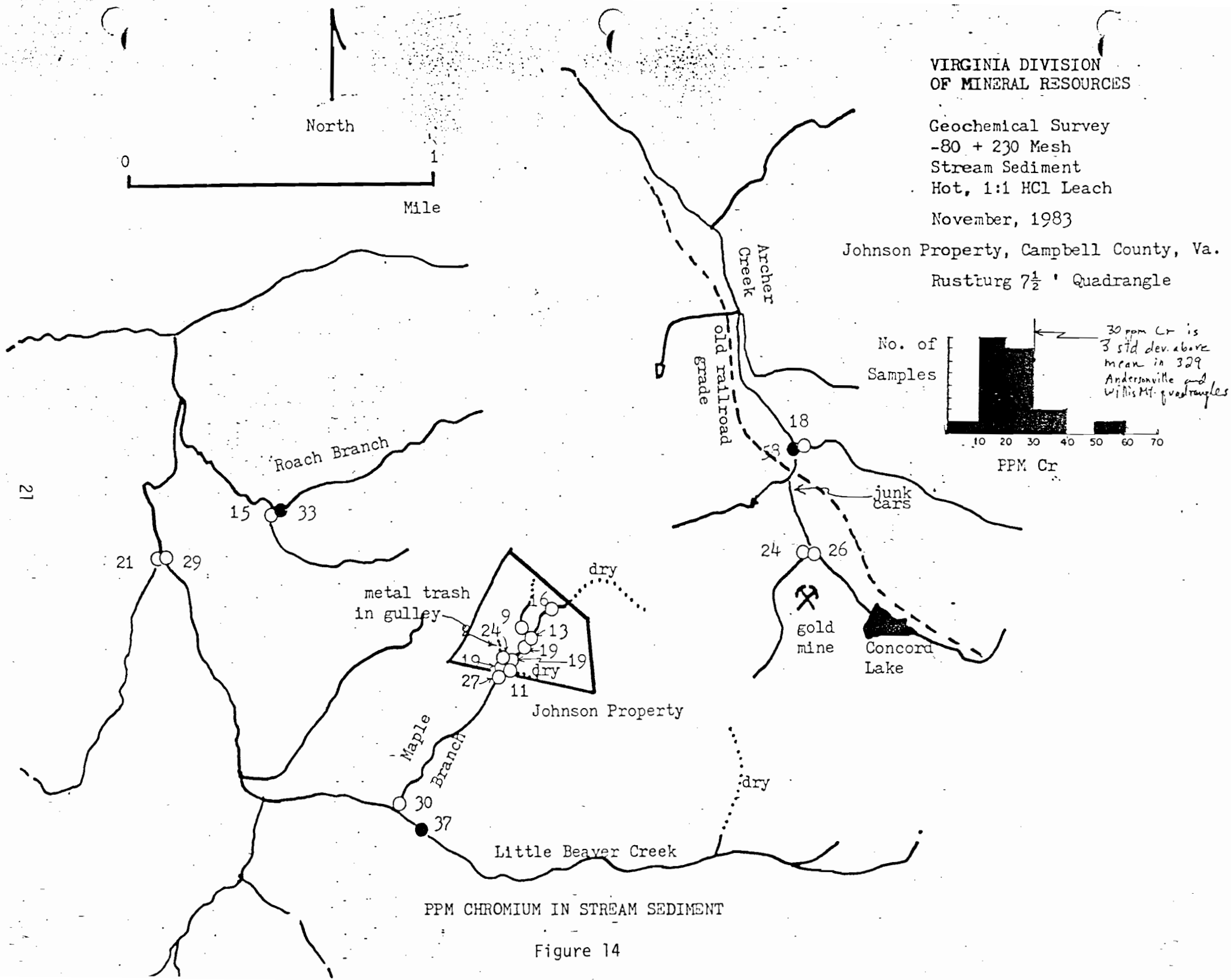

VIRGINIA DIVISION
OF MINERAL RESOURCES
Geochemical Survey
-80 + 230 Mesh
Stream Sediment
Hot, 1:1 HCl Leach
November, 1983
Johnson Property, Campbell County, Va.
Rustburg 7½ ' Quadrangle
North
0
1
Mile
No. of Samples
PPM Lead
Archer Creek
old railroad grade
junk cars
gold mine
Concord Lake
Roach Branch
metal trash in gulley
dry
Johnson Property
Maple Branch
Little Beaver Creek
PARTS PER MILLION LEAD IN STREAM SEDIMENT

