

file INA/015/004  
# 2

United States  
Department of  
Agriculture

Forest  
Service

Manti-LaSal  
National Forest

599 West Price River Dr.  
Price, Utah 84501

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Reply to: 2820

Date: September 18, 1986

Lowell Braxton  
Utah Dept. of Natural Resources & Energy  
Division of Oil, Gas and Mining  
355 West North Temple  
3 Triad Center - Suite 350  
Salt Lake City, Utah 84180-1203

Dear Mr. Braxton:

Enclosed, as requested during our meeting in your office on August 19, 1986,  
is a copy of Vaughn Hansen's report for the hydrologic study that he conducted  
regarding Little Bear Spring in 1977.

Sincerely,



for  
REED C. CHRISTENSEN  
Forest Supervisor

Enclosure

**RECEIVED**  
SEP 23 1986

DIVISION OF  
OIL, GAS & MINING

WATER QUALITY AND HYDROLOGIC STUDY  
IN VICINITY OF  
HUNTINGTON CREEK MINE NO. 4 AND LITTLE BEAR SPRING

Prepared for  
SWISHER COAL COMPANY

August 1977



CONSULTANTS/ENGINEERS  
**VAUGHN  
HANSEN  
ASSOCIATES**  
SALT LAKE CITY, UTAH

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CONTRACT RESPONSIBILITY

The study described in the following report was conducted for the purpose of determining the potential impact on ground water resulting from mining operations of Swisher Coal Company with recommendations for mitigating any potentially serious ground water impacts.

PROBLEM

Swisher Coal Company plans to expand their mining activity at Huntington Creek Mine No. 4 and Mill Fork Canyon, which is approximately twelve miles northwest of Huntington, Utah up Huntington Canyon. The expansion would be to the northwest in the vicinity of Little Bear Spring in Little Bear Canyon. Water from the spring is being used near Huntington for a domestic water supply. Concern has been expressed that extension of coal mining activity toward Little Bear Spring might intercept part or all of the flow that is now appearing at the spring and also that the quality of the spring water might be deteriorated.

OBJECTIVE OF THE STUDY

Vaughn Hansen Associates was requested to study the water quality and the hydrology in the vicinity of the intended activity. Two objectives were to guide the endeavor: (1) to determine the probable impact on Little Bear Spring of expanded mining and (2) to obtain background information pertaining to water quality for a reference to assess the cause of any changes in future quantity and quality of water at Little Bear Spring.

## COORDINATION WITH FOREST SERVICE

Leases essential to the intended expansion of the mine are being requested from the U. S. Forest Service. This Federal Agency is concerned, therefore, about the probable adverse impact from the mining.

Several meetings have been held with staff from the Price office of the Forest Service to discuss the problem, to outline data acquisition procedures, and to discuss observations.

Forest Service personnel were to make geological observations in the area. Vaughn Hansen Associates was to gather and have analyzed water quality samples and to study the hydrology and fracturing patterns that may be related to water movement and water yield.

### PERIOD OF FIELD STUDY

Field studies were conducted from November 8th through the 12th, 1976. These observations were after a dry fall and before the winter storms commenced. Data from water samples would, in general, reflect a base flow condition. In addition, samples were taken and field observations made during the period of May 31st through June 4th, 1977. This period of observation and sampling was preceded by an unusually wet May. Some ice was still melting in the deeper sections of Little Bear Creek. However, the snow cover had melted.

Little Bear Canyon, a tributary to Huntington Creek, is situated between Crandall Canyon and Mill Fork. (See Figure 1). It is located primarily in sections 8 and 9 of T.16S., R.7E. Because of the abrupt drainage divide created by the incision of Crandall Canyon and Mill Fork, Little Bear Canyon has been left quite isolated from surrounding canyons by past geologic events. Its average change in elevation of 1600 feet per mile compares with 660 feet per mile in Crandall Canyon and 590 feet per mile in Mill Fork. This rate of change difference and degree of isolation is especially striking when seen from aerial photos and from figure 1, which shows that lines of equal elevation occur in Little Bear Canyon at a point much further east than in the surrounding canyons. Ridges are sharp and the sides of the canyons surrounding Little Bear Canyon are steep. Drainage into Crandall Canyon and into Mill Fork Canyon has eroded to a common sharp ridge only one-half of a mile west of the head of Little Bear Canyon. This erosional pattern essentially intercepts any shallow ground water flow before it can reach Little Bear Canyon.

The drainage basin of Little Bear Canyon, covering approximately 755 acres, exposes six different geologic types, primarily cretaceous in age (See Figure 2): The North Horn Formation (a fluvial sandstone and mudstone), the Price River Formation (fluvial and marine sandstone and mudstone), the Castle Gate Sandstone (deltaic in origin), the Blackhawk Formation (sandstone, mudstone, shale, and coal), the Star Point Sandstone (deltaic and beach deposits), and the Masuk Shale member of the Mancos

FIGURE 1: ELEVATION CONTOUR MAP OF LITTLE BEAR AND NEIGHBORING CANYONS

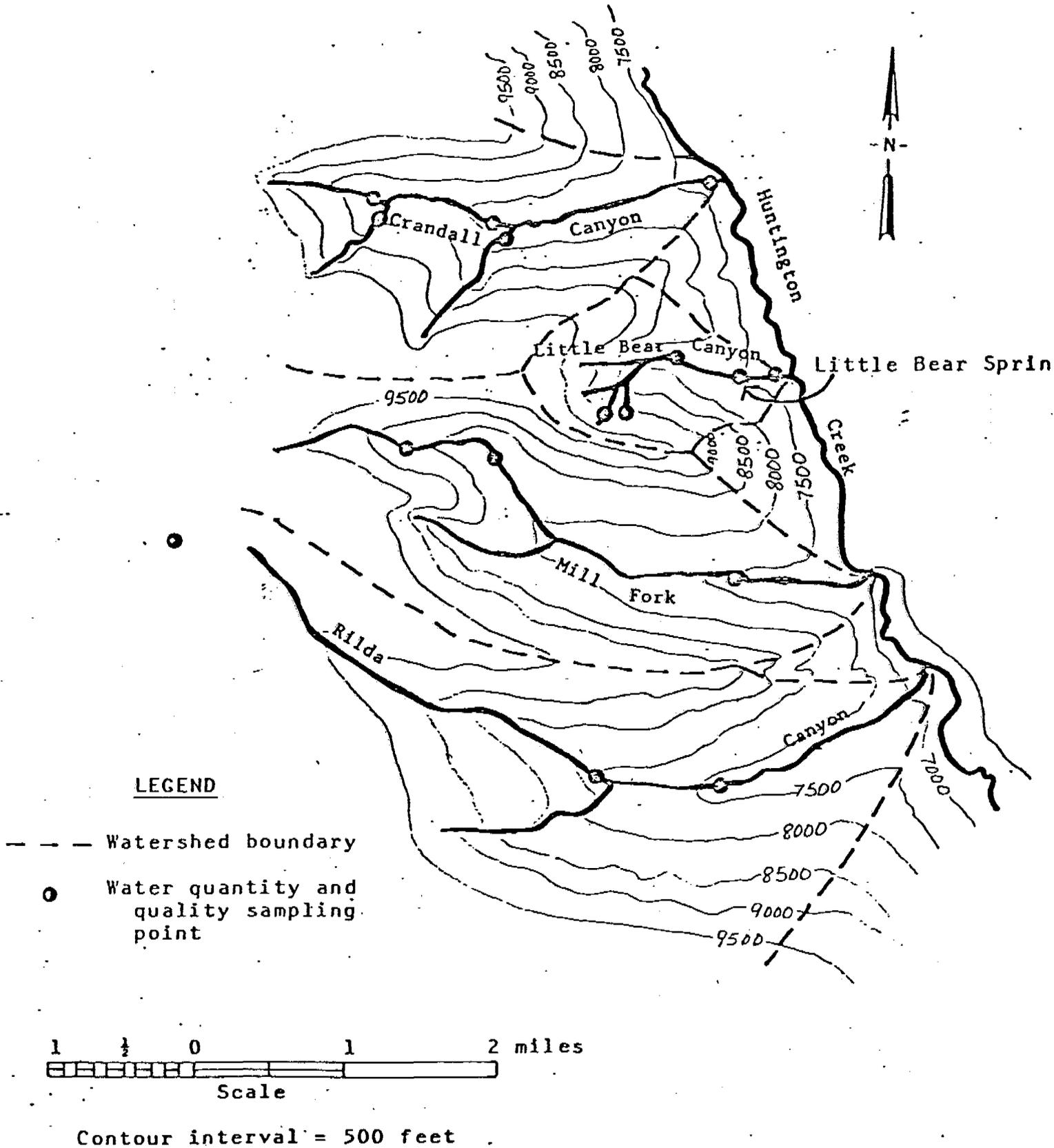
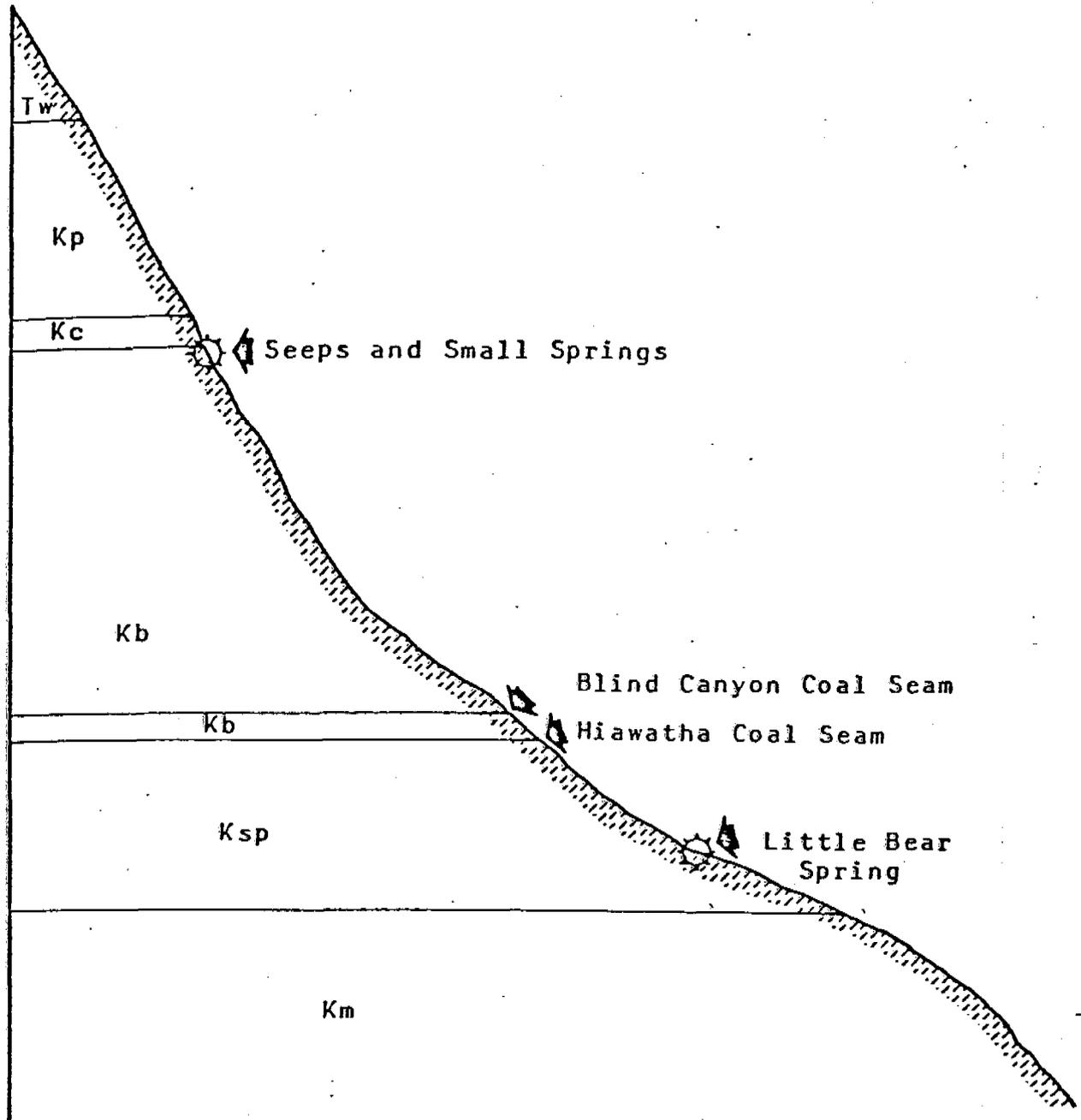


FIGURE 2: CROSS-SECTION OF LITTLE BEAR CANYON FROM WESTERN MOST POINT TO MOUTH SHOWING GEOLOGICAL TYPES, SEEPS, AND SPRINGS.



LEGEND

- Tw = North Horn Formation
- Kp = Price River Formation
- Kc = Castle Gate Sandstone
- Kb = Blackhawk Formation
- Ksp = Star Point Sandstone
- Km = Mancos Shale (Masuk Member)

shale (marine in origin). The Hiawatha and Blind Canyon Coal Seams, of interest in this study, appear at or near the bottom of the Blackhawk Formation. Springs surface in the upper reaches of the canyon near the Castle Gate Sandstone - Blackhawk Formation boundary while Little Bear Spring issues from the Star Point Sandstone. The predominate faulting pattern according to information supplied by the U.S. Forest Service, is from the northwest to the southeast accompanied by additional faults in a northeast southwest direction and a set of faults orthogonal to the former set extending in a southwest - northeast direction.

Jeppson et al. (1968) indicate a normal annual precipitation of approximately 20 inches and a potential evapotranspiration of 18 to 21 inches per year in and near Little Bear Canyon. A comparison of the area with the headwaters of the nearby Price River Basin (as reported by Mundorff, 1972) leads one to believe that most of this precipitation falls as snow during the winter months. The steepness of Little Bear Canyon suggests that only a small portion of the summer precipitation infiltrates and appears later as spring flow. The bulk presumably runs off as surface flow.

#### METHODS OF DATA COLLECTION

A total of sixteen water quantity and quality sampling stations were selected in Crandall, Little Bear, Mill Fork, and Rilda Canyons (see Figure 3). A more complete description of the

FIGURE 3: WATER QUANTITY AND QUALITY SAMPLING STATIONS  
NEAR HUNTINGTON CREEK MINE NO. 4

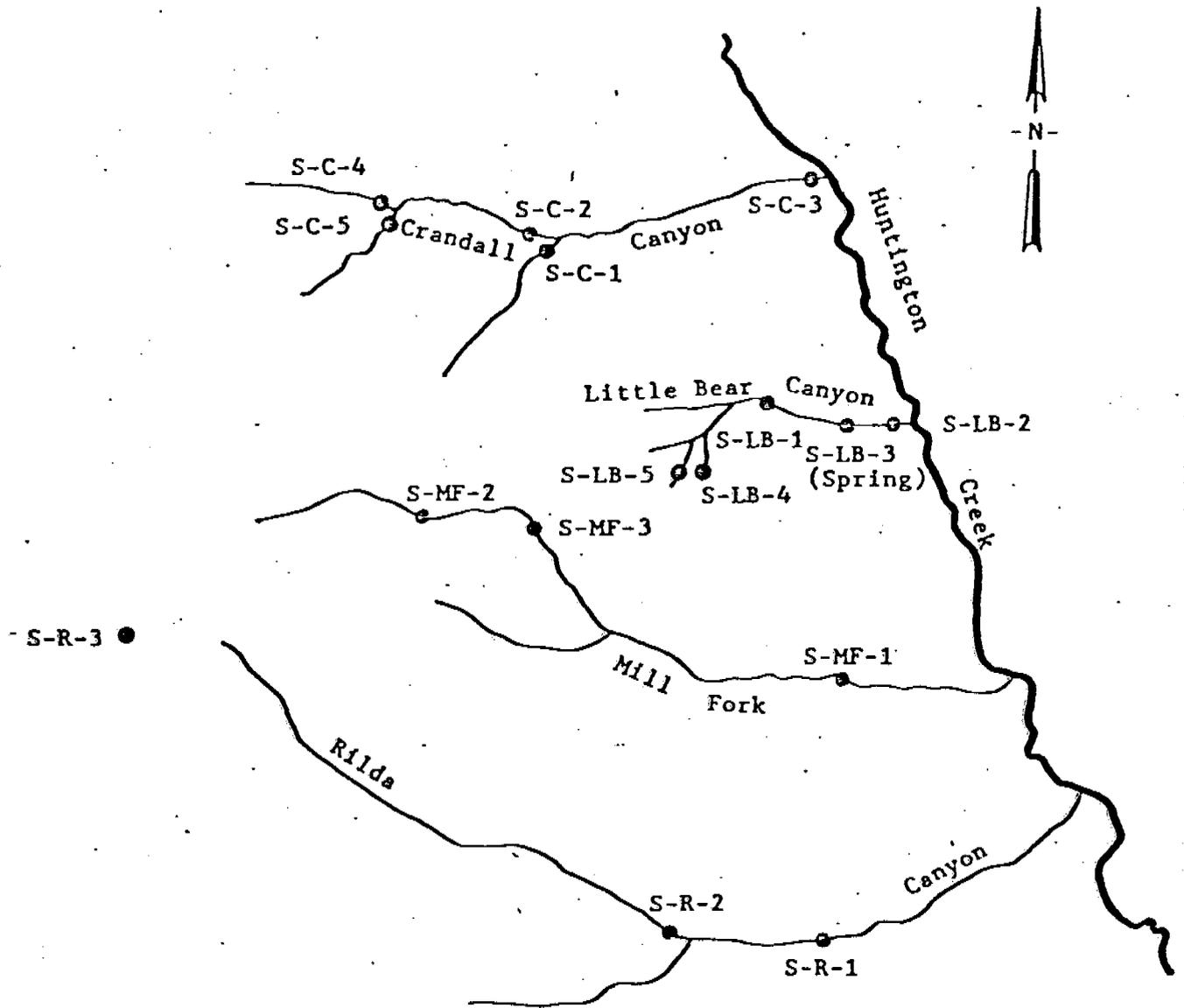


TABLE 1

DESCRIPTION OF WATER QUANTITY AND QUALITY SAMPLING  
STATIONS NEAR HUNTINGTON CREEK MINE NO. 4

<u>Station Code</u>	<u>Location*</u>	<u>Description</u>
S-C-1	(D-16-7) 6 dab	Crandall Canyon, 100 yards above confluence with West Branch.
S-C-2	(D-16-7) 6 dba	Crandall Canyon, 1.6 miles above highway, 200 yards above confluence with East Branch.
S-C-3	(D-16-7) 4 bbd	Crandall Canyon Creek above confluence with Huntington Creek.
S-C-4	(D-16-6) 1 acb	2.5 miles up Crandall Canyon on Right Fork of East Branch, beyond fence.
S-C-5	(D-16-6) 1 acb	2.5 miles up Crandall Canyon on Left Fork of East Branch, beyond fence.
S-LB-1	(D-16-7) 8 daa	Little Bear Creek, 2400 feet north and 500 feet west of southeast corner of Section 8.
S-LB-2	(D-16-7) 9dac	Little Bear Creek, above confluence with Huntington Creek.
S-LB-3	(D-16-7) 9cad	Little Bear Spring, 0.3 mile up Little Bear Canyon.
S-LB-4	(D-16-7) 8dbd	Draw flowing north-west from hillside, below last fork, Little Bear Canyon.
S-LB-5	(D-16-7) 8 dbb	Middle Fork of south branch, Little Bear Canyon.
S-MF-1	(D-16-7) 21 baa	Mill Fork Canyon Spring near lower coal loading area, 1 mile up canyon.
S-MF-2	(D-16-6) 13 aab	Spring 3.9 miles up Mill Fork Canyon, on north branch.
S-MF-3	(D-16-7) 18 abd	Mill Fork Canyon, 100 yards below major split in canyon east side.
S-R-1	(D-16-7) 28 cab	Rilda Canyon Creek, 30 feet above bridge at old Helco Mine.

TABLE 1 con't  
DESCRIPTION OF WATER QUANTITY AND QUALITY SAMPLING  
STATIONS NEAR HUNTINGTON CREEK MINE NO. 4

<u>Station Code</u>	<u>Location*</u>	<u>Description</u>
S-R-2	(D-16-7) 29 bdd	Rilda Canyon Springs water system, 2.6 miles up canyon on north fork.
S-R-3	(D-16-6) 14 cdb	Spring near the head of Rilda Canyon, near upper ridge.

\* Based on the well and spring numbering system used in the State of Utah.

stations is found in Table 1. Stations four and five in Crandall and Little Bear Canyons as well as station three in Rilda Canyon were added for the June 1977 sampling period along with the other eleven stations sampled in November 1976.

During each of the sampling periods, data were collected to assess water quantity and quality. Flow measurements were estimated by the float method when applicable or by visual estimation in the case of low flows. The flow at Little Bear Spring was measured at a 90° V-notch weir located slightly downstream from the spring. Dip samples were also collected for chemical analyses. Those samples to be analyzed for trace metals were fixed with nitric acid. Chemical analyses were completed by Ford Chemical Laboratory in Salt Lake City.

For convenience in making comparisons, stations S-LB-3, S-MF-1, and S-R-1 have been grouped together and collectively called the lower springs. All other stations will be referred to as the upper stations. This was deemed justifiable due to the similarities found among the lower springs, as will be discussed.

## RESULTS AND DISCUSSION

### Water Quantity

Water in the upper portion of each of the canyons studied flows intermittently and originates as interflow which surfaces above or near the Castle Gate Sandstone - Blackhawk Formation interface

and/or overland flow. The former process presumably dominates during the spring runoff season while the latter is most common during the summer thundershower period, especially in Little Bear Canyon as previously discussed.

Springs throughout the area appear to be surfacing primarily above and below the Blackhawk Formation, with little groundwater activity showing in the Blackhawk, field observations in mines located in the San Rafael and Price River Basins have shown that typically, only a limited amount of subsurface water is found in the Blackhawk Formation. Apparently, even though fracturing in the area has presumably also penetrated the Blackhawk, the nature of the material (i.e. fine texture) is such that these fractures have sealed and thus remained relatively impermeable. It would appear, therefore, that water which does enter the ground in either the Castle Gate or Star Point Sandstone surfaces in the same formation in which it entered, with very little passing through the Blackhawk.