Figure 12



PARTS PER MILLION MANGANESE IN STREAM SEDIMENT

Figure 13



PPM CHROMIUM IN STREAM SEDIMENT

Figure 14

property ~~anomaly~~ is generated by hidden mineralization near the surface or from a rock type not exposed. From previous experience in stream sediment geochemistry in the Blue Ridge it is known that the same techniques used in this report have yielded lower average values for granitic rocks (Fordham, 1978) and higher average background values for the Catoctin mafic metavolcanics (Halliday, 1977). No outcrops of greenstones were observed in the area within the Johnson property boundaries, but one piece of float of an epidote-quartz rock (epidosite) was found in the flood plain on the west side of Maple Branch. Brown's (1958) map does indicate small mafic bodies within the Candler Formation which he thought could be Catoctin age equivalents and which were mapped as "greenstone." Such a hidden body could conceivably cause a geochemical anomaly, but in the writer's experience would be likely to do so only if it were clearly exposed or yielded widespread float in the immediate source area. Detailed grid coverage for both soil samples (probably at 50 or even 25 foot intervals) and magnetometer and electromagnetic surveys would be needed to establish definite mineralization. Shallow backhoe or bulldoz~~ing~~er trenching could be used as a cheaper alternative to diamond drilling.

The one soil sample traverse (twenty samples taken at 100 foot intervals at 90° to the regional strike of the foliation) indicated high iron values in samples J-2, J-4, J-6, J-9, J-15, J-16, J-17 (Fig. 2; Table 4) that have been typically associated with massive pyrite or magnetite schists. However, the copper values are not high enough (normally 100-800 ppm copper in soils) to suggest near surface chalcopyrite. The iron and copper in the soil do show a fairly strong correlation with a Pearson coefficient of 0.60 (Table 1). None of the

soil values suggest zinc, nor do the soils indicate barite or manganese mineralization. Different results could be obtained with deeper sampling or closer spacing. It should be noted that the soil traverse did not cross the area of anomalous steam sediment samples.

Geophysical Results

Airborne magnetic data (Fig. 15) shows a magnetic flat area with no relief on or near the Johnson property except a slight "high" of 4711 compared to 4600 gammas background contour. The "high" is on the west side of Route 656 off the Johnson property. The aeromagnetic data does not suggest a large mafic body such as Catoctin or Slippery Creek greenstones covered by mica schists. Small greenstone bodies might only show from ground surveys. No ground data is available because of instrumental difficulties.

Airborne radioactivity coverage to the northeast ends just at the Rustburg quadrangle. Ground coverage was made with a single scintillometer traverse with discriminant functions for total count, potassium, uranium and thorium. Fig. 16 shows total counts ranging from 20 to 39 which reflects lithologic changes and depth of soil cover, but no apparent near surface uranium mineralization. The high at station J-15 was measured for radioactive components and the breakdown was:

Total Count:	38.99 c.p.s
Potassium	3.04
Uranium	0.62
Thorium	0.46

The potassium is largely attributed to muscovite or clay and is the major component. A uranium/thorium ratio of slightly greater than one

is usual for accessory minerals such as zircon or allanite, and does not indicate unleached uranium or thorium mineralization near the surface.

Conclusion

Reconnaissance examination does suggest the definite possibility of base metal mineralization on the Johnson property. Stream sediment analyses indicate anomalously high amounts of iron, copper, zinc, cobalt, barium, and nickel in the southern part of the property along Maple Branch. The strong, multi-element geochemical anomaly was probably generated by unexposed, near surface iron, copper, and zinc sulfide mineralization.

The multimetal character of the anomaly, the lack of anomalous values from a metal-trash filled gully, and the lack of exposures or extensive float of mafic metavolcanic rocks such as Slippery Creek or Catoctin greenstones, or Triassic-Jurassic diabase dikes strongly supports an interpretation of a mineralization anomaly. Point source pollutants (poultry, hog or orchard sprays; copper whiskey stills) generally generate copper or copper-lead anomalies.

Unpublished data from one exploration company that performed geochemical surveying to the northeast of the Johnson property in the 1960's did indicate occurrences of chalcopyrite and sphalerite in zones up to 25 feet thick. The grades were of economic interest but total tonnages small (Dr. Robert S. Young*, personal communication). Barium, iron, and manganese mineralization that was mined occurs two and a half miles to the northwest and gold mineralization that was mined is known 3/4 of a mile to the east of the Johnson property.

No further assessment can be made at this time without more detailed geochemical and geophysical surveying. This would involve grid type soil surveys with deeper auguring in the area surrounding the sediment anomalies. The one soil traverse bisecting the Johnson property did show several high iron values but did not intersect the area containing anomalous sediments. Gridded magnetometer and electromagnetic surveys should also be done. If results of detailed examination proved favorable, trenching and diamond drilling would be necessary to definitely establish potentially economic mineralization. Any additional assessment should be undertaken by private industry.

* Consultant, North American Exploration Company, Charlottesville, VA

Sampling and Laboratory Procedures

Geochemical: Soil samples for geochemical examination were collected at 100-foot intervals along a WNW+ESE traverse cutting across the property roughly at right angle to the NE regional foliation of the metamorphic rocks. Samples were collected by auger from about 6 inch to 1 foot depths, and were oven dried and screened through -80 mesh nylon screen prior to atomic absorption spectrometry at the Virginia Division of Mineral Resources laboratory. One gram of sample was treated with hot 1:1 HCl acid digestion in Teflon beakers prior to atomic absorption spectrometry measurement.

Stream sediment samples were collected at several places at each sample site from portions of the stream bed with running water so that sediment grains with maximum buildup of trace metals in the iron oxide and diatomaceous coatings would be leached with acid attack. Sediment was screened through -10 mesh stainless steel screened in the field, then dried and screened in the laboratory with stainless steel sieves to a fine sand (.177 - .0625 mm, -80 + 230 mesh) fraction. Previous studies by the Division in geochemical evaluation of anomalies generated from base metal mineralization in the Piedmont show that many or most anomalies related to mineralization are: 1) low level and not obvious without close statistical control; 2) that control of particle size is necessary because silt-clay fractions (-230 mesh or .0625 mm) contain 2-4 times higher metal values than fine sand fractions. The silt-clay grains have a greater surface area per unit weight compared to sand grains. The grain-sizing step is commonly omitted in commercial geochemical exploration analyses. Sediment samples were then analyzed by the same 1:1 hot HCl leach.

Geophysics

Radioactivity was measured by a Geometric Model GR-310 portable gamma ray spectrometer with a 2" x 2" (104 cm^3) thallium-doped sodium iodide detector and an internal calibration reference isotope (^{133}Ba). The spectrometer measures total gamma count, potassium (K^{40}), uranium (as ^{214}Bi), and thorium (^{208}Tl). Sample stations were 100 feet apart on the same locations as soil samples. Total count measurements for 100 seconds were triplicated and averaged for plotting.

Magnetic measurements were made using a McPhar 700 vertical force magnetometer. This instrument was borrowed from North American Exploration because of equipment breakdown of a Division instrument. The results were not found to be satisfactory because of an unusually high base station drift. A buried cable and telephone line are also present on the property. However, with the use of another type of instrument, not currently available to the Division, it is hoped that a satisfactory magnetic traverse can be made. This should be done if further geochemical results warrant further evaluation.