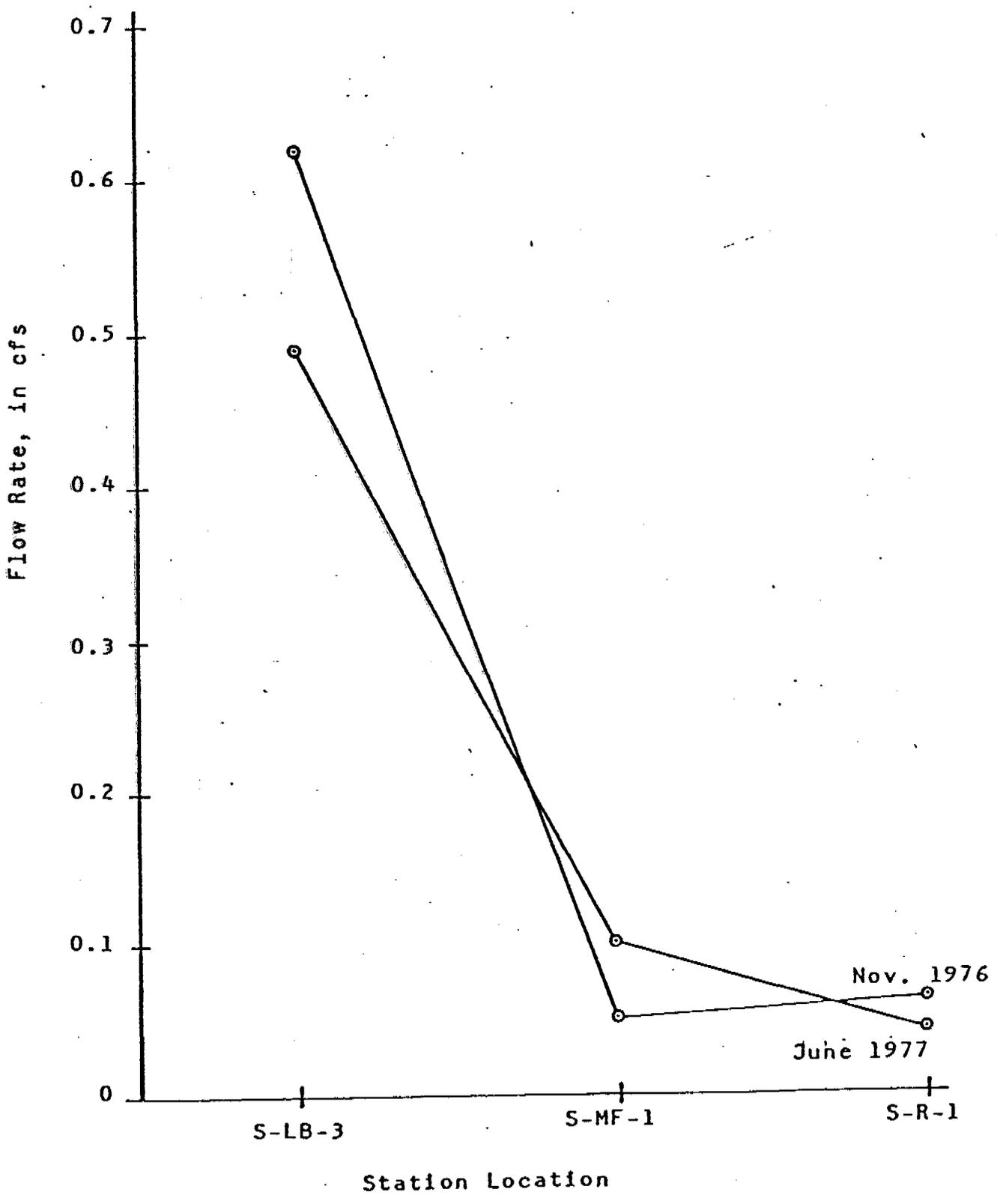
Subtracting the previously indicated annual potential evapotranspiration from the normal annual precipitation, the expected yield from Little Bear Canyon should be on the order of one to two inches per year. A comparison with similar areas in the nearby Price River Basin indicates that an upper limit of four inches of runoff might be expected from the canyon annually (See Utah Division of Water Resources, 1975). Measurements of flow quantities at Little Bear Spring during each of the two

sampling periods, however indicate an average annual yield of approximately six inches from the spring alone during the course of a severe drought period. This suggests that at least a portion of the water in Little Bear Spring is originating at some point other than on the watershed to the west above. Hughes<sup>1</sup> has indicated that springs issuing from fractures in the Star Point Sandstone between Rilda Canyon and Bear Creek Canyon to the south produce flows at a fairly constant rate, almost independent of season. Such a faulting system is present in the Star Point at and near Little Bear Spring, as indicated by field observations by the U.S. Forest Service and Vaughn Hansen Associates.

It has been observed that spring and surface water flow rates decrease in a southerly direction from canyon to canyon in the study area. This phenomenon is especially marked in the lower springs as seen in Figure 4. In addition, information supplied by the U.S. Forest Service indicates that the number of springs in the Huntington Creek drainage decrease as one approaches Little Bear Spring from the northwest. This, plus the information already presented, leads to the conclusion that ground water is approaching the area from the north or northwest, with a progressive downstream depletion of the aquifer.

<sup>1</sup>Treavor C. Hughes, Associate Professor of Civil and Environmental Engineering, Utah Water Research Laboratory, Logan, Utah. Written communication received 18 July 1977.

FIGURE 4: FLOW RATES MEASURED AT THE LOWER SPRINGS  
NEAR HUNTINGTON CREEK MINE NO. 4



In summary, fractures in the more permeable sandstones above and below the Blackhawk Formation are presumably the means whereby ground water is surfacing in the area. The presence of the less permeable Blackhawk, the isolated nature and relatively small surface contributing area of Little Bear Canyon, the large flow measured at the spring, and the southward depletion in spring flow rates throughout the area indicate that water at Little Bear Spring originates primarily in the north, flowing through the Star Point Sandstone, rather than originating on the watershed to the west.

#### Water Quality

The waters of Crandall, Little Bear, Mill Fork, and Rilda Canyons are all chemically very closely related. The cation-anion configurations for all samples collected confirms this (see Figure 5 and 6). A progressive deterioration in water quality from north to south and west to east is also seen. It appears that if the water could be intercepted high in the system and discharged without passing through the lower portions of the various canyons, water of a higher quality would be available.

The major cation and anion concentrations remained fairly constant from November 1976 to June 1977. An increase in magnesium, noted at the lower stations, was observed in June with decreases in most other cases. The cation-anion ratios for all stations were similar during both sampling periods. The following is a synopsis of chemical quality results of the samples collected. See Appendix A

FIGURE 5: CATION-ANION DIAGRAMS OF SAMPLES COLLECTED NOVEMBER 8 THROUGH 12, 1976

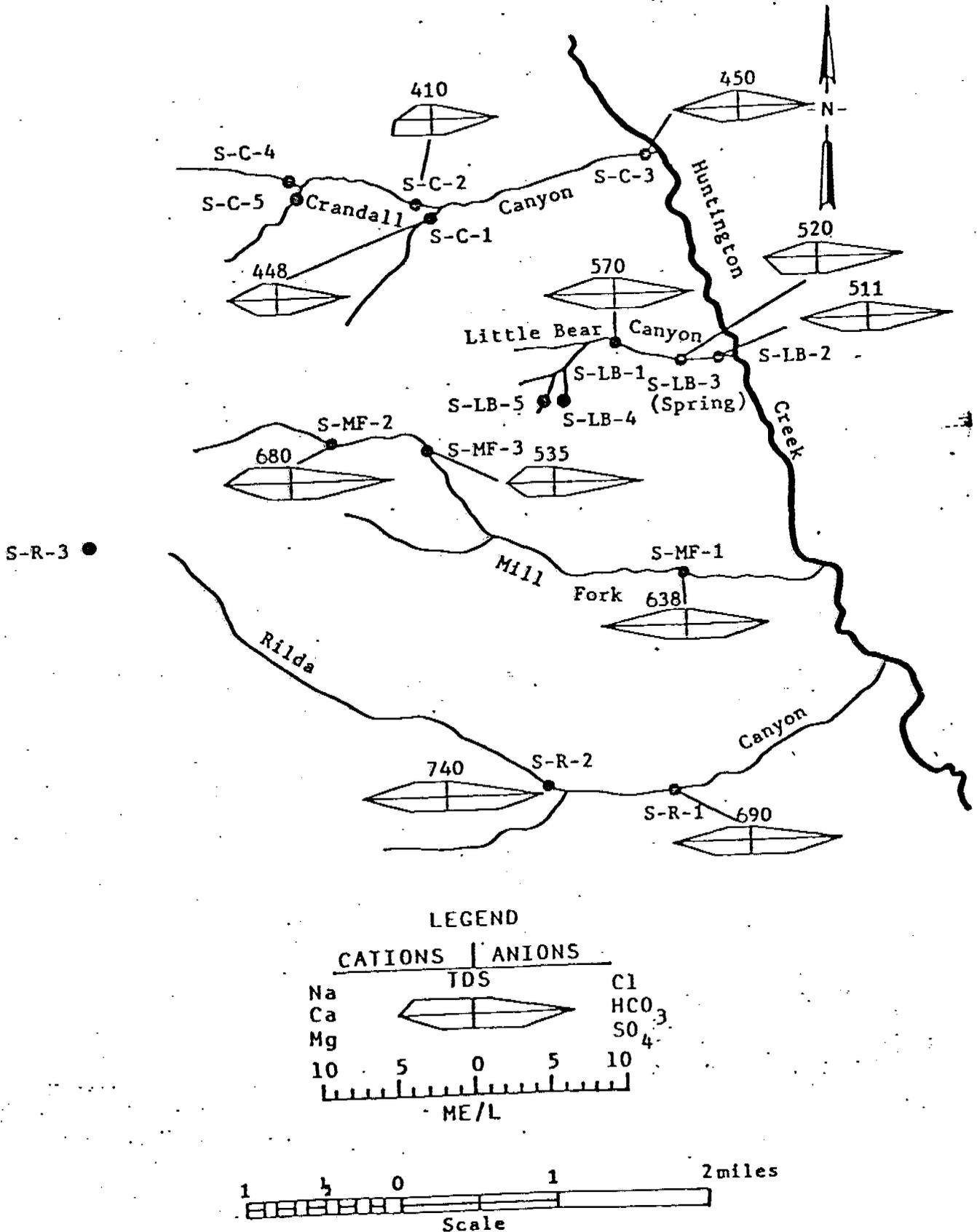
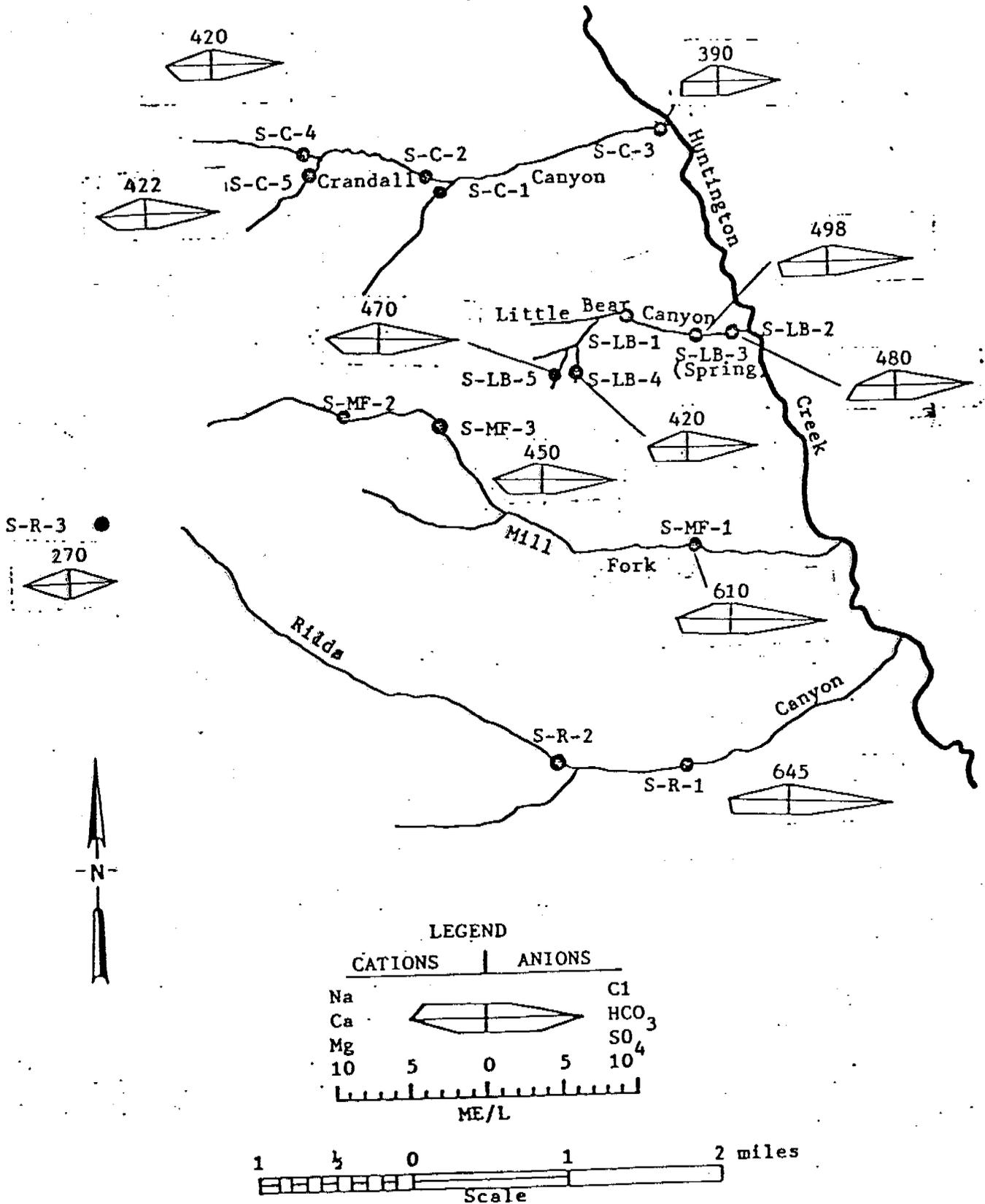


FIGURE 6: CATION-ANION DIAGRAMS OF SAMPLES COLLECTED  
MAY 31 to JUNE 4, 1977



for a tabular presentation of all water quality data and Appendix B for maps showing the location of these data in the field.

### Total Dissolved Solids

The recommended drinking water standard limit of 500 mg/l was exceeded at eight of the eleven stations sampled in the Fall. The average concentration was 563 mg/l. No samples in Crandall Canyon were in excess of 500 mg/l. During June 1977 two of the eleven stations sampled had TDS concentrations in excess of 500 mg/l. The average concentration was 461 mg/l. The two stations in excess of the recommended standard were the lower stations in both Mill Fork and Rilda Canyons. Concentrations typically increased from north to south in the study area.

### Hardness

Hardness levels tended to increase as the water reached the deeper parts of the various canyons.

### Alkalinity

Increases in alkalinity levels are seen as the water reaches the deeper canyon area.

### Barium

None of the water samples exceeded the mandatory maximum limit of 1.0 mg/l. The concentrations ranged from 0.002 mg/l to 0.37 mg/l.

### Bicarbonate

Bicarbonate showed the same increasing trends as alkalinity and hardness.

### Boron

In November 1976, all analyses for boron were below the laboratory detection limit of 0.001 mg/l. In June 1977, the concentrations for boron ranged from less than 0.001 mg/l to 0.085 mg/l.

### Calcium

Calcium concentrations increased as the water reached the deeper portions of Huntington Canyon. The highest concentrations were found in Rilda Canyon.

### Chloride

Chloride is of little concern in this area. The recommended maximum concentration for drinking water supplies is 250 mg/l and the highest concentration found was 10 mg/l. The average concentration was 5 mg/l.

### Copper

Copper concentrations were consistently low. The high concentration was 0.040 mg/l, found in Little Bear Spring, Mill Fork, and Rilda Canyons during the November sampling period. The high concentration in June was 0.035 mg/l in lower Crandall.

### Fluoride

Fluoride concentrations averaged 0.18 mg/l. The concentrations increased deeper in the canyons.

Iron

Iron concentrations averaged 0.14 mg/l for both sampling periods. Upper Little Bear Canyon had the high concentration of 0.311 mg/l in November 1976.

Magnesium

Magnesium concentrations ranged from 2.88 mg/l on top of Rilda Canyon to 46.08 mg/l at the lower Rilda Canyon station. The average concentration for all samples was 25.09 mg/l. The June sampling averaged 10 mg/l higher in concentration than the November samples.

Manganese

No violations of the 0.05 mg/l recommended limit were observed. The average concentration was 0.008 mg/l.

Potassium

Potassium concentrations averaged 1.17 mg/l in November and 1.99 mg/l in June. The concentrations increased as the water reached the deeper parts of the canyons.

Sodium

Sodium concentrations increased in the deeper portions of Huntington Canyon. The November average was 31.1 mg/l. June's average concentration was 9.6 mg/l.

### Sulfate

Sulfate concentrations increased from north to south with the highest concentrations being found in Rilda Canyon. The average concentrations were 74.9 mg/l and 41.8 mg/l in November and June, respectively. There was a greater range of sulfate concentrations in the Fall (27.7 to 167 mg/l) over the Summer (34 to 66 mg/l).

### Zinc

Zinc concentrations increased in the lower waters. The average in November was 0.055 mg/l while only 0.010 mg/l in June.

The water quality data thus far collected indicate concentration gradients in both a north-south and west-east direction. This again leads to the conclusion that subsurface water supplies originate from one of two sources: (1) water which falls in the upper portions of the canyons tributary to Huntington Creek and subsequently infiltrates and flows east, surfacing normally above the Blackhawk Formation or (2) water which enters the area through aquifers in the Star Point Sandstone from the north, possibly being fed by Huntington Creek or its tributaries.

Data from this study and from the 208 water Quality Study show increases in concentration from increased contact with the mancos derived soils. The deeper the canyon, the more both the Blackhawk formation above the Star Point Sandstone and the underlying mancos formation are exposed. The longer the flow path, the greater the concentration.

## CONCLUSIONS

Water quantity and quality data collected during November 1976 and June 1977 suggest that surface and subsurface water enters the study area both from the west and also from the north. Because of the apparent limited amount of ground water which flows through the less permeable Blackhawk Formation, water at Little Bear Spring is suspected to originate in the north, flowing through aquifers in the Star Point Sandstone, and surfacing usually at fractures in the formation. The southward depletion in flow noted at the lower springs suggests that little ground water would be encountered if mining coal at the Blackhawk Formation-Star Point Sandstone interface were to expand in that direction.

The water table at Little Bear Spring is below the coal seams to be mined. Crandall Canyon serves as a major interceptor drain cutting into the Star Point Formation. These conditions indicate that increased mining proposed by Swisher Coal Company would have little or no effect on the Little Bear Spring.

Water quantity and quality should be monitored during the mining operation to document the impact on adjacent ground water.

LITERATURE CITED

Jeppson, R. W., G. L. Ashcroft, A. L. Huber, G. V. Skogerboe, and J. M. Bagley. 1968 Hydrologic Atlas of Utah, Utah Water Research Laboratory and Utah Department of Natural Resources. PRWG 35-1, Utah State University, Logan, Utah.

Mundorff, J. D. 1972. Reconnaissance of Chemical Quality of Surface Water and Fluvial Sediment in the Price River Basin, Utah. Utah Department of Natural Resources, Division of Water Rights. Technical Publication No. 39, Salt Lake City.

Utah Division of Water Resources, 1975. Hydrologic Inventory of the Price River Basin. Utah Department of Natural Resources, Salt Lake City.