Table 1

IRON

Soil Sample	Percent Iron
J 1	3.37
J 2	6.72
J 3	3.40
J 4	7.89
J 5	3.86
J 6	6.40
J 7	4.46
J 8	3.89
J 9	7.11
J 10	1.97
J 11	2.90
J 12	1.22
J 13	1.34
J 14	3.36
J 15	5.61
J 16	7.72
J 17	6.41
J 18	3.87
J 19	2.95
J 20	3.03

Stream Sediment	Percent Iron
SED 1	5.79
SED 2	5.03

COPPER

Soil Sample	PPM Cu
J 1	23
J 2	38
J 3	20
J 4	61
J 5	14
J 6	38
J 7	18
J 8	14
J 9	68
J 10	13
J 11	23
J 12	9
J 13	10
J 14	25
J 15	46
J 16	64
J 17	57
J 18	21
J 19	12
J 20	9

Stream Sediment	
SED 1	50
SED 2	40

MANGANESE

Soil Sample (-80 Mesh)	PPM MN
J 1	329
J 2	268
J 3	214
J 4	200
J 5	405
J 6	326
J 7	487
J 8	709
J 9	353
J 10	291
J 11	136
J 12	446
J 13	342
J 14	170
J 15	76
J 16	119
J 17	119
J 18	109
J 19	58
J 20	75

Stream Sediment (-80 +230 Mesh)	
SED 1	470
SED 2	400

ZINC

Soil Sample	PPM Zn
J 1	26
J 2	27
J 3	17
J 4	38
J 5	21
J 6	34
J 7	37
J 8	35
J 9	33
J 10	16
J 11	34
J 12	23
J 13	19
J 14	35
J 15	28
J 16	34
J 17	25
J 18	21
J 19	11
J 20	14

Stream Sediment	PPM Zn
SED 1	65
SED 2	53

Table 2

LEAD

Soil Sample	PPM Pb
J 1	18
J 2	21
J 3	11
J 4	19
J 5	15
J 6	25
J 7	29
J 8	19
J 9	21
J 10	13
J 11	21
J 12	12
J 13	17
J 14	15
J 15	15
J 16	21
J 17	16
J 18	15
J 19	12
J 20	17

Stream Sediment	PPM Pb
SED 1	16
SED 2	14

COBALT

Soil Sample	PPM Co
J 1	5
J 2	10
J 3	4
J 4	8
J 5	6
J 6	8
J 7	5
J 8	7
J 9	10
J 10	6
J 11	6
J 12	7
J 13	4
J 14	8
J 15	7
J 16	8
J 17	6
J 18	4
J 19	3
J 20	3

Stream Sediment	PPM Co
SED 1	19
SED 2	18

BARIUM

Soil Sample	PPM Ba
J 1	70
J 2	30
J 3	30
J 4	30
J 5	50
J 6	60
J 7	70
J 8	50
J 9	50
J 10	30
J 11	40
J 12	40
J 13	40
J 14	30
J 15	30
J 16	20
J 17	30
J 18	40
J 19	30
J 20	40

Stream Sediment	PPM Ba
SED 1	40
SED 2	40

NICKEL

Soil Sample	PPM Ni
J 1	9
J 2	10
J 3	8
J 4	17
J 5	6
J 6	10
J 7	9
J 8	7
J 9	13
J 10	4
J 11	12
J 12	7
J 13	6
J 14	9
J 15	13
J 16	20
J 17	21
J 18	7
J 19	8
J 20	7

Stream Sediment	PPM Ni
SED 1	21
SED 2	15

Table 3

CHROMIUM

Soil Sample	PPM Cr
J 1	21
J 2	31
J 3	20
J 4	29
J 5	22
J 6	33
J 7	26
J 8	21
J 9	33
J 10	12
J 11	19
J 12	9
J 13	11
J 14	25
J 15	34
J 16	67
J 17	53
J 18	42
J 19	26
J 20	25

Stream Sediment	PPM Cr
SED 1	22
SED 2	19

Table 4

Zinc in - 80 + 230 Mesh Stream Sediment

Sediment Sample		PPM Zn
JJ	1	65
	2	21
	3	59
	4	24
	5	53
	6	37
	7	12
	8	38
	9	30
AC	1	24
	2	48
	3	25
	4	98
BC	1	25
	2	29
	3	29
	4	23
RB	1	62
	2	24