APPENDIX A

RAW WATER QUALITY DATA

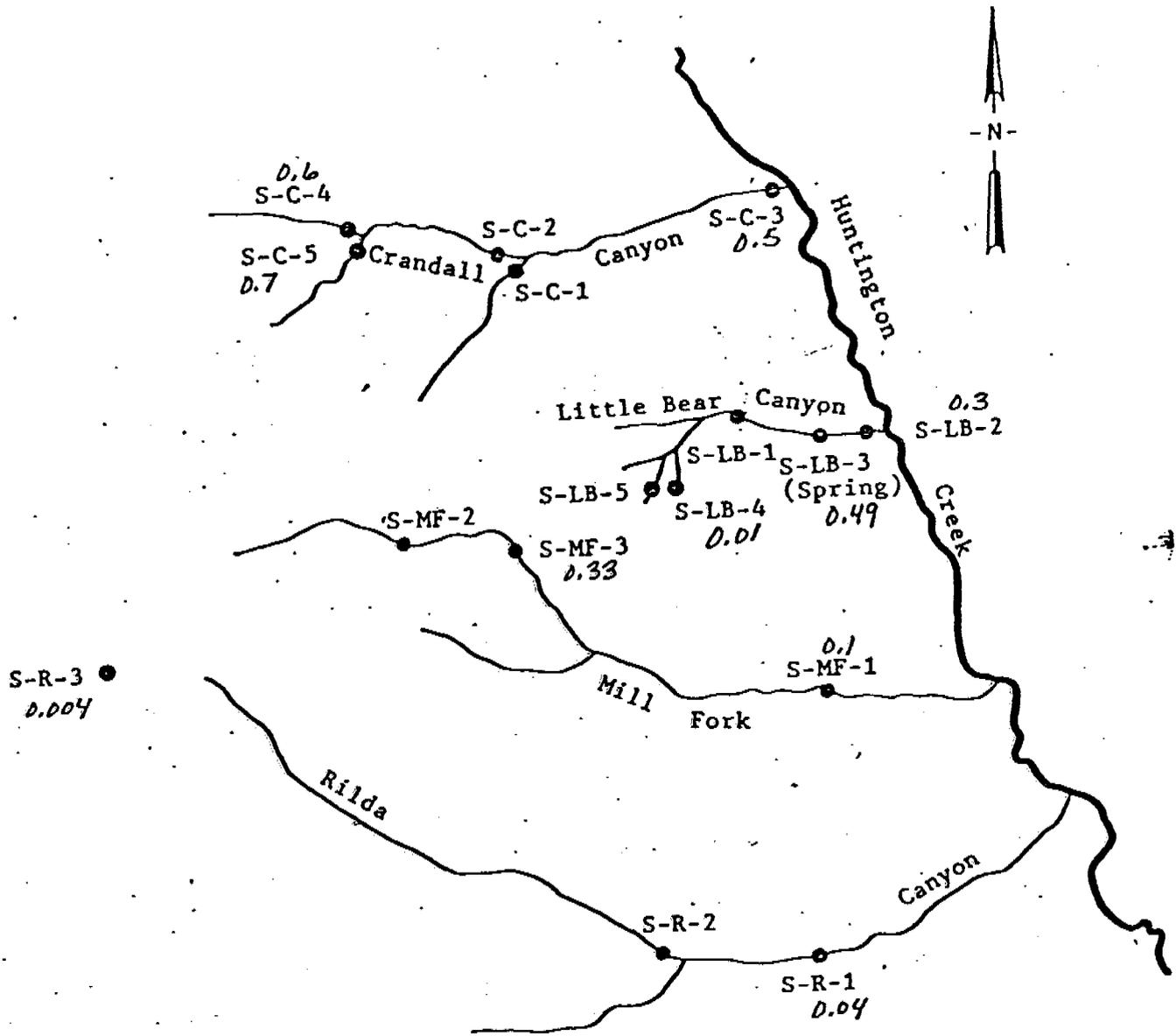




APPENDIX B

WATER QUALITY SAMPLING  
LOCATION MAPS

WATER QUALITY SAMPLING LOCATIONS  
HUNTINGTON CREEK MINE 4  
SWISHER COAL COMPANY



Parameter Flow  
Date May 31 to June 4, 1977

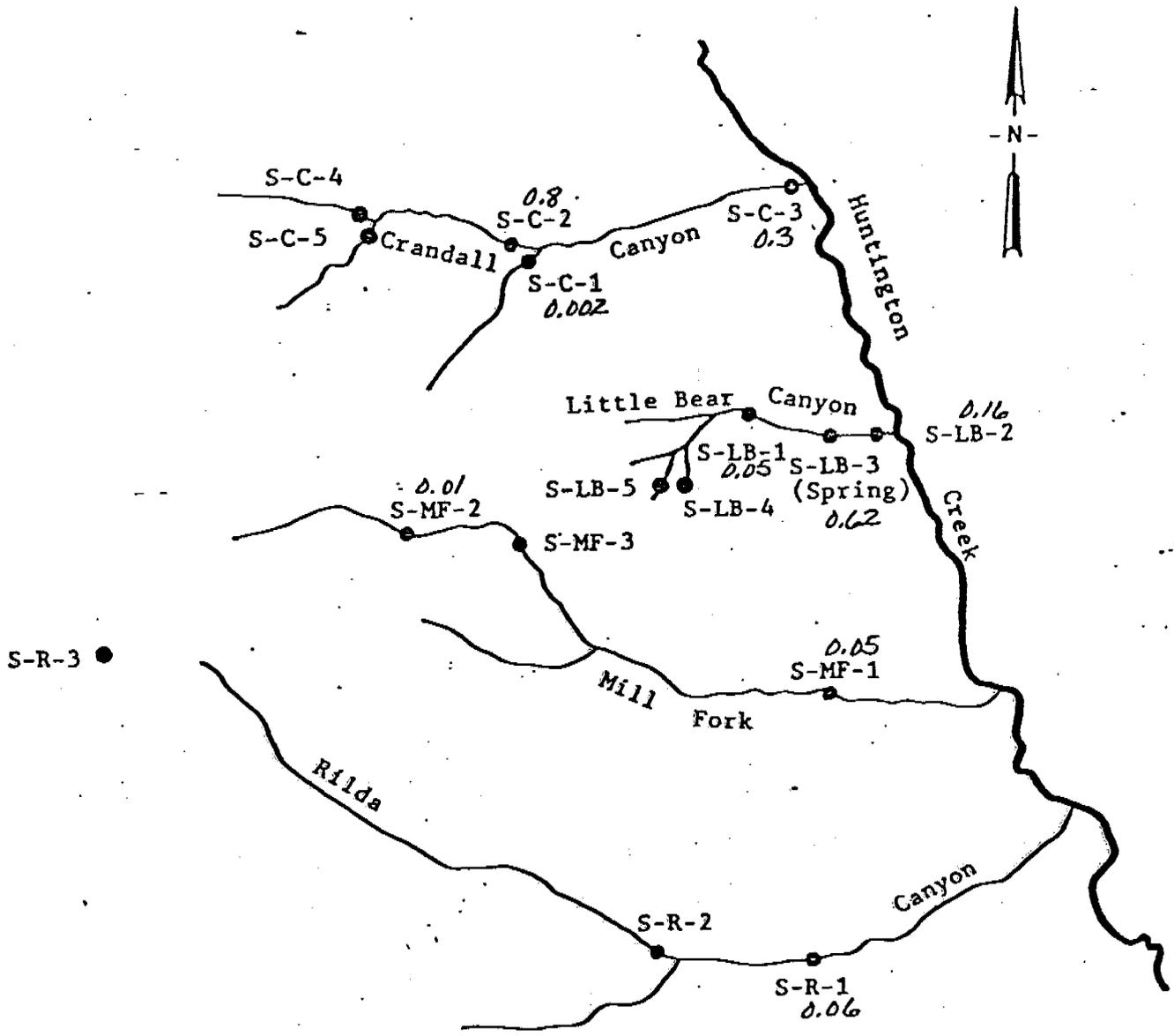
NOTE: Stations marked in red are outside of state limits for the sample taken during the above sampling period.

LIMITS:  
lower \_\_\_\_\_  
upper \_\_\_\_\_

Vaughn Hansen Associates  
5620 South 1475 East  
Salt Lake City, Utah 84121



WATER QUALITY SAMPLING LOCATIONS  
HUNTINGTON CREEK MINE 4  
SWISHER COAL COMPANY

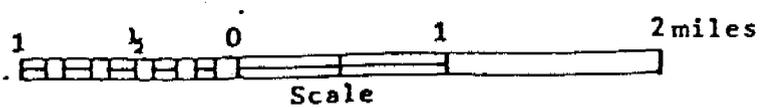


Parameter Flow, cfs.  
Date November 8-12, 1976

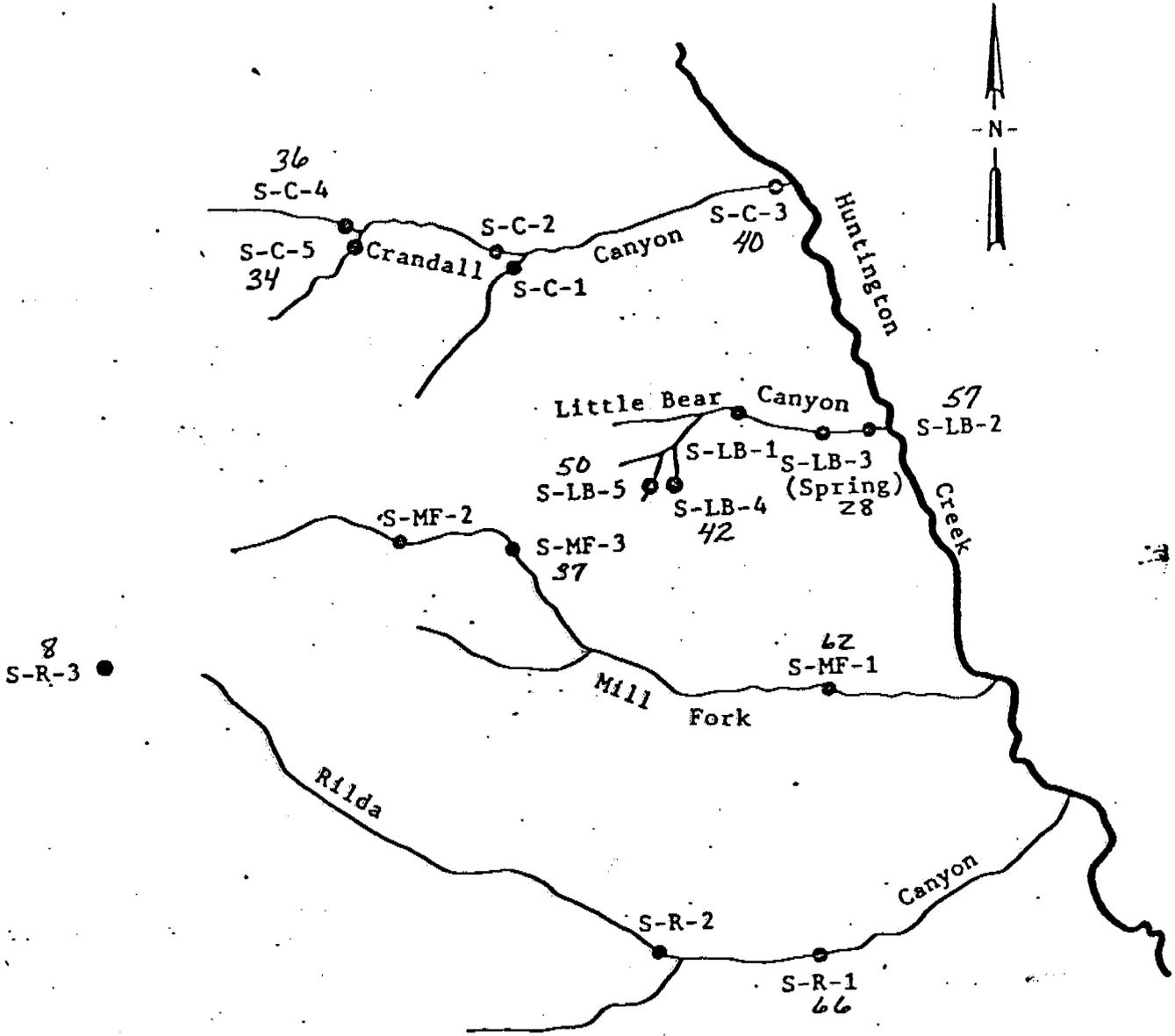
NOTE: Stations marked in red are outside of state limits for the sample taken during the above sampling period.

LIMITS:  
lower \_\_\_\_\_  
upper \_\_\_\_\_

Vaughn Hansen Associates  
5620 South 1475 East  
Salt Lake City, Utah 84121



WATER QUALITY SAMPLING LOCATIONS  
 HUNTINGTON CREEK MINE 4  
 SWISHER COAL COMPANY



Parameter Sulfate  
 Date May 31 to June 4, 1977

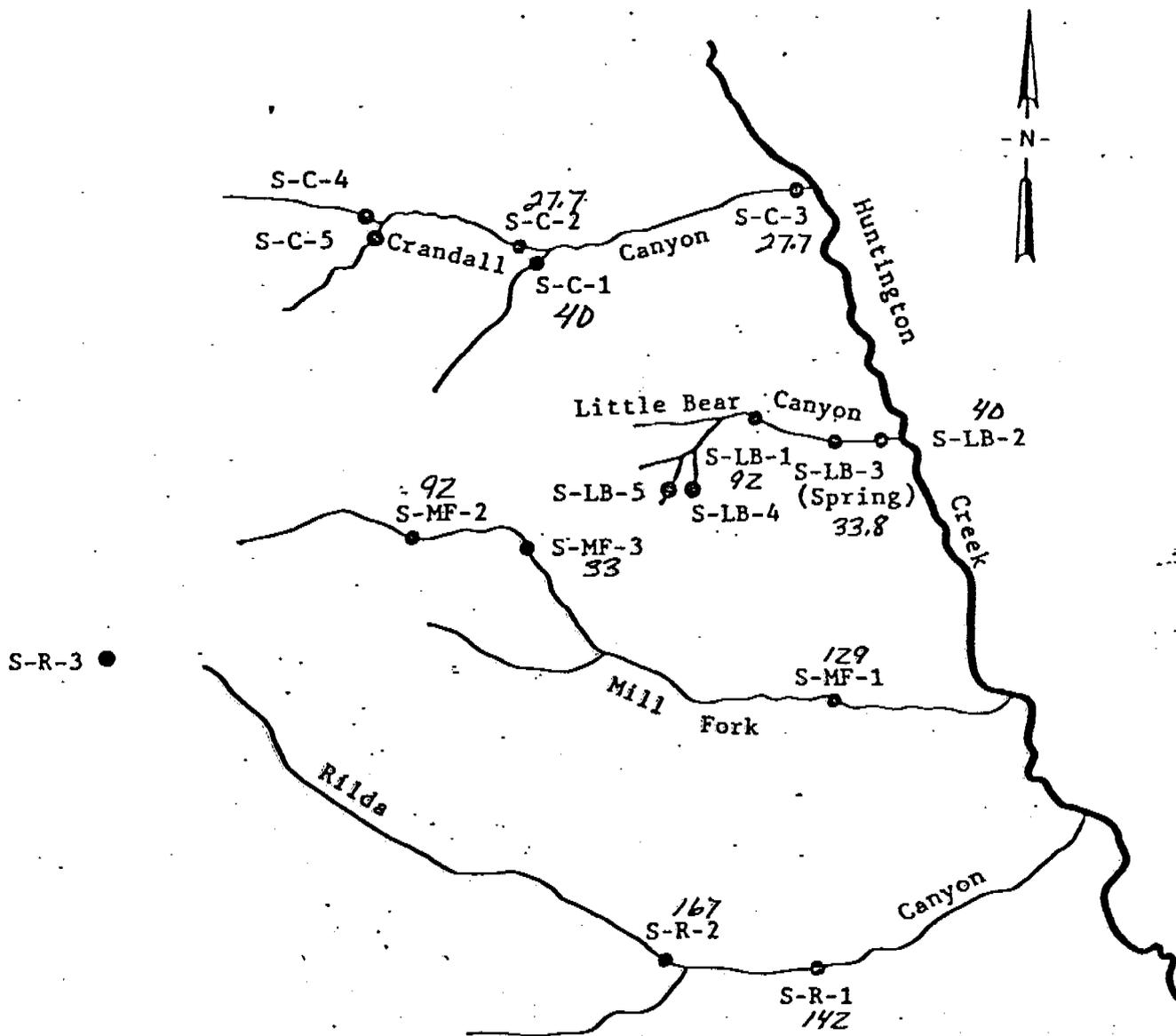
NOTE: Stations marked in red are outside of state limits for the sample taken during the above sampling period.

LIMITS:  
 lower \_\_\_\_\_  
 upper 250 mg/l Recommended

Vaughn Hansen Associates  
 5620 South 1475 East  
 Salt Lake City, Utah 84121



WATER QUALITY SAMPLING LOCATIONS  
HUNTINGTON CREEK MINE 4  
SWISHER COAL COMPANY



Parameter Sulfate  
Date November 8-12, 1976

NOTE: Stations marked in red are outside of state limits for the sample taken during the above sampling period.

LIMITS:  
lower \_\_\_\_\_  
upper 250 mg/l Recommended

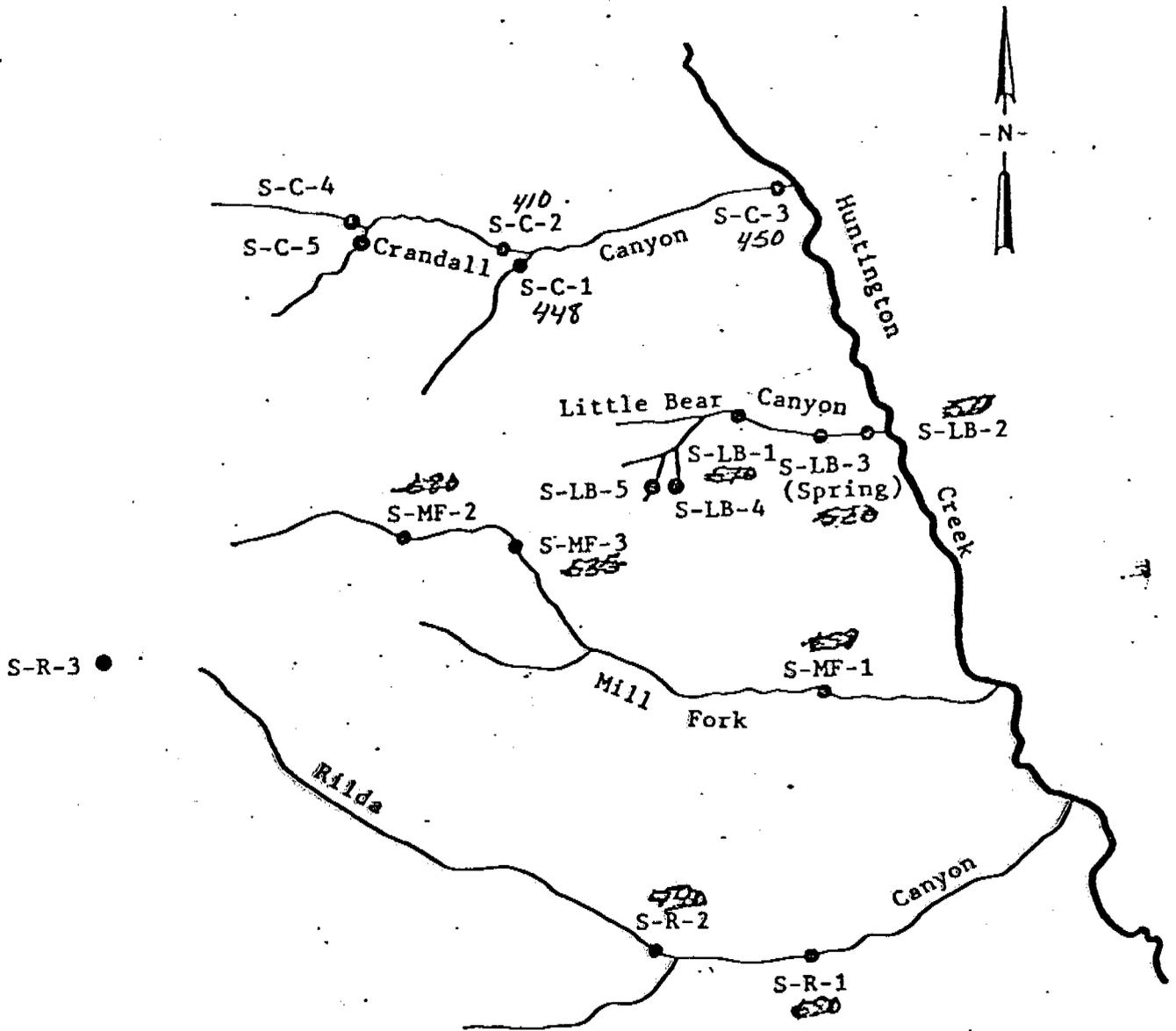
Vaughn Hansen Associates  
5620 South 1475 East  
Salt Lake City, Utah 84121



WATER QUALITY SAMPLING LOCATIONS

HUNTINGTON CREEK MINE 4

SWISHER COAL COMPANY

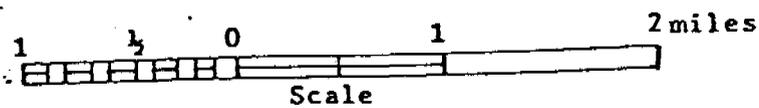


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Date November 8-12, 1976

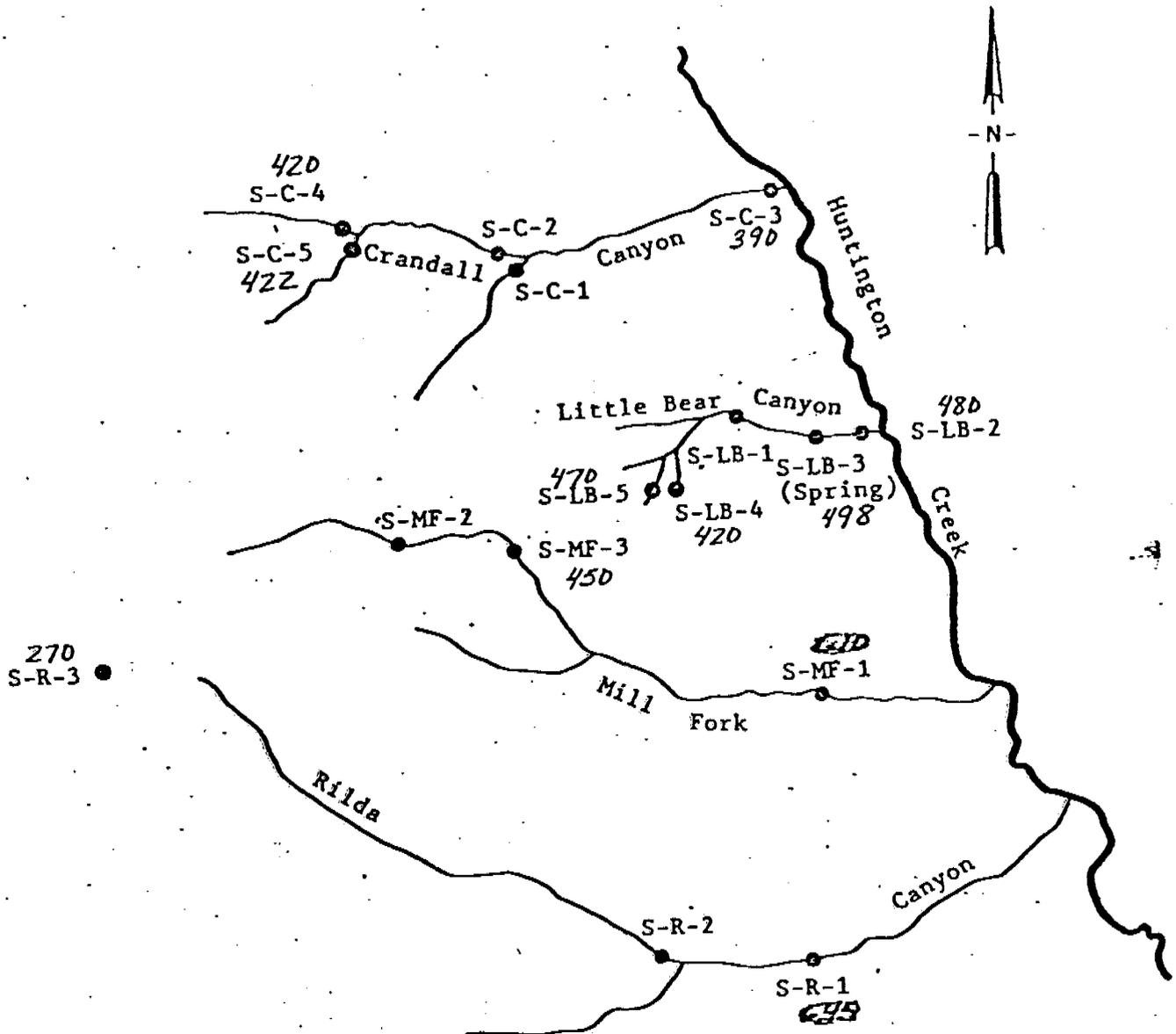
NOTE: Stations marked in red are outside of state limits for the sample taken during the above sampling period.