Lead in - 90 + 230 Mesh Stream Sediment

Sediment Sample		PPM
JJ	1	14
	2	17
	3	19
	4	15
	5	15
	6	15
	7	10
	8	17
	9	17
AC	1	16
	2	17
	3	19
	4	31
BC	1	19
	2	15
	3	13
	4	15
RB	1	14
	2	9

Iron in - 80 + 230 Mesh Stream Sediment

Sediment Sample		Per Cent Iron
JJ	1	9.50
	2	4.14
	3	7.54
	4	7.80
	5	8.02
	6	5.05
	7	3.02
	8	3.36
	9	3.89
AC	1	5.27
	2	4.49
	3	3.24
	4	9.10
BC	1	6.67
	2	10.49
	3	8.50
	4	4.73
RB	1	6.04
	2	3.12

Copper in - 80 + 230 Stream Sediment

Sediment Sample		PPM Cu
JJ	1	40
	2	15
	3	50
	4	13
	5	39
	6	22
	7	4
	8	19
	9	11
AC	1	6
	2	13
	3	10
	4	39
BC	1	9
	2	8
	3	18
	4	9
RB	1	24
	2	10

Table 5

Manganese in - 80 + 230 Mesh Stream Sediment

Sediment Sample	PPM Mn
JJ 1	493
2	516
3	560
4	308
5	697
6	489
7	539
8	593
9	427
AC 1	594
2	516
3	651
4	1389
BC 1	379
2	379
3	268
4	331
RB 1	320
2	211

Chromium in - 80 + 230 Mesh Stream Sediment

Sediment Sample	PPM Cr
JJ 1	27
2	11
3	19
4	24
5	19
6	19
7	9
8	13
9	16
AC 1	24
2	26
3	18
4	58
BC 1	30
2	37
3	29
4	21
RB 1	33
2	15

Ni in - 80 + 230 Mesh Stream Sediment

Sediment Sample	PPM Ni
JJ 1	22
2	6
3	21
4	11
5	17
6	14
7	5
8	9
9	7
AC 1	8
2	12
3	10
4	30
BC 1	16
2	16
3	15
4	9
RB 1	23
2	8

Cobalt in - 80 + 230 Mesh Stream Sediment

Sediment Sample	PPM Co
JJ 1	27
2	9
3	25
4	13
5	23
6	16
7	6
8	11
9	9
AC 1	8
2	13
3	10
4	28
BC 1	12
2	14
3	15
4	7
RB 1	14
2	9

Table 6

Cadmium in - 80 + 230 Mesh Stream Sediment

Sediment Sample	PPM Cd
JJ 1	0
2	0
3	0
4	0
5	0
6	0
7	0
8	0
9	0
AC 1	1
2	0
3	0
4	1
BC 1	0
2	0
3	0
4	0
RB 1	1
2	0

Barium in - 80 + 230 Mesh Stream Sediment

Sediment Sample	PPM Ba	
JJ 1	50	
2	20	
3	60	
4	30	
5	50	
6	30	
7	10	
8	30	
9	20	
AC 1	20	
2	30	
3	20	
4	100	110
BC 1	30	
2	20	
3	20	
4	20	
RB 1	30	
2	10	

Silver in - 80 + 230 Mesh Stream Sediment

Sediment Sample	PPM Ag
JJ 1	0
2	0
3	0
4	0
5	0
6	0
7	0
8	0
9	0
AC 1	0
2	0
3	0
4	0
BC 1	0
2	0
3	0
4	0
RB 1	0
2	0

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Figure 15

AEROMAGNETIC CONTOUR MAP

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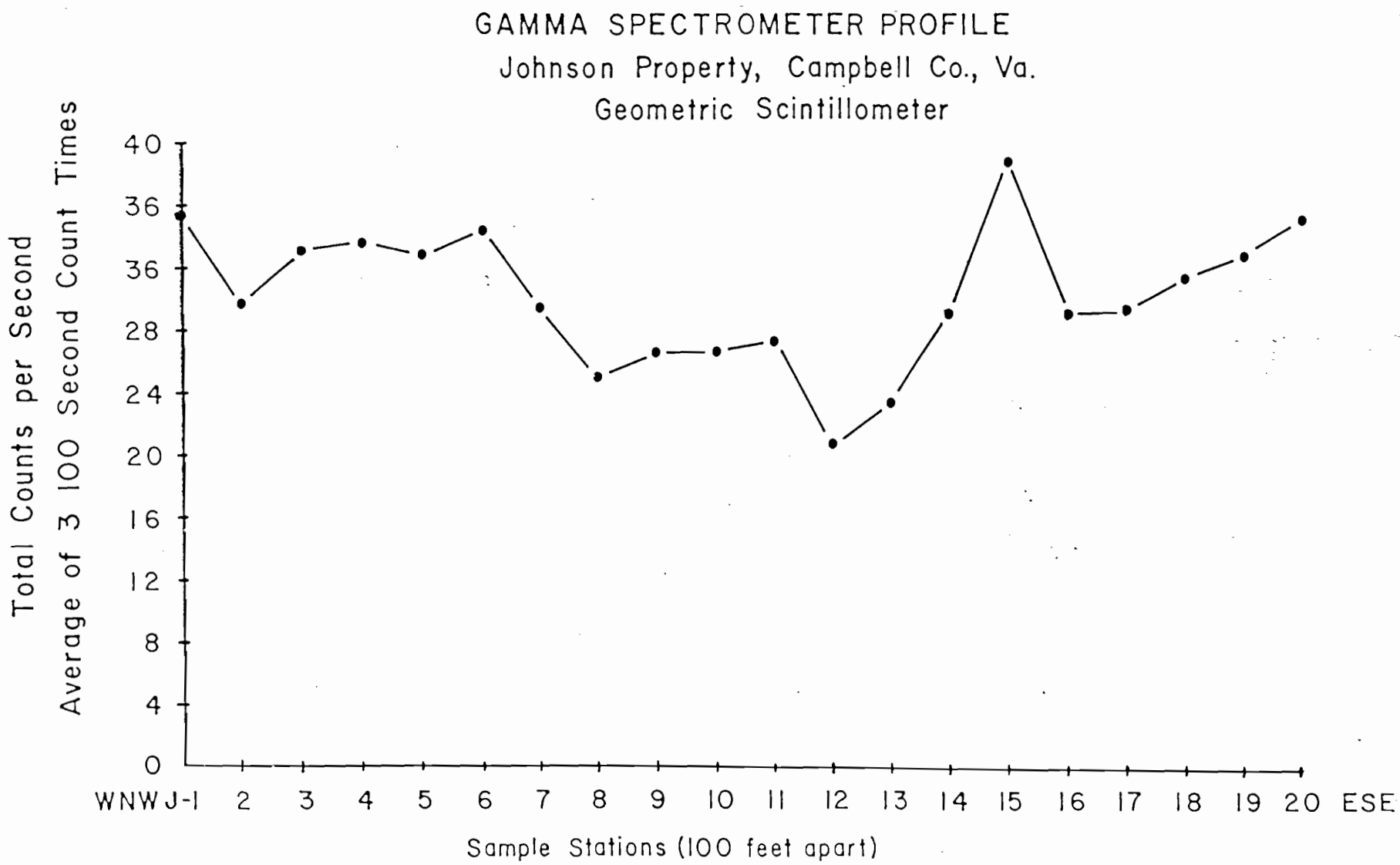
GAMMA SPECTROMETER PROFILE
Johnson Property, Campbell Co., Va.
Geometric Scintillometer
Total Counts per Second
Average of 3 100 Second Count Times
40
36
36
28
24
20
16
12
8
4
0
WNW J-1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
ESE
Sample Stations (100 feet apart)

Figure 16

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