LIMITS:  
lower \_\_\_\_\_  
upper 500 mg/l Recommended

Vaughn Hansen Associates  
5620 South 1475 East  
Salt Lake City, Utah 84121



WATER QUALITY SAMPLING LOCATIONS  
 HUNTINGTON CREEK MINE 4  
 SWISHER COAL COMPANY



Parameter Total Dissolved Solids  
 Date May 31 to June 4, 1977

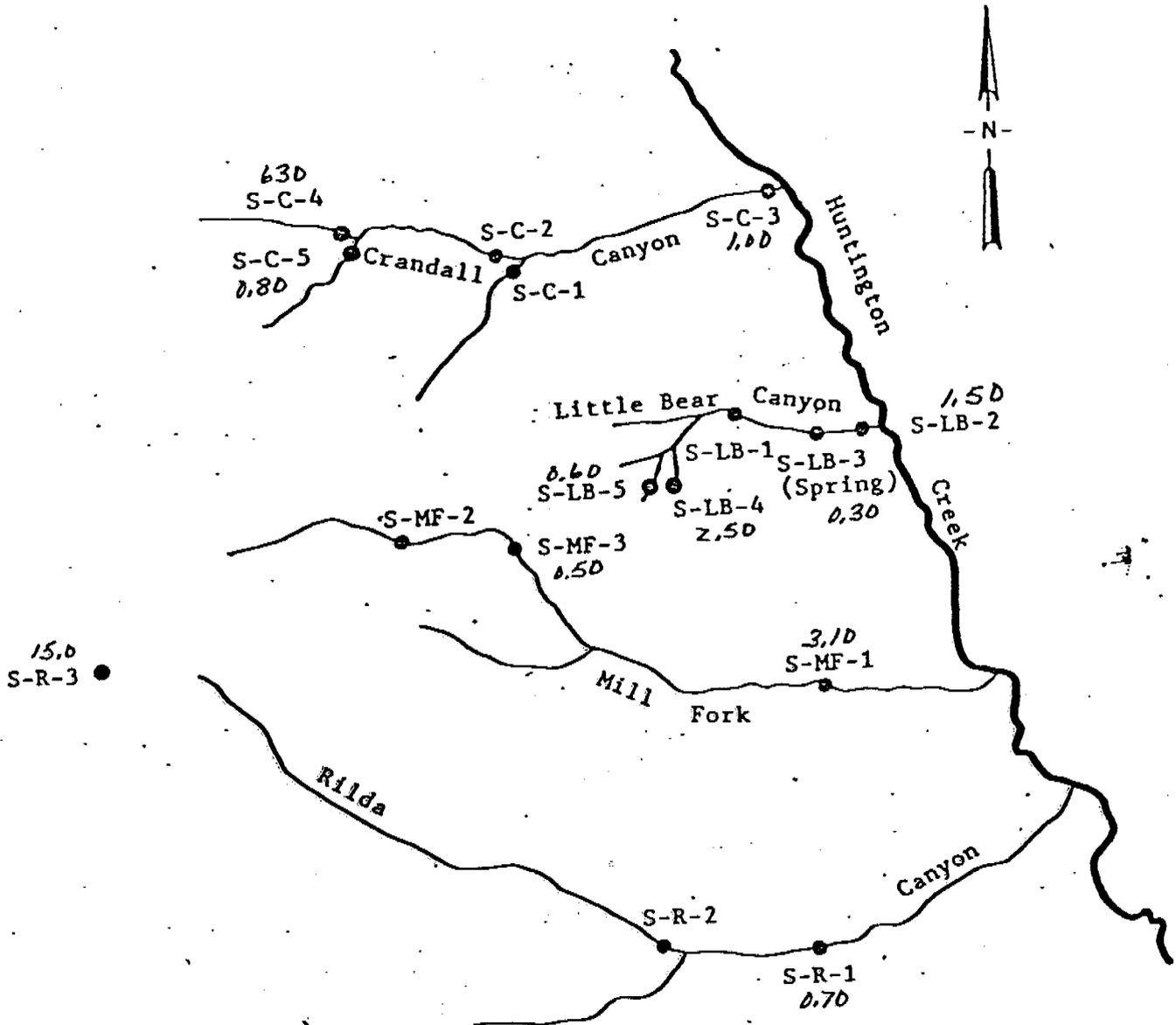
NOTE: Stations marked in red are outside of state limits for the sample taken during the above sampling period.

LIMITS:  
 lower \_\_\_\_\_  
 upper 500 mg/l Recommended

Vaughn Hansen Associates  
 5620 South 1475 East  
 Salt Lake City, Utah 84121



WATER QUALITY SAMPLING LOCATIONS  
 HUNTINGTON CREEK MINE 4  
 SWISHER COAL COMPANY



Parameter Turbidity  
 Date May 31 to June 4, 1977

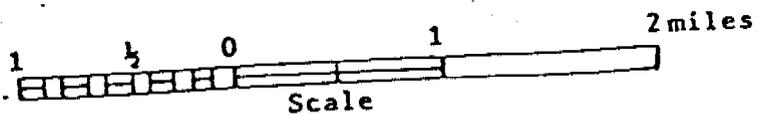
NOTE: Stations marked in red are outside of state limits for the sample taken during the above sampling period.

LIMITS:

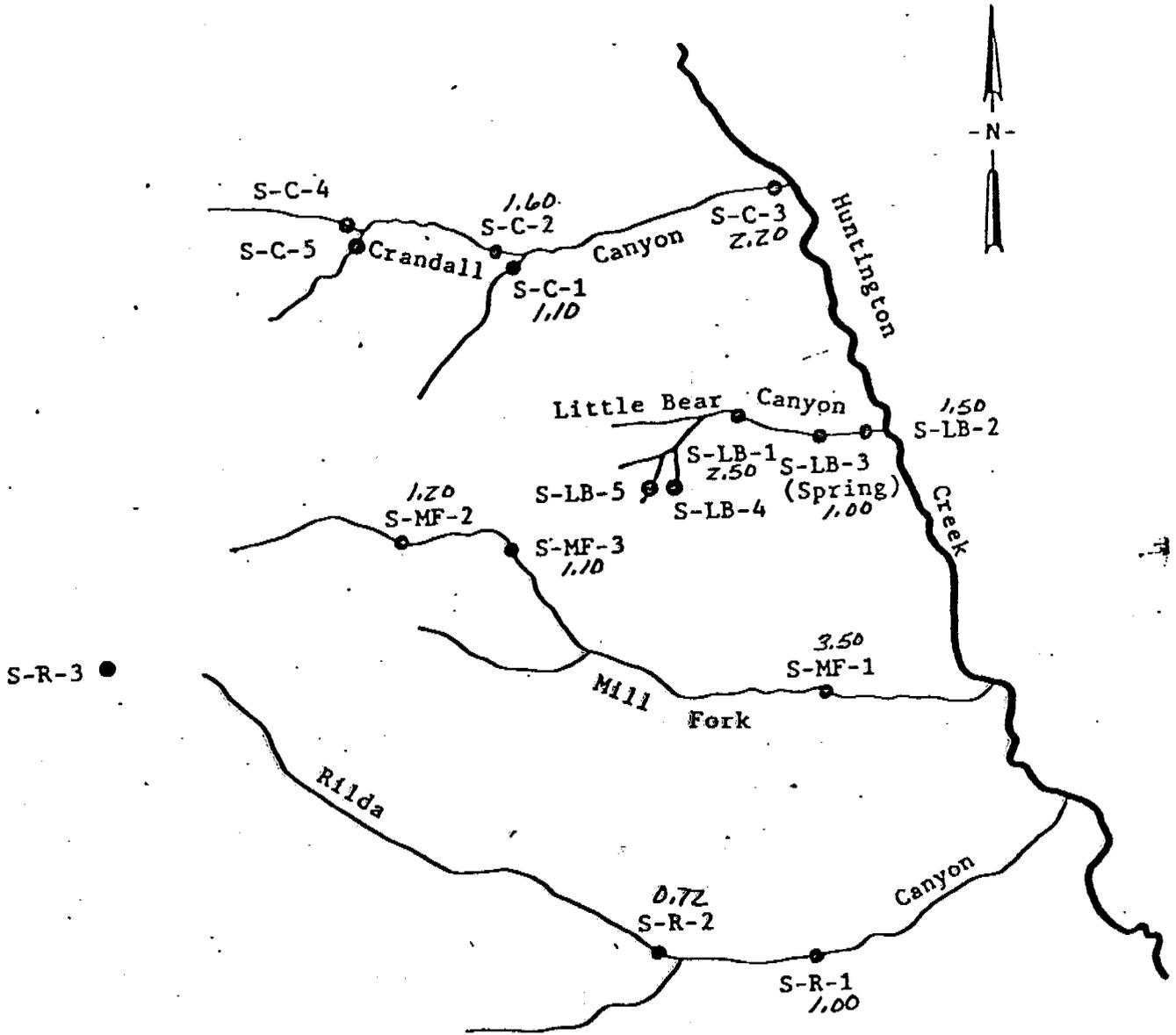
lower \_\_\_\_\_

upper \_\_\_\_\_

Vaughn Hansen Associates  
 5620 South 1475 East  
 Salt Lake City, Utah 84121



WATER QUALITY SAMPLING LOCATIONS  
HUNTINGTON CREEK MINE 4  
SWISHER COAL COMPANY



Parameter Turbidity  
Date November 8-12, 1976

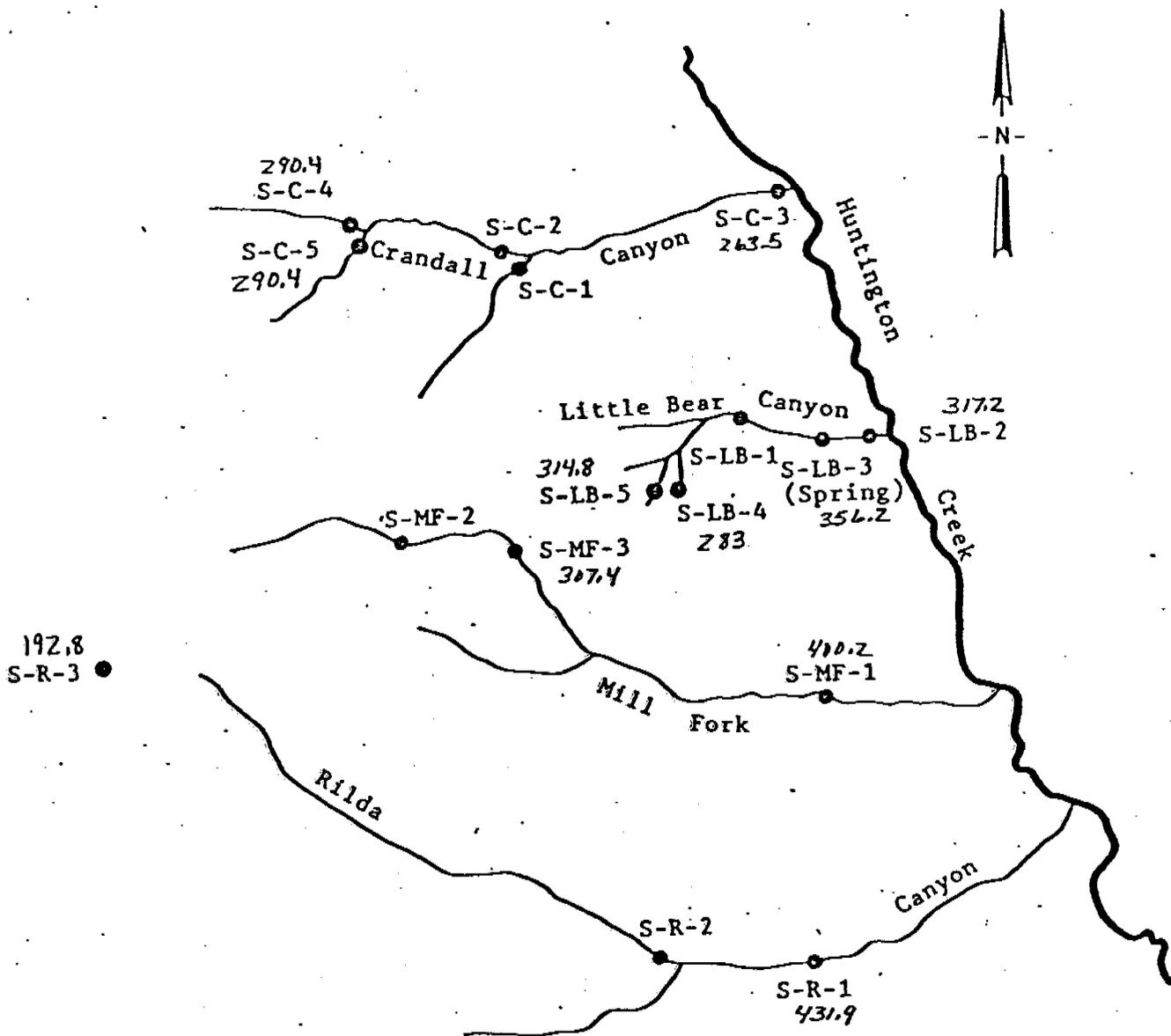
NOTE: Stations marked in red are outside of state limits for the sample taken during the above sampling period.

LIMITS:  
lower \_\_\_\_\_  
upper \_\_\_\_\_

Vaughn Hansen Associates  
5620 South 1475 East  
Salt Lake City, Utah 84121



WATER QUALITY SAMPLING LOCATIONS  
HUNTINGTON CREEK MINE 4  
SWISHER COAL COMPANY

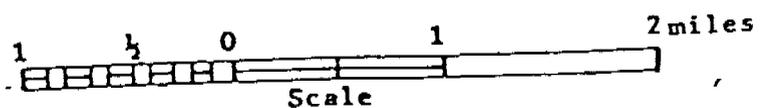


Parameter Bicarbonate  
Date May 31 to June 4, 1977

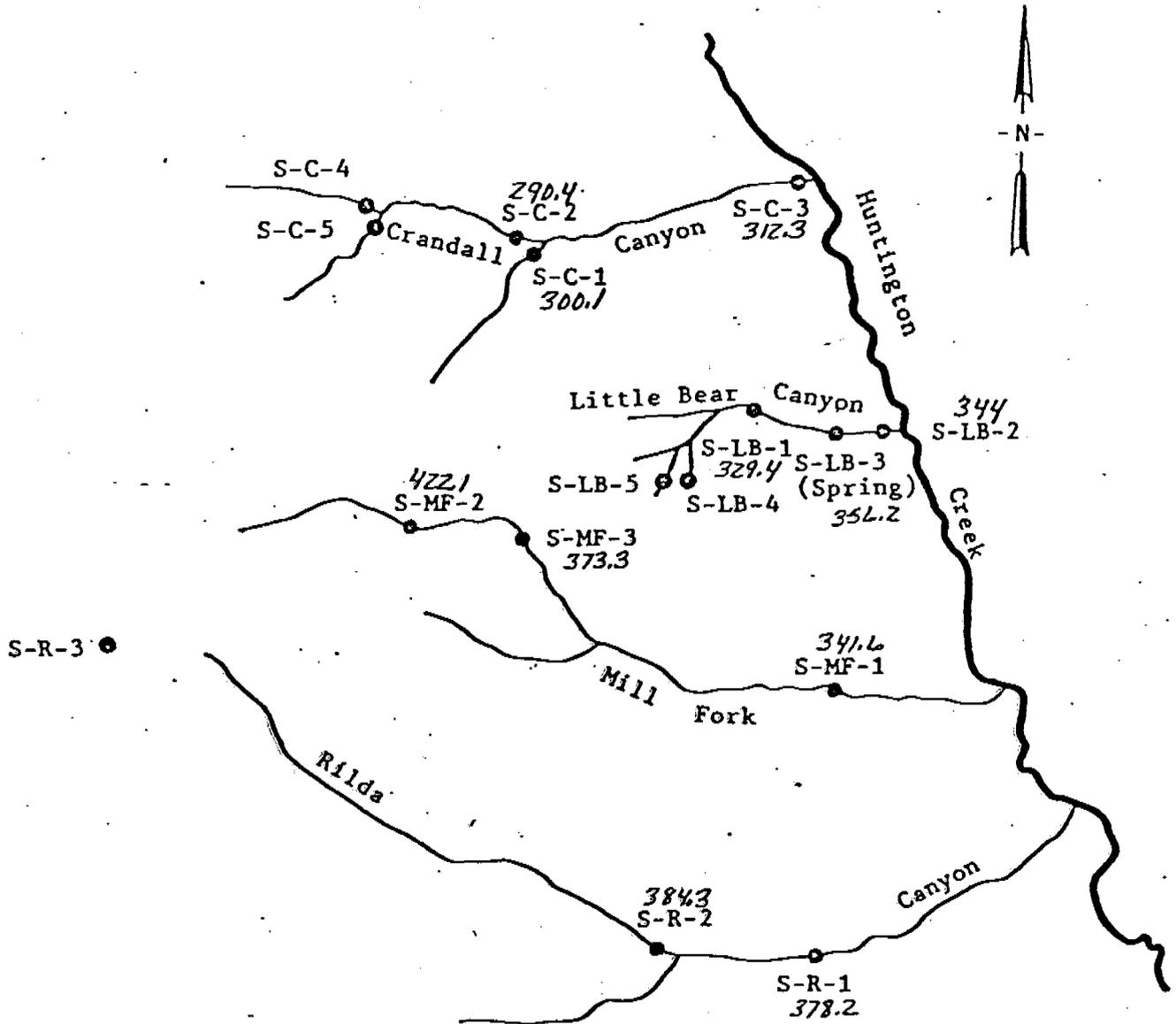
NOTE: Stations marked in red are outside of state limits for the sample taken during the above sampling period.

LIMITS:  
lower \_\_\_\_\_  
upper \_\_\_\_\_

Vaughn Hansen Associates  
5620 South 1475 East  
Salt Lake City, Utah 84121



WATER QUALITY SAMPLING LOCATIONS  
HUNTINGTON CREEK MINE 4  
SWISHER COAL COMPANY



Parameter Bicarbonate  
Date November 8-12, 1976

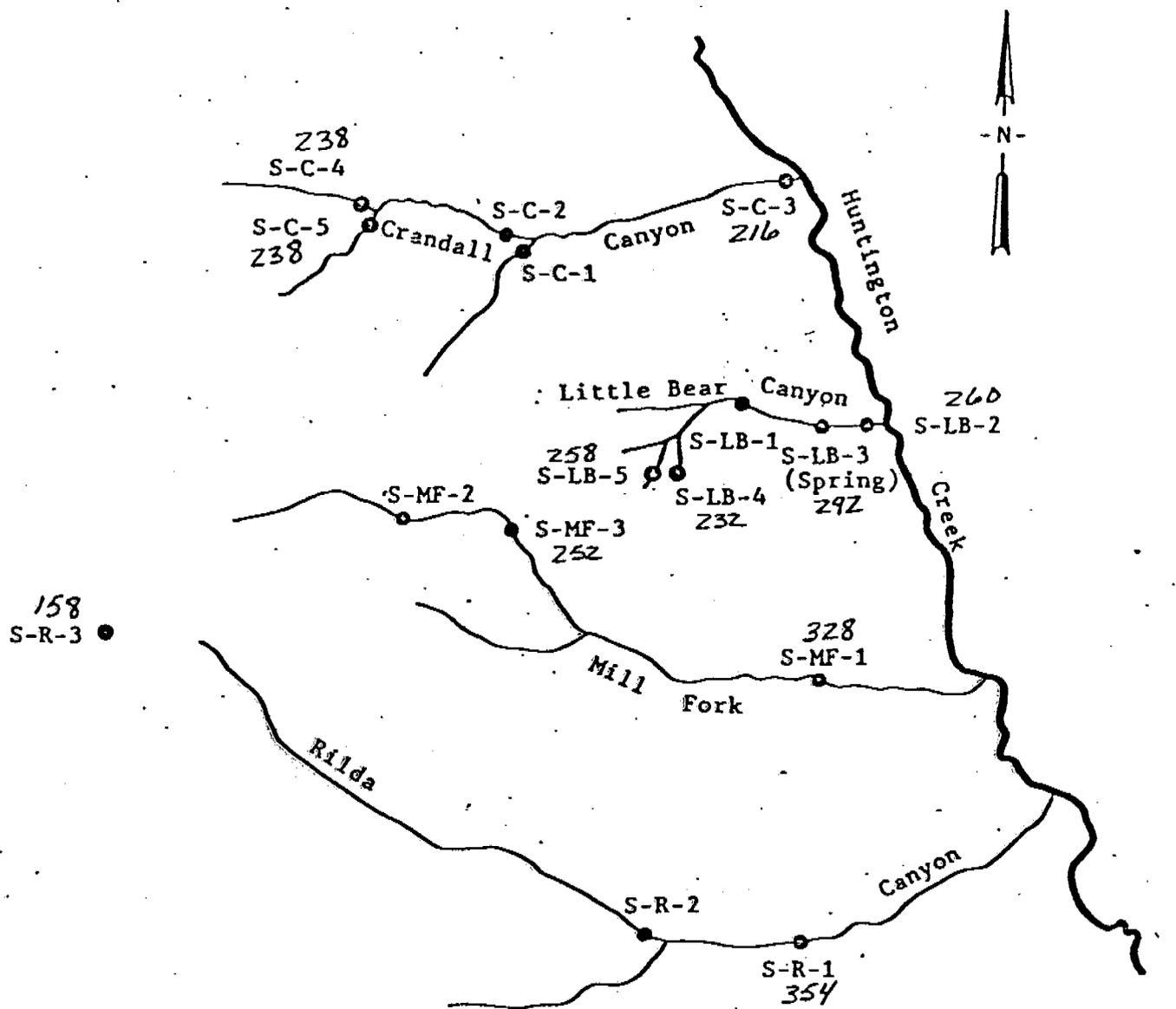
NOTE: Stations marked in red are outside of state limits for the sample taken during the above sampling period.

Vaughn Hansen Associates  
5620 South 1475 East  
Salt Lake City, Utah 84121

LIMITS:  
lower \_\_\_\_\_  
upper \_\_\_\_\_



WATER QUALITY SAMPLING LOCATIONS  
HUNTINGTON CREEK MINE 4  
SWISHER COAL COMPANY



Parameter Total Alkalinity  
Date May 31 to June 4, 1977

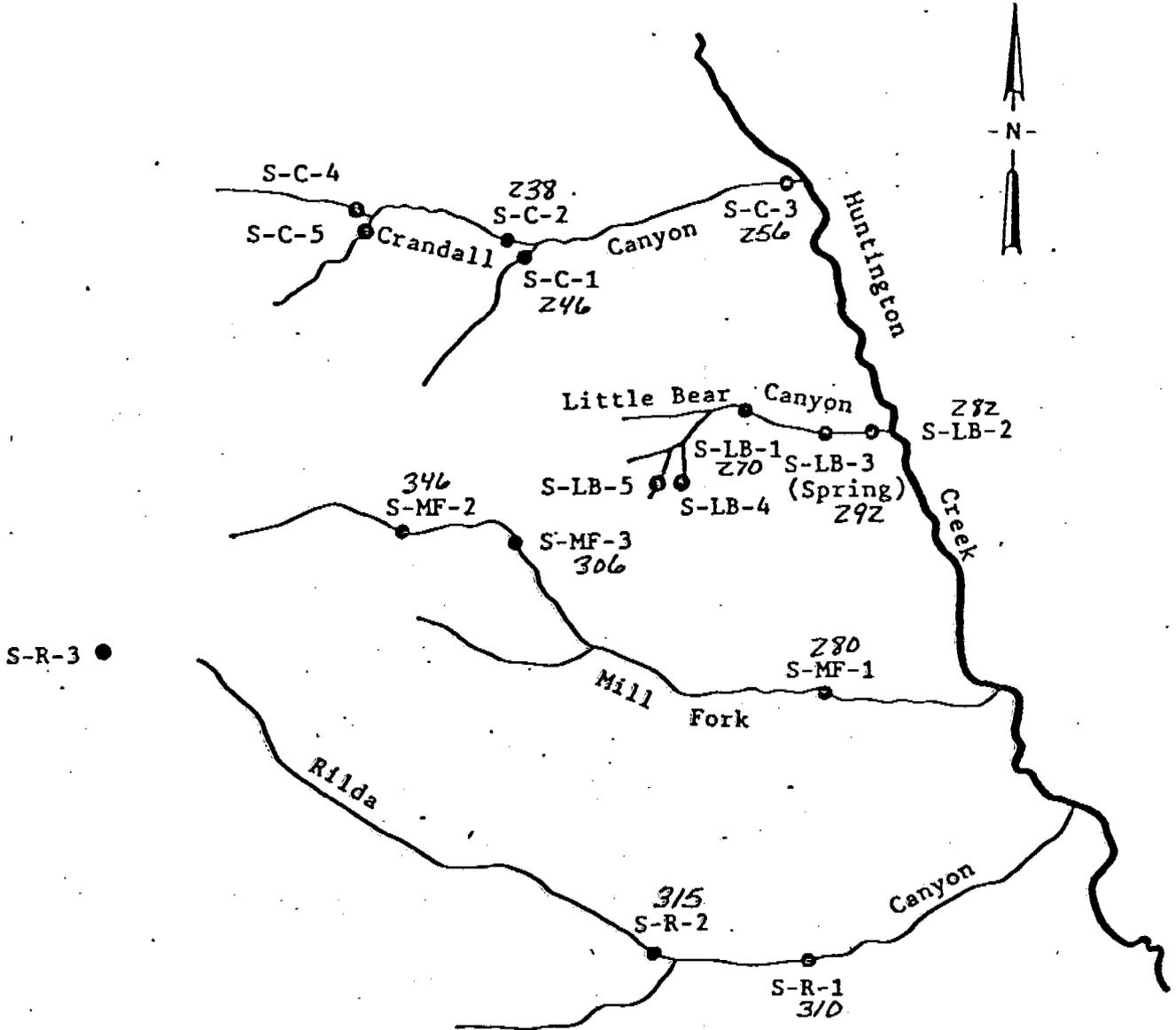
NOTE: Stations marked in red are outside of state limits for the sample taken during the above sampling period.

LIMITS:  
lower \_\_\_\_\_  
upper \_\_\_\_\_

Vaughn Hansen Associates  
5620 South 1475 East  
Salt Lake City, Utah 84121



WATER QUALITY SAMPLING LOCATIONS  
HUNTINGTON CREEK MINE 4  
SWISHER COAL COMPANY

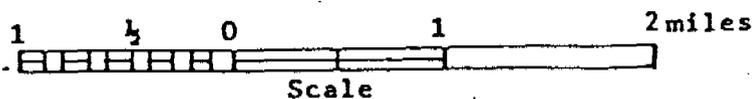


Parameter Alkalinity (Total)  
Date November 8-12, 1976

NOTE: Stations marked in red are outside of state limits for the sample taken during the above sampling period.

LIMITS:  
lower \_\_\_\_\_  
upper \_\_\_\_\_

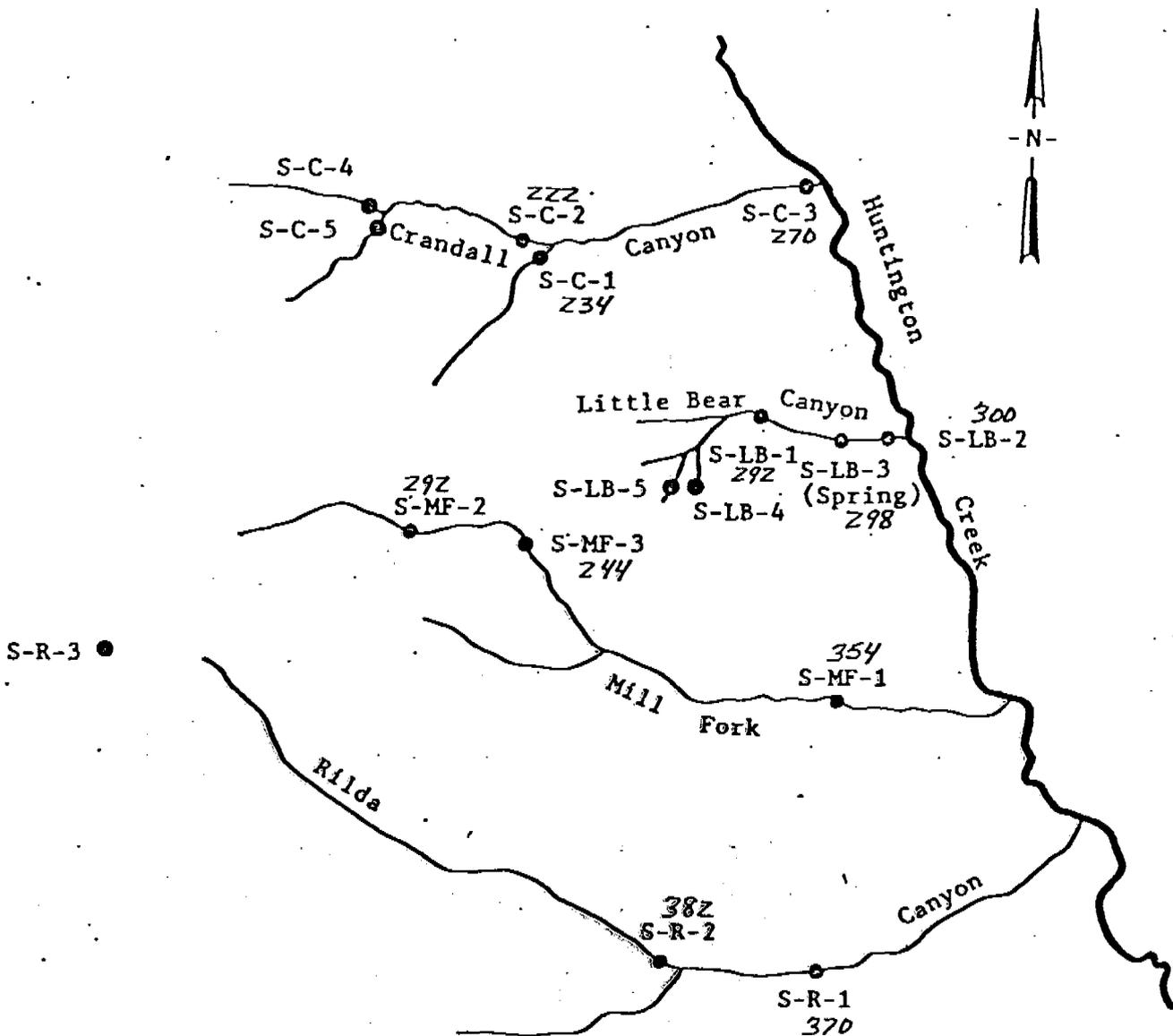
Vaughn Hansen Associates  
5620 South 1475 East  
Salt Lake City, Utah 84121



WATER QUALITY SAMPLING LOCATIONS

HUNTINGTON CREEK MINE 4

SWISHER COAL COMPANY



Parameter Hardness  
 Date November 8-12, 1976

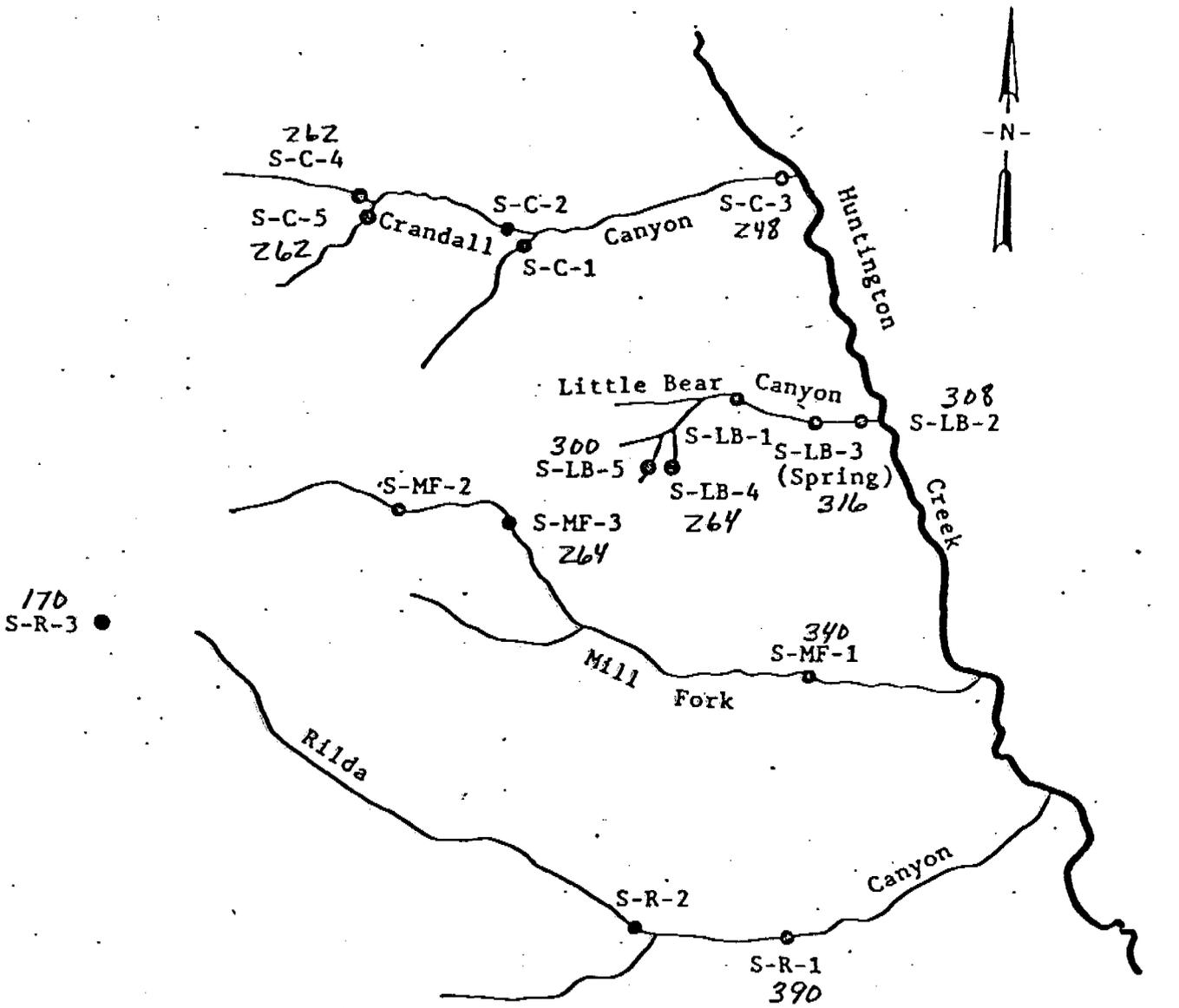
NOTE: Stations marked in red are outside of state limits for the sample taken during the above sampling period.

LIMITS:  
 lower \_\_\_\_\_  
 upper \_\_\_\_\_

Vaughn Hansen Associates  
 5620 South 1475 East  
 Salt Lake City, Utah 84121



WATER QUALITY SAMPLING LOCATIONS  
 HUNTINGTON CREEK MINE 4  
 SWISHER COAL COMPANY



Parameter Hardness  
 Date May 31 to June 4, 1977

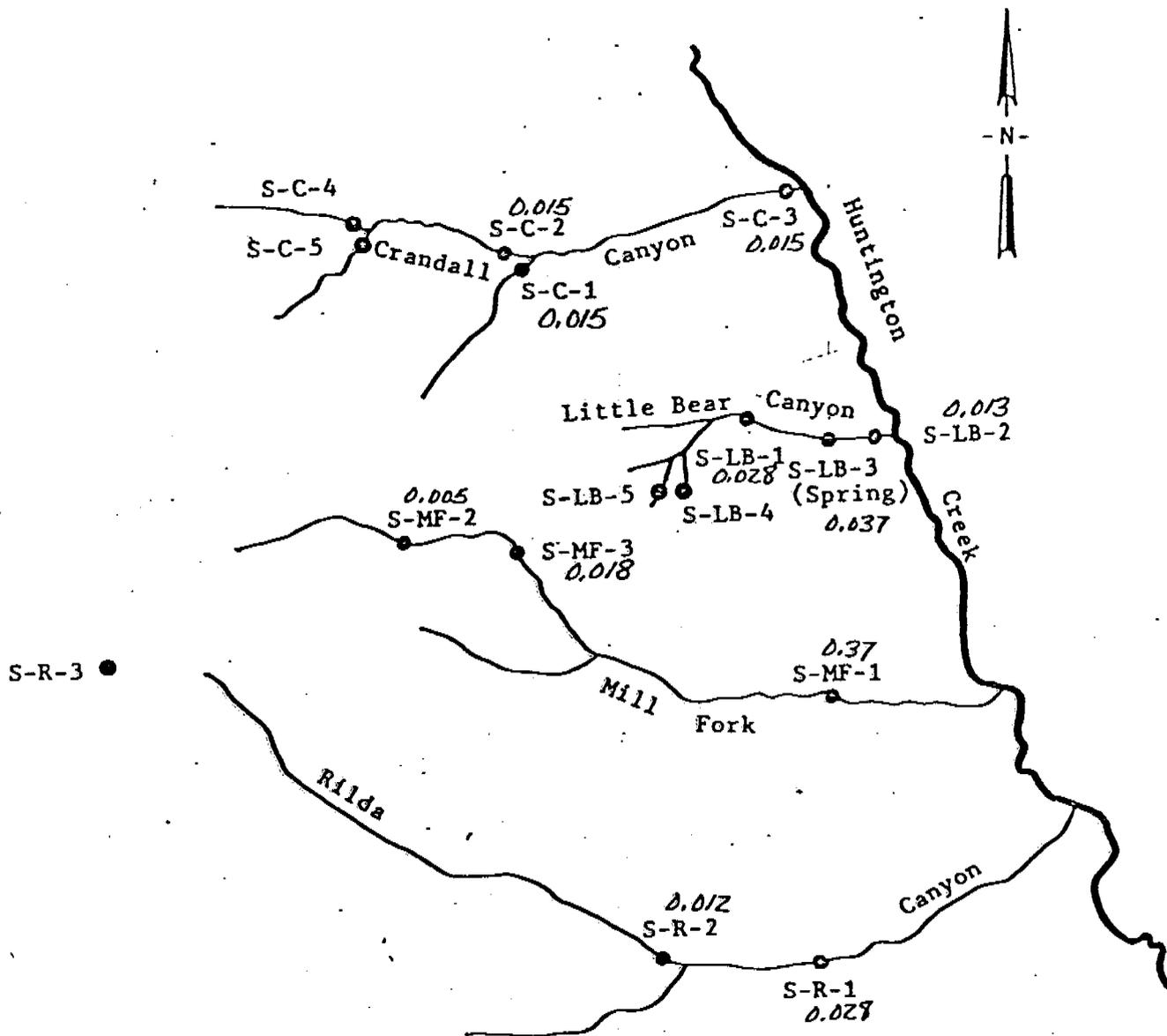
NOTE: Stations marked in red are outside of state limits for the sample taken during the above sampling period.

LIMITS:  
 lower \_\_\_\_\_  
 upper \_\_\_\_\_

Vaughn Hansen Associates  
 5620 South 1475 East  
 Salt Lake City, Utah 84121



WATER QUALITY SAMPLING LOCATIONS  
HUNTINGTON CREEK MINE 4  
SWISHER COAL COMPANY



Parameter Barium  
Date November 8-12, 1976

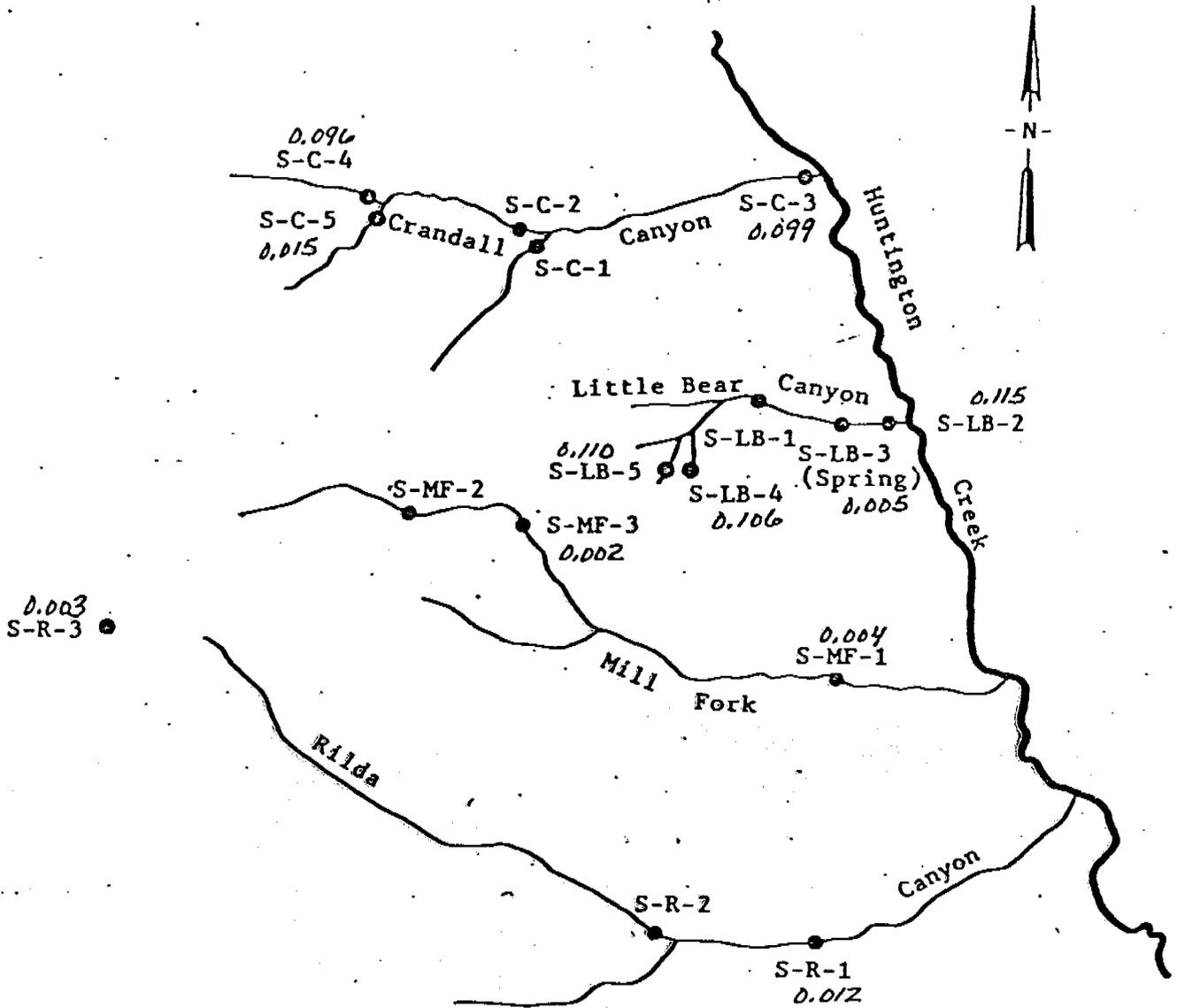
NOTE: Stations marked in red are outside of state limits for the sample taken during the above sampling period.

LIMITS:  
lower \_\_\_\_\_  
upper 1.0 mg/l Mandatory

Vaughn Hansen Associates  
5620 South 1475 East  
Salt Lake City, Utah 84121



WATER QUALITY SAMPLING LOCATIONS  
 HUNTINGTON CREEK MINE 4  
 SWISHER COAL COMPANY



Parameter Barium  
 Date May 31 to June 4, 1977

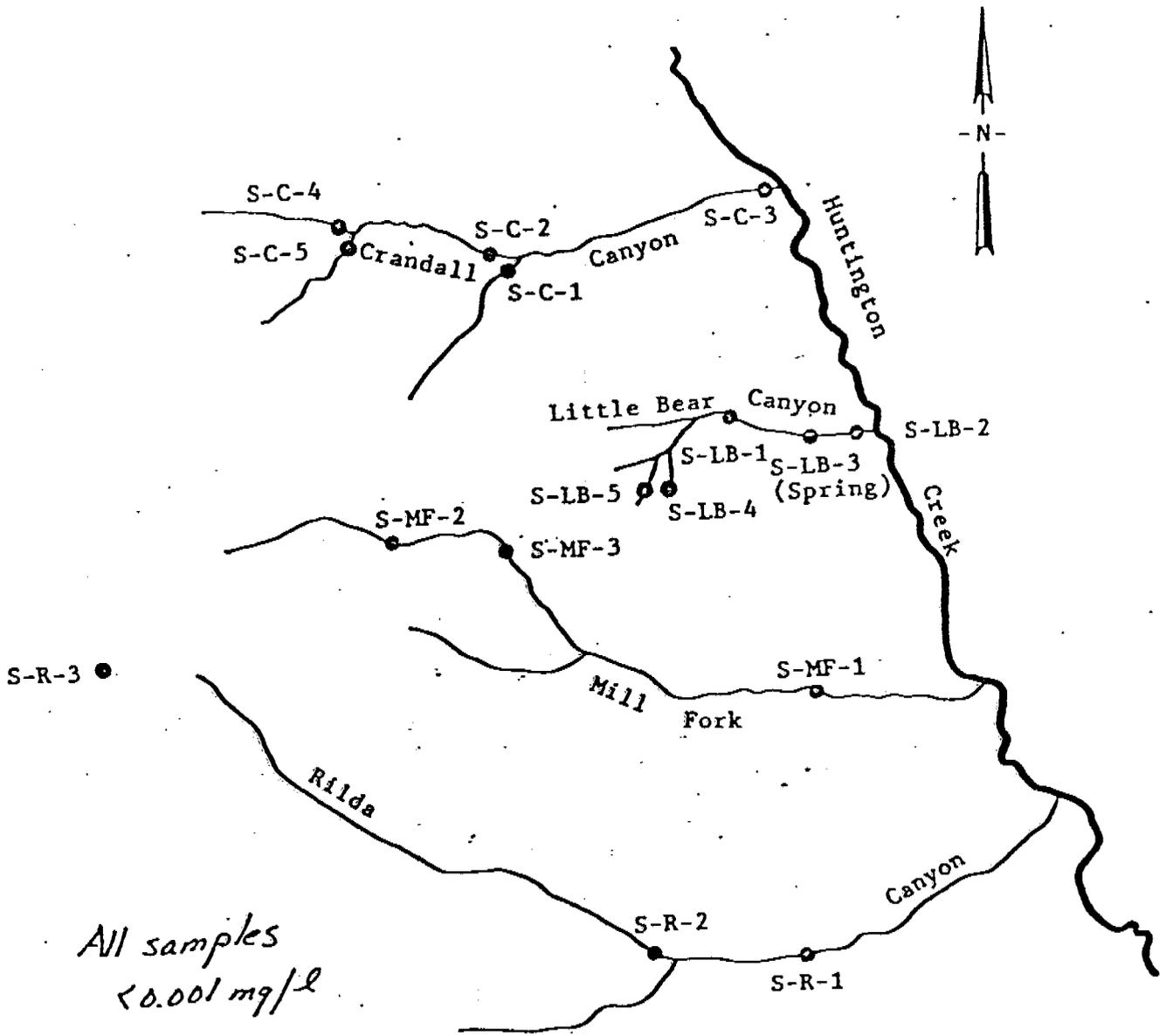
NOTE: Stations marked in red are outside of state limits for the sample taken during the above sampling period.

LIMITS:  
 lower \_\_\_\_\_  
 upper 1.0 mg/l Mandatory

Vaughn Hansen Associates  
 5620 South 1475 East  
 Salt Lake City, Utah 84121



WATER QUALITY SAMPLING LOCATIONS  
HUNTINGTON CREEK MINE 4  
SWISHER COAL COMPANY.

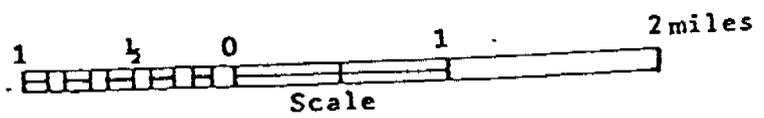


Parameter Boron  
Date November 8-12, 1976

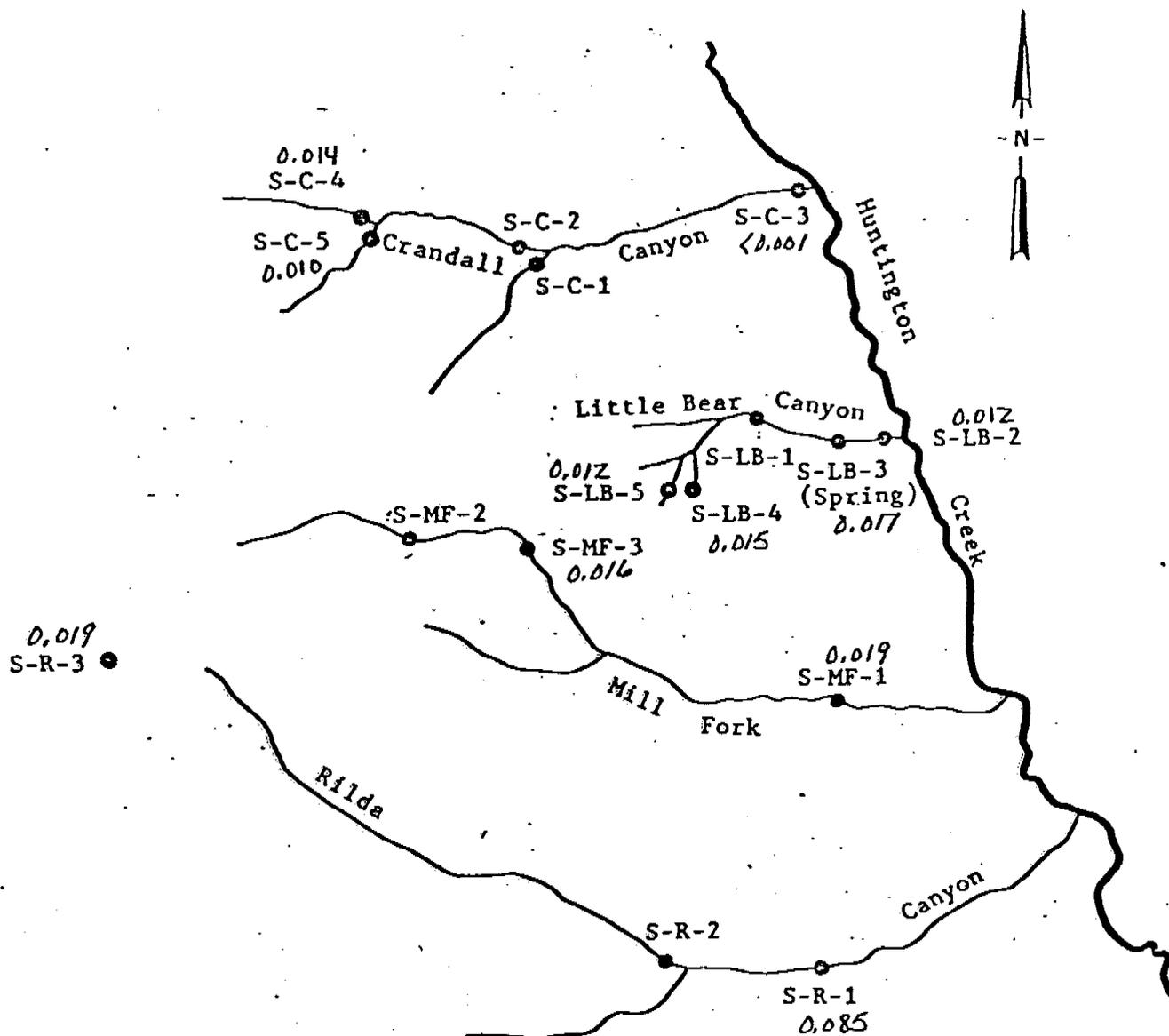
NOTE: Stations marked in red are outside of state limits for the sample taken during the above sampling period.

LIMITS:  
lower \_\_\_\_\_  
upper \_\_\_\_\_

Vaughn Hansen Associates  
5620 South 1475 East  
Salt Lake City, Utah 84121



WATER QUALITY SAMPLING LOCATIONS  
 HUNTINGTON CREEK MINE 4  
 SWISHER COAL COMPANY



Parameter Boron  
 Date May 31 to June 4, 1977

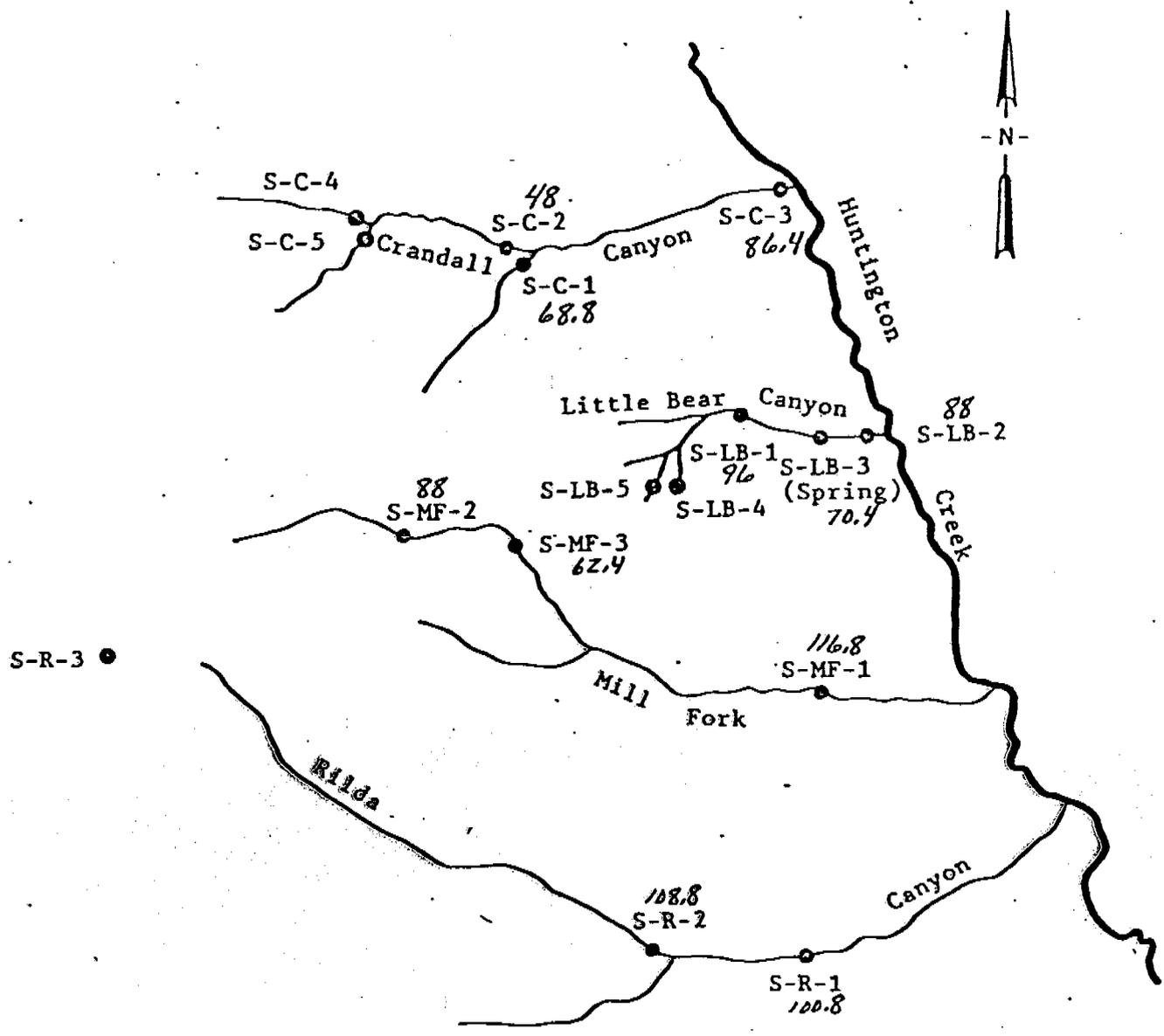
NOTE: Stations marked in red are outside of state limits for the sample taken during the above sampling period.

LIMITS:  
 lower \_\_\_\_\_  
 upper \_\_\_\_\_

Vaughn Hansen Associates  
 5620 South 1475 East  
 Salt Lake City, Utah 84121



WATER QUALITY SAMPLING LOCATIONS  
HUNTINGTON CREEK MINE 4  
SWISHER COAL COMPANY

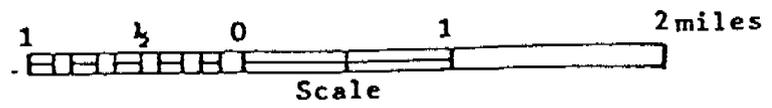


Parameter Calcium  
Date November 8-12, 1976

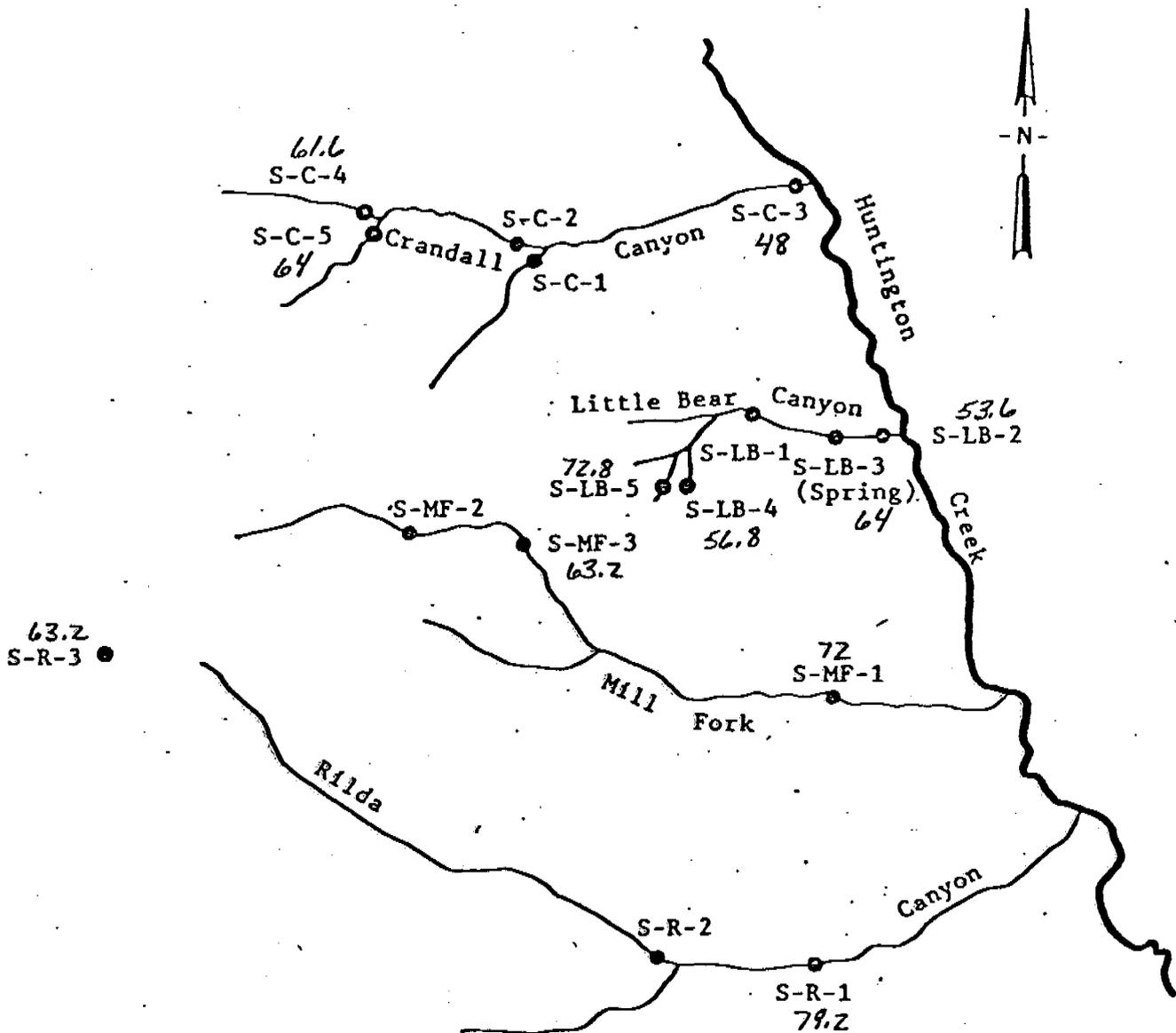
NOTE: Stations marked in red are outside of state limits for the sample taken during the above sampling period.

LIMITS:  
lower \_\_\_\_\_  
upper \_\_\_\_\_

Vaughn Hansen Associates  
5620 South 1475 East  
Salt Lake City, Utah 84121



WATER QUALITY SAMPLING LOCATIONS  
 HUNTINGTON CREEK MINE 4  
 SWISHER COAL COMPANY



Parameter Calcium  
 Date May 31 to June 4, 1977

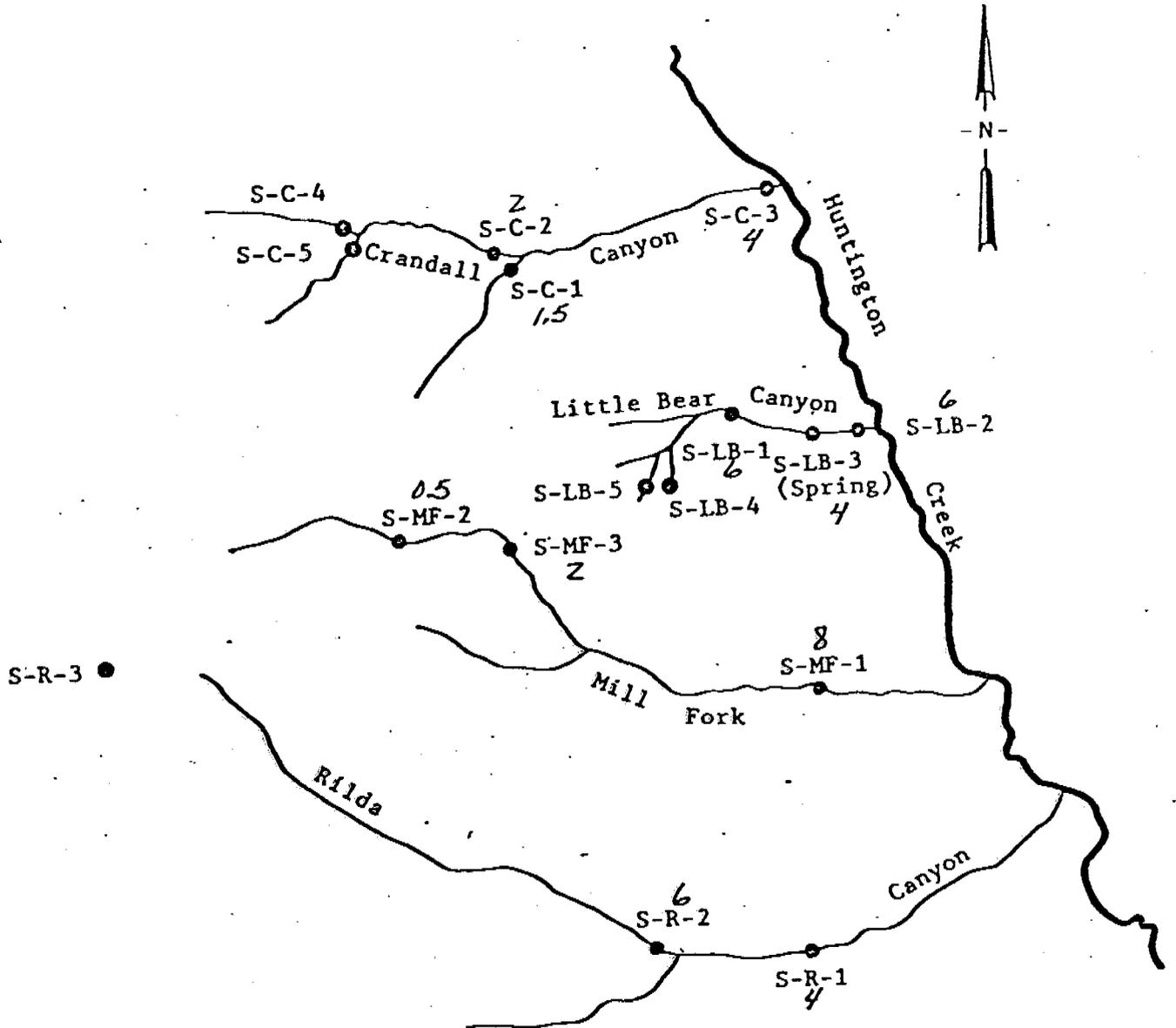
NOTE: Stations marked in red are outside of state limits for the sample taken during the above sampling period.

LIMITS:  
 lower \_\_\_\_\_  
 upper \_\_\_\_\_

Vaughn Hansen Associates  
 5620 South 1475 East  
 Salt Lake City, Utah 84121



WATER QUALITY SAMPLING LOCATIONS  
 HUNTINGTON CREEK MINE 4  
 SWISHER COAL COMPANY



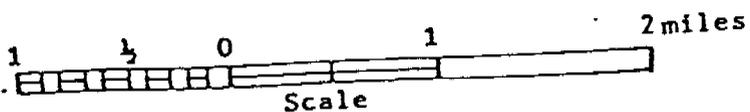
Parameter Chloride  
 Date November 8-12, 1976

NOTE: Stations marked in red are outside of state limits for the sample taken during the above sampling period.

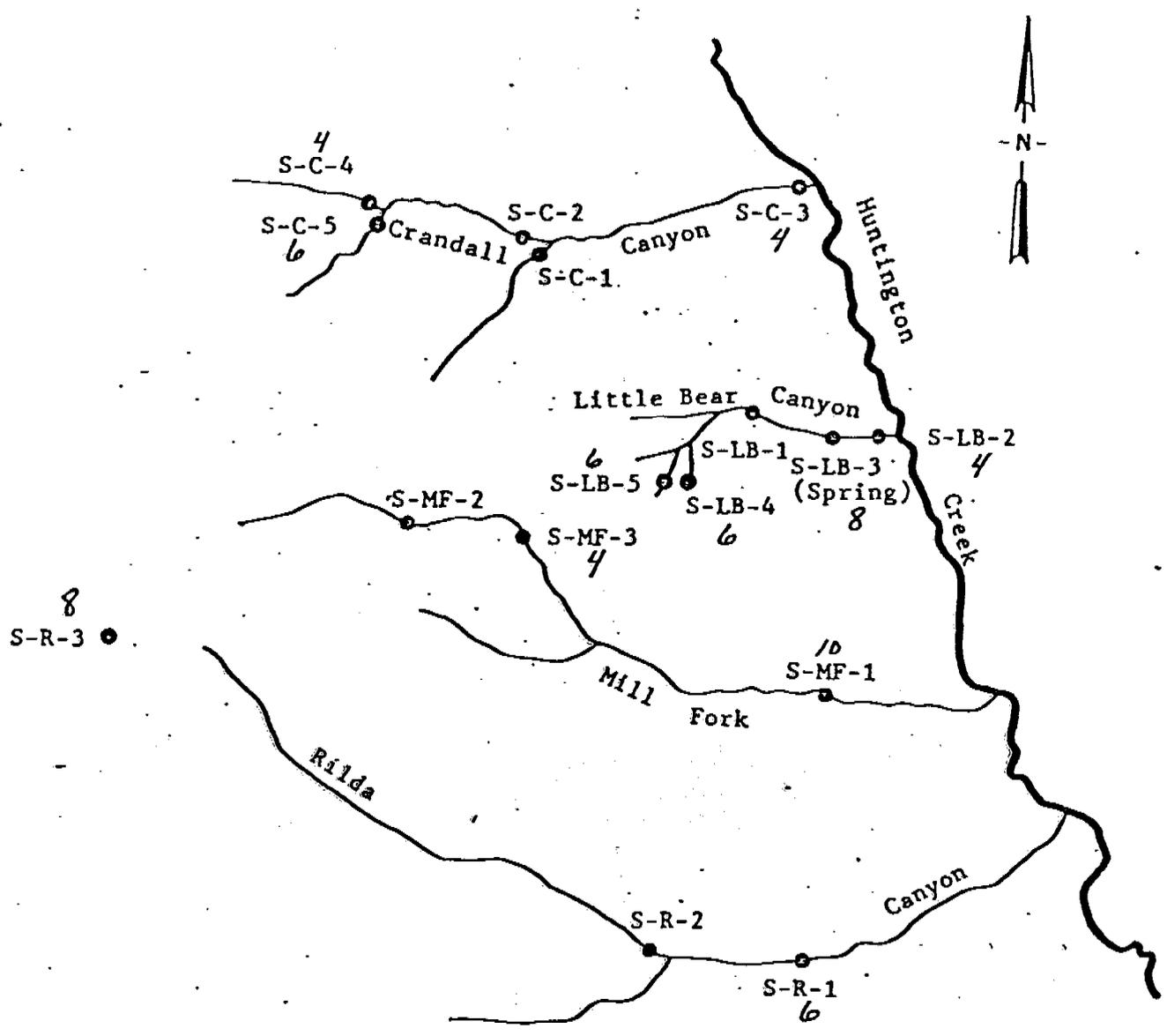
LIMITS:

lower \_\_\_\_\_  
 upper 250 mg/l Recommended

Vaughn Hansen Associates  
 5620 South 1475 East  
 Salt Lake City, Utah 84121



WATER QUALITY SAMPLING LOCATIONS  
HUNTINGTON CREEK MINE 4  
SWISHER COAL COMPANY

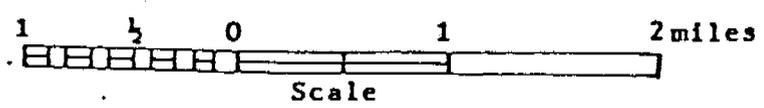


Parameter Chloride  
Date May 31 to June 4, 1977

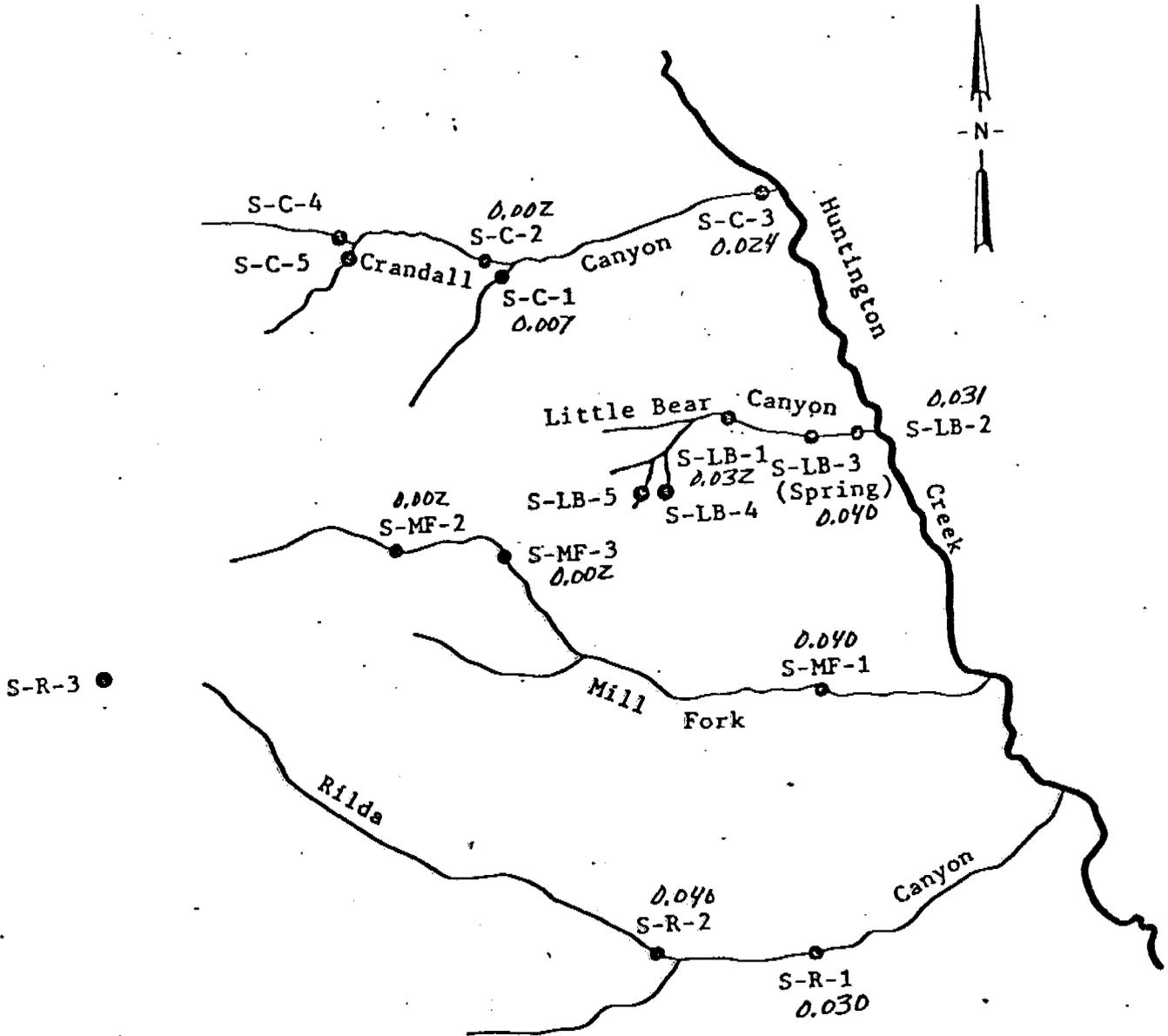
NOTE: Stations marked in red are outside of state limits for the sample taken during the above sampling period.

LIMITS:  
lower \_\_\_\_\_  
upper 250 mg/l Recommended

Vaughn Hansen Associates  
5620 South 1475 East  
Salt Lake City, Utah 84121



WATER QUALITY SAMPLING LOCATIONS  
HUNTINGTON CREEK MINE 4  
SWISHER COAL COMPANY



Parameter Copper  
Date November 8-12, 1976

NOTE: Stations marked in red are outside of state limits for the sample taken during the above sampling period.

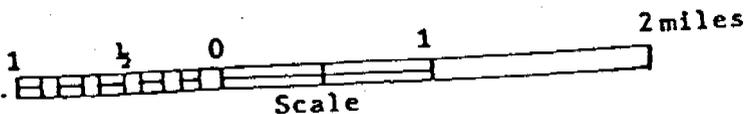
LIMITS:

lower

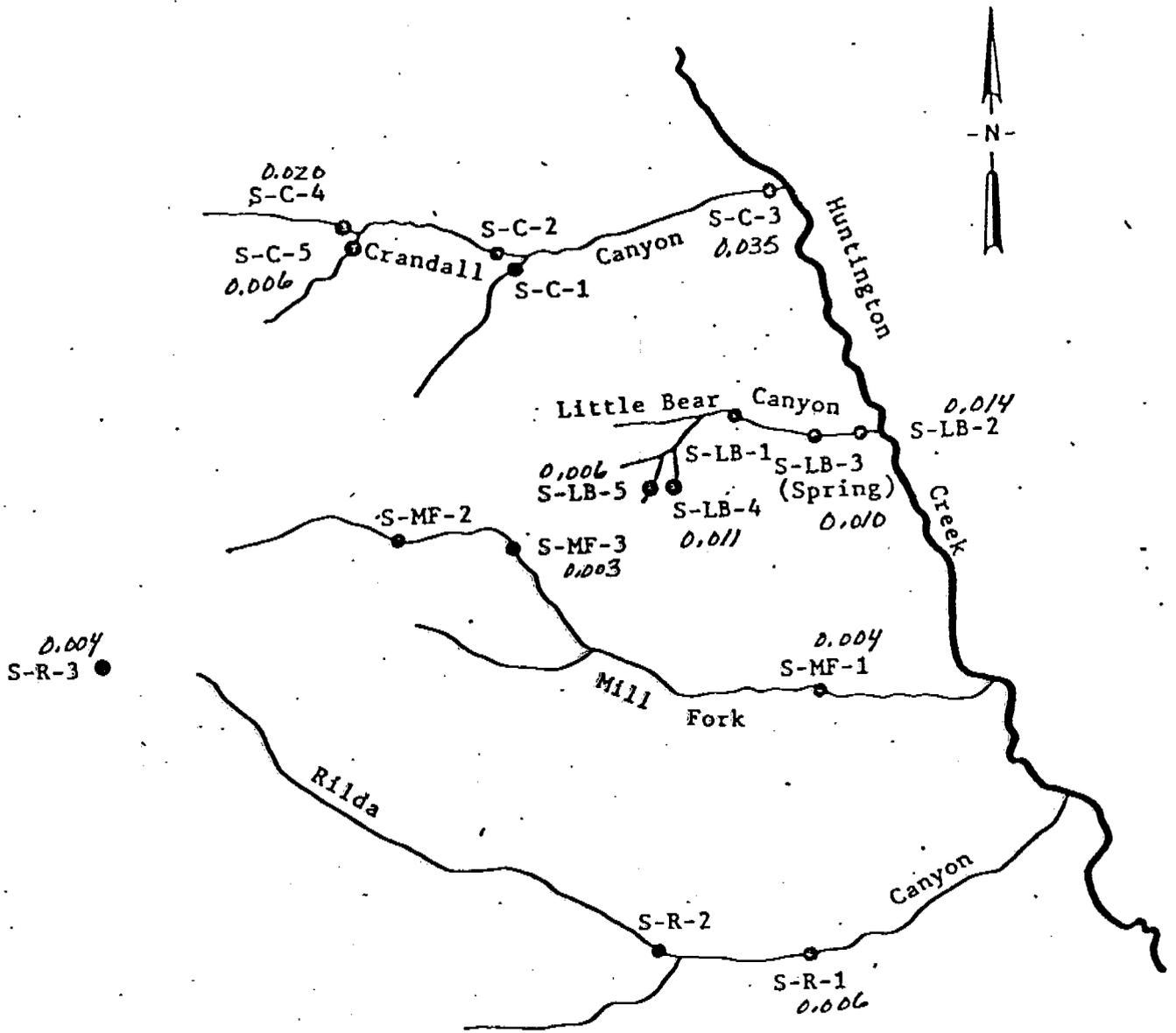
upper

1.0 mg/l Recommended

Vaughn Hansen Associates  
5620 South 1475 East  
Salt Lake City, Utah 84121



WATER QUALITY SAMPLING LOCATIONS  
HUNTINGTON CREEK MINE 4  
SWISHER COAL COMPANY

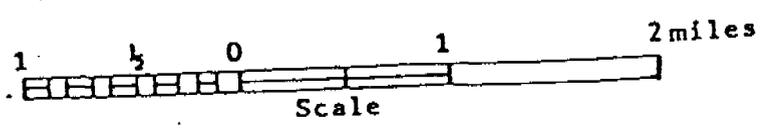


Parameter Copper  
Date May 31 to June 4, 1977

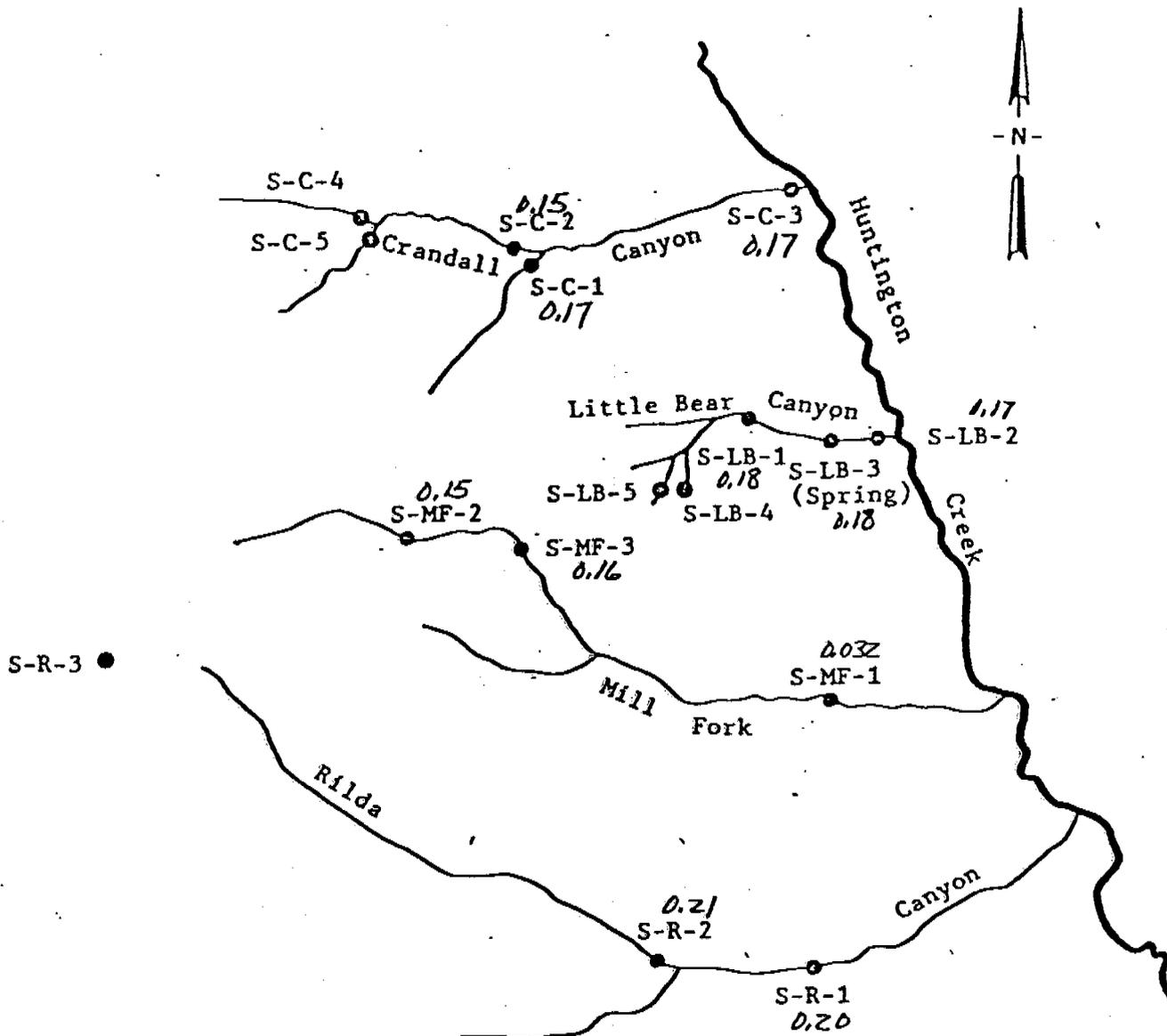
NOTE: Stations marked in red are outside of state limits for the sample taken during the above sampling period.

LIMITS:  
lower \_\_\_\_\_  
upper 1.0 mg/l Recommended

Vaughn Hansen Associates  
5620' South 1475 East  
Salt Lake City, Utah 84121



WATER QUALITY SAMPLING LOCATIONS  
HUNTINGTON CREEK MINE 4  
SWISHER COAL COMPANY

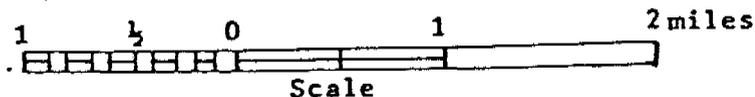


Parameter Fluoride  
Date November 8-12, 1976

NOTE: Stations marked in red are outside of state limits for the sample taken during the above sampling period.

LIMITS: 1.0 mg/l Recommended  
upper 2.0 mg/l mandatory

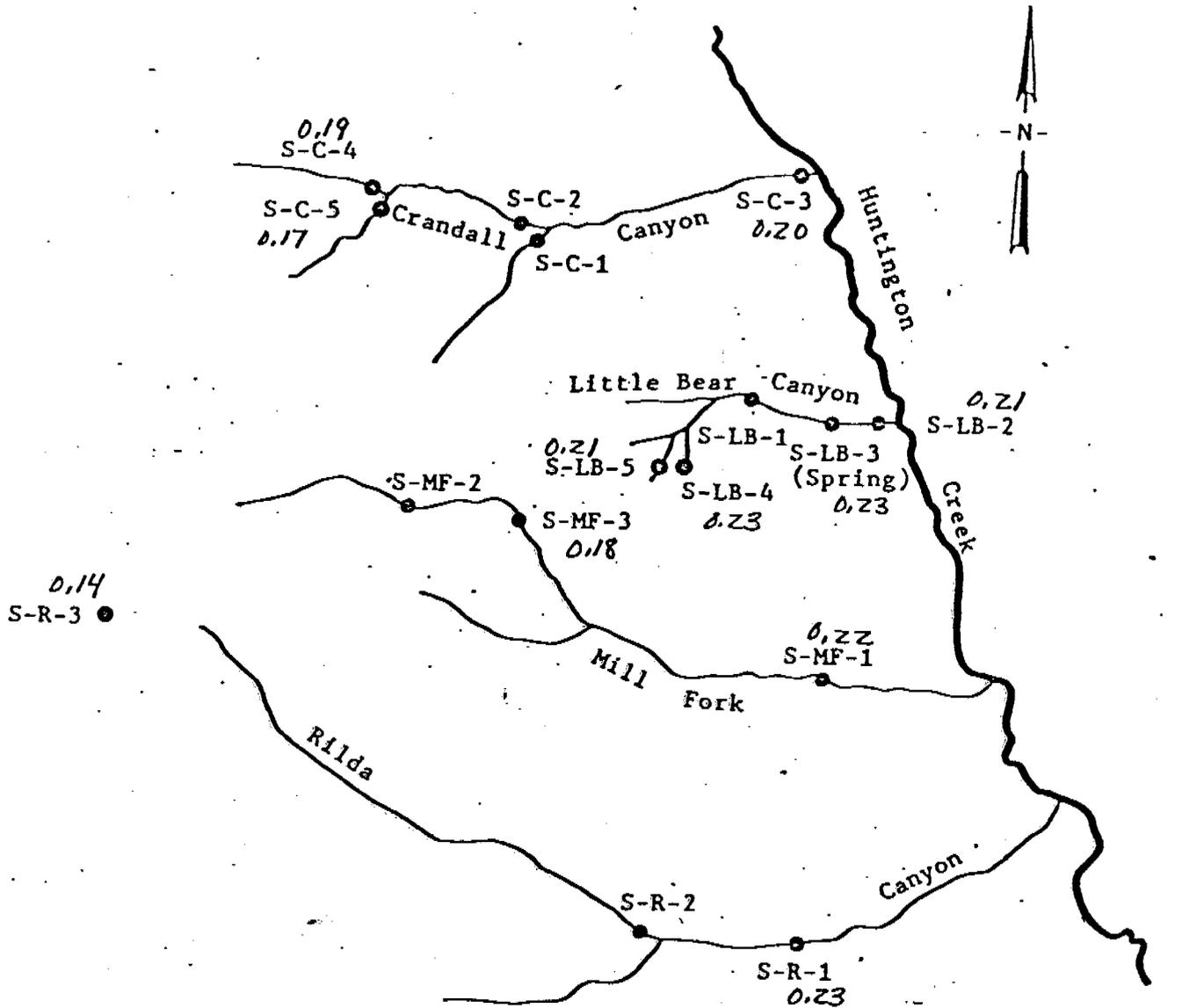
Vaughn Hansen Associates  
5620 South 1475 East  
Salt Lake City, Utah 84121



WATER QUALITY SAMPLING LOCATIONS

HUNTINGTON CREEK MINE 4

SWISHER COAL COMPANY

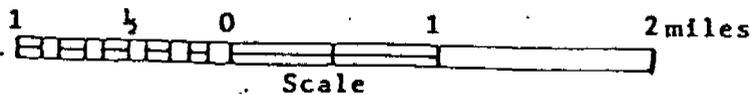


Parameter Fluoride  
 Date May 31 to June 4, 1977

NOTE: Stations marked in red are outside of state limits for the sample taken during the above sampling period.

LIMITS:  
1.0 mg/l Recommended  
 upper 2.0 mg/l Mandatory

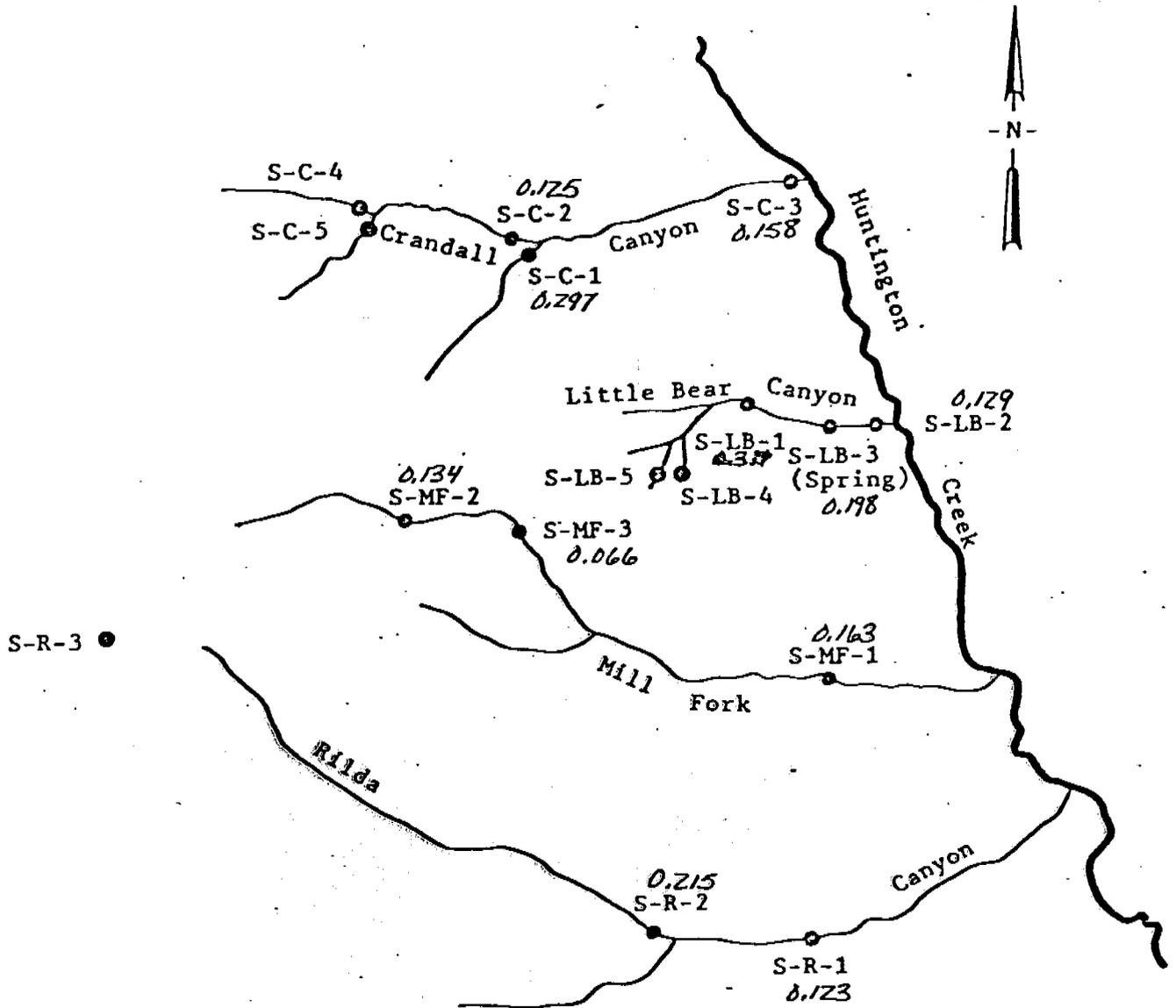
Vaughn Hansen Associates  
 5620 South 1475 East  
 Salt Lake City, Utah 84121



WATER QUALITY SAMPLING LOCATIONS

HUNTINGTON CREEK MINE 4

SWISHER COAL COMPANY



Parameter Iron - (Total)  
 Date November 8-12, 1976

NOTE: Stations marked in red are outside of state limits for the sample taken during the above sampling period.

LIMITS:  
 lower \_\_\_\_\_  
 upper 0.3 mg/l Recommended

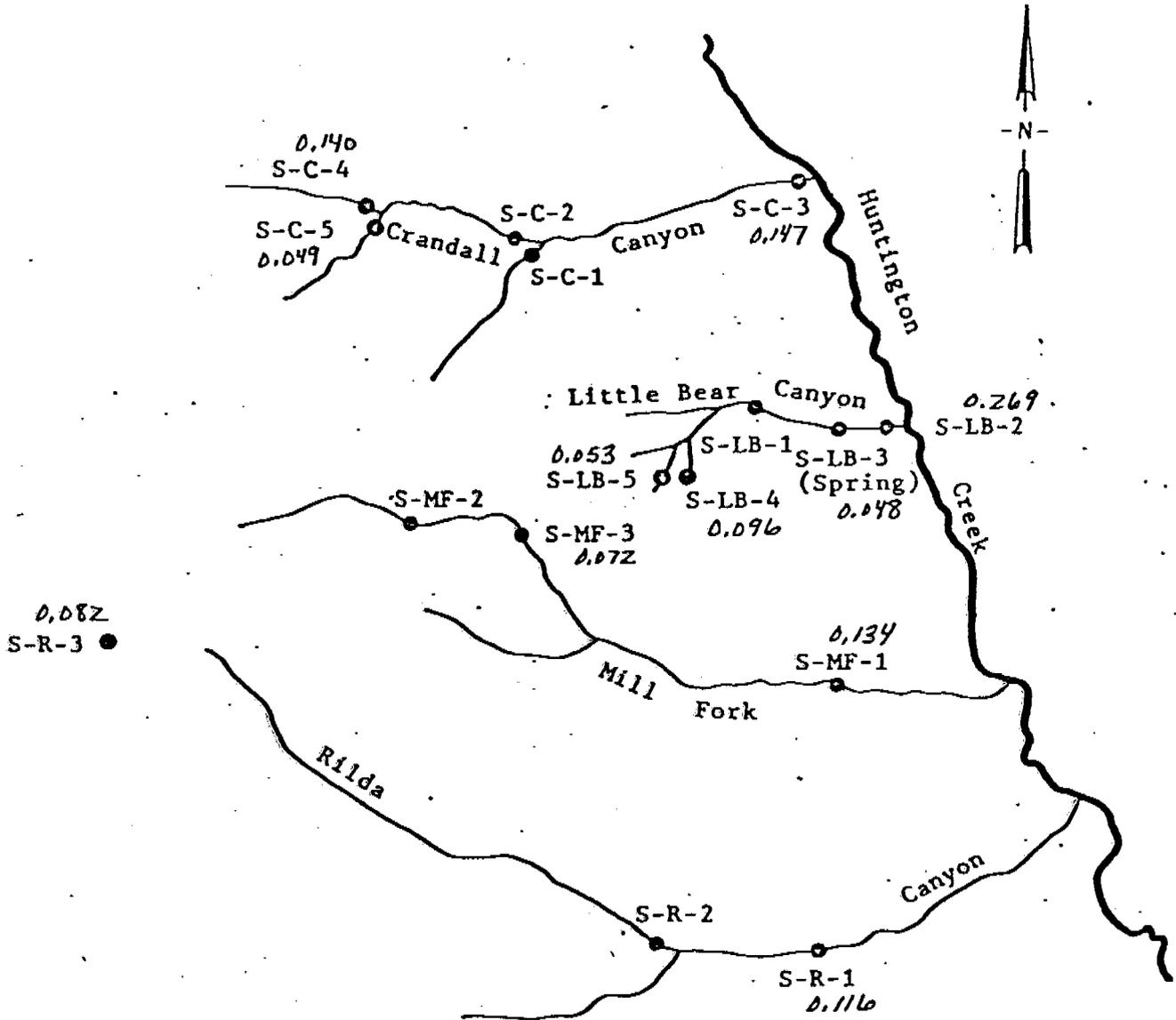
Vaughn Hansen Associates  
 5620 South 1475 East  
 Salt Lake City, Utah 84121



WATER QUALITY SAMPLING LOCATIONS

HUNTINGTON CREEK MINE 4

SWISHER COAL COMPANY

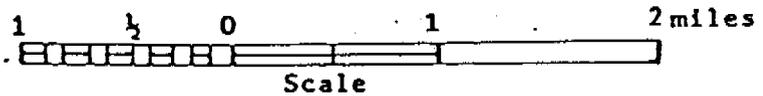


Parameter Iron (Total)  
Date May 31 to June 4, 1977

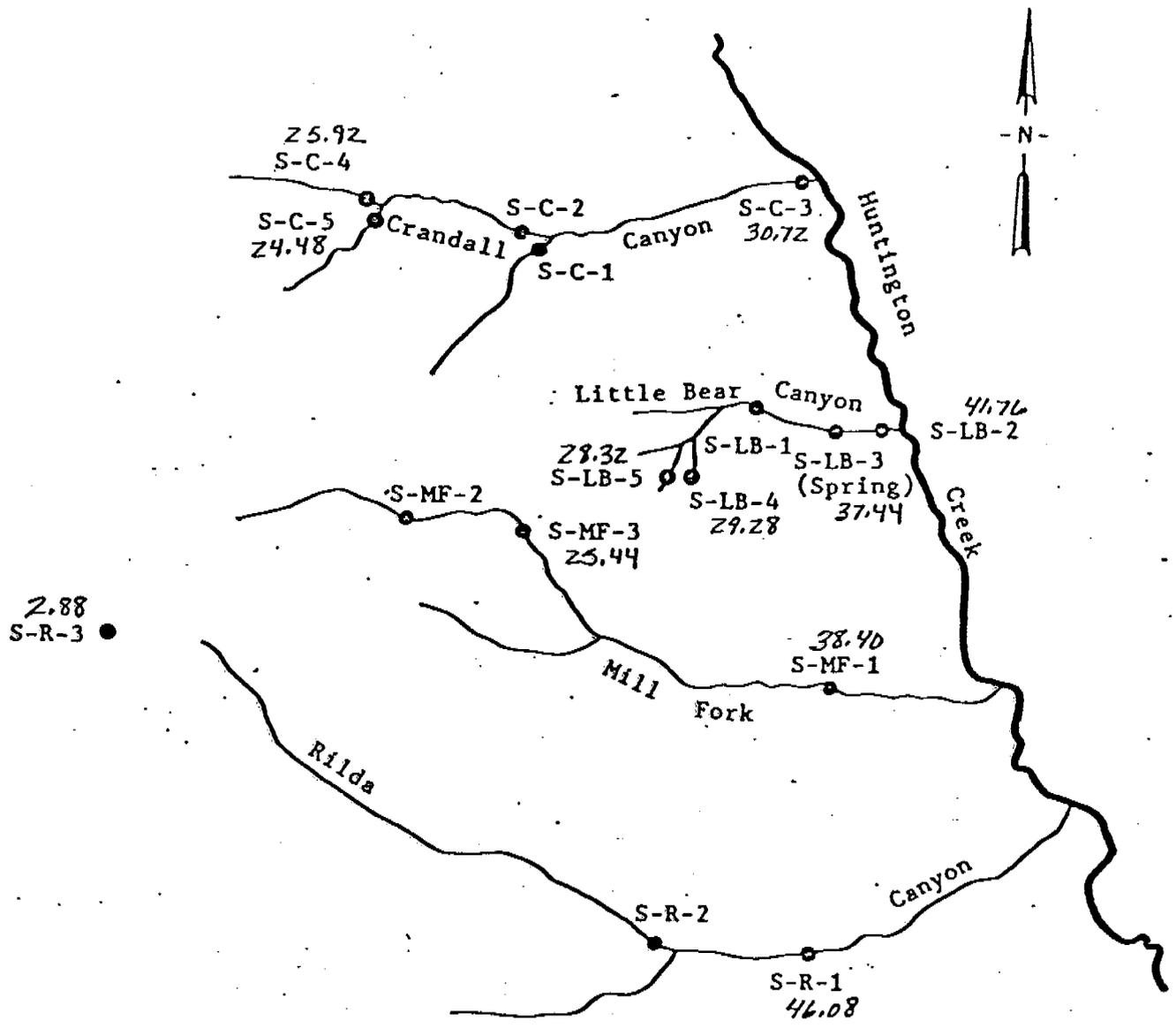
NOTE: Stations marked in red are outside of state limits for the sample taken during the above sampling period.

Vaughn Hansen Associates  
5620 South 1475 East  
Salt Lake City, Utah 84121

LIMITS:  
lower \_\_\_\_\_  
upper 0.3 mg/l Recommended



WATER QUALITY SAMPLING LOCATIONS  
HUNTINGTON CREEK MINE 4  
SWISHER COAL COMPANY



Parameter Magnesium  
Date May 31 to June 4, 1977

NOTE: Stations marked in red are outside of state limits for the sample taken during the above sampling period.

LIMITS:  
lower \_\_\_\_\_  
upper \_\_\_\_\_

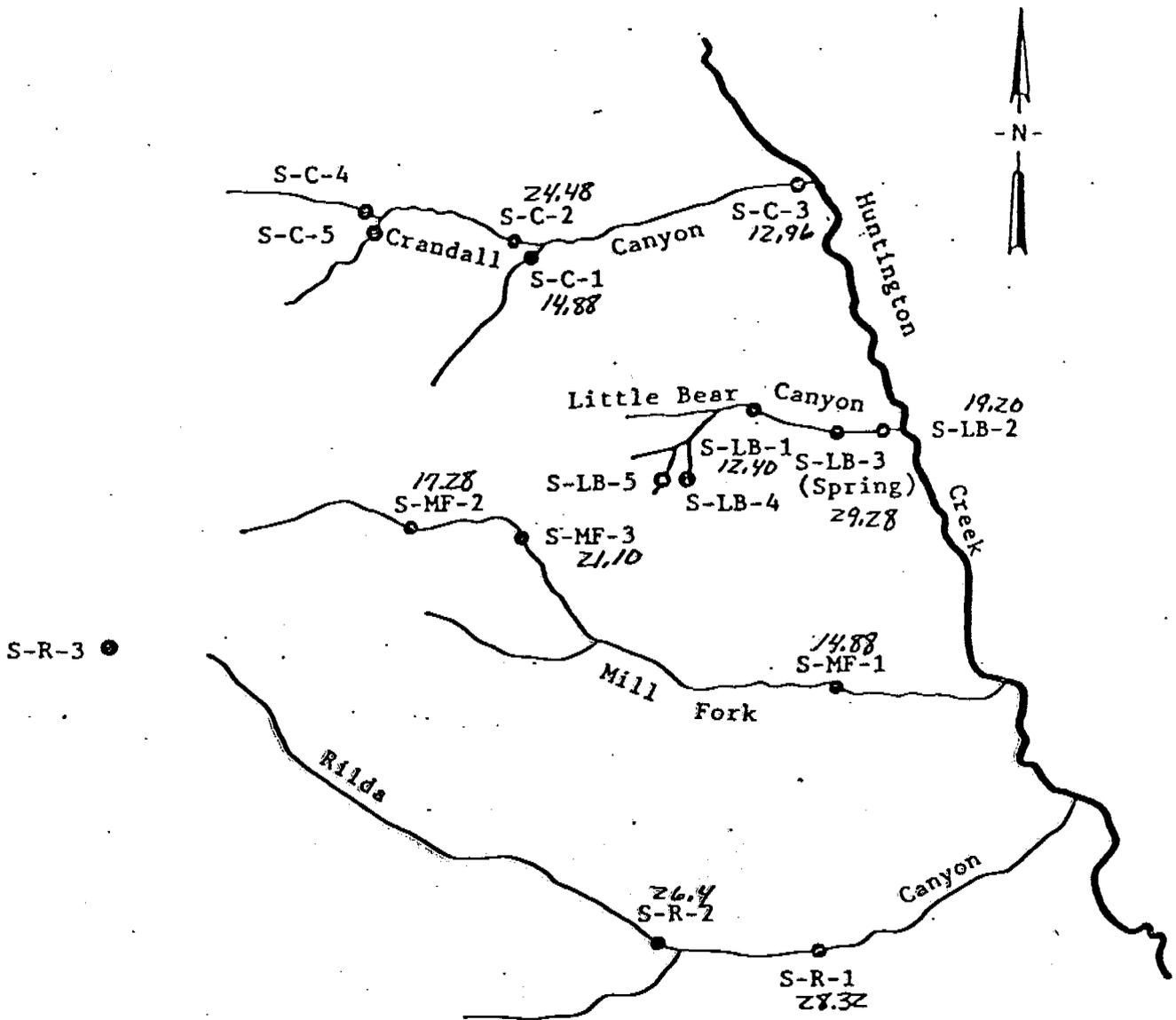
Vaughn Hansen Associates  
5620 South 1475 East  
Salt Lake City, Utah 84121



WATER QUALITY SAMPLING LOCATIONS

HUNTINGTON CREEK MINE 4

SWISHER COAL COMPANY

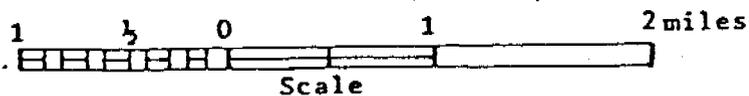


Parameter Magnesium  
 Date November 8-12, 1976

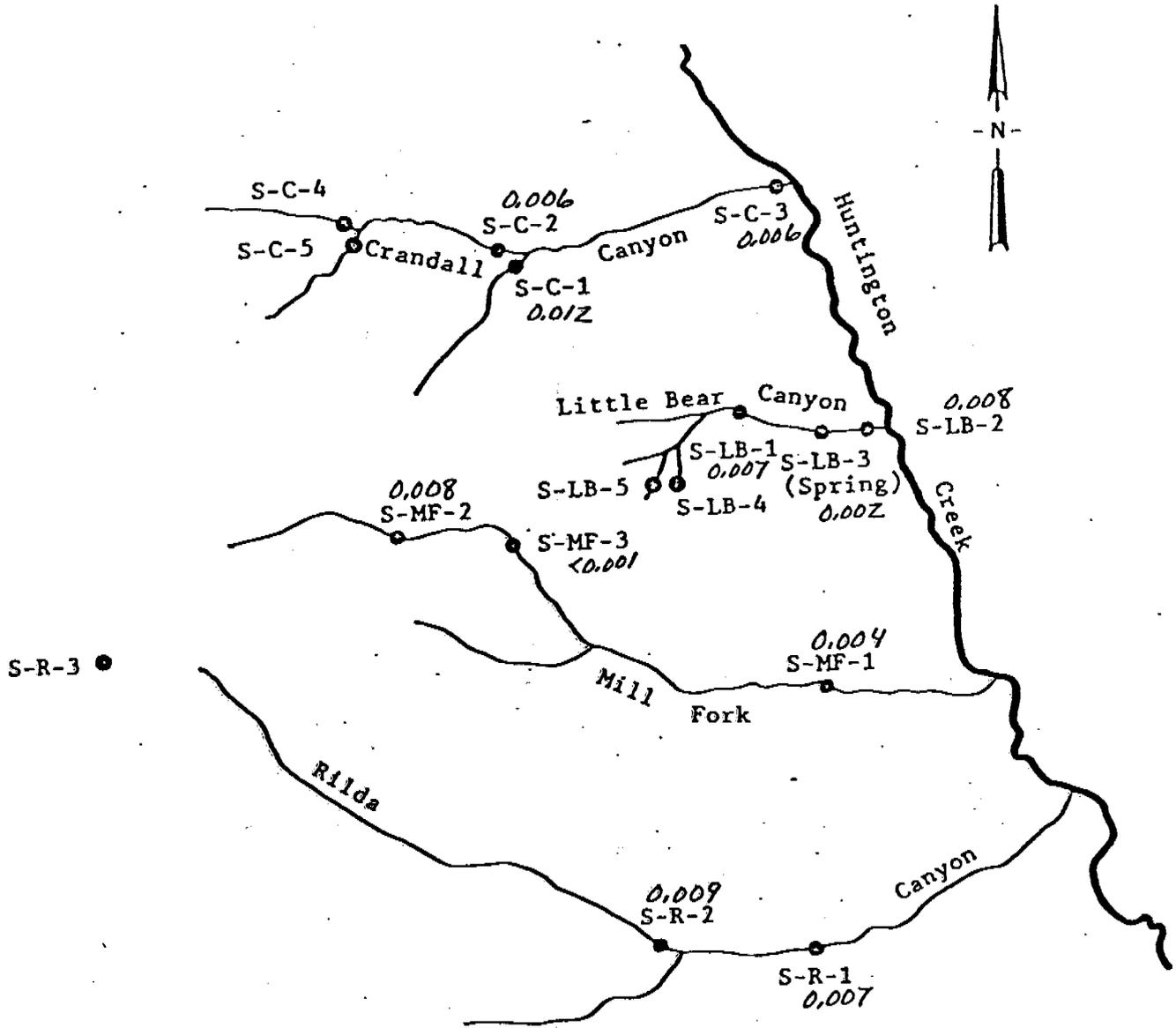
NOTE: Stations marked in red are outside of state limits for the sample taken during the above sampling period.

Vaughn Hansen Associates  
 5620 South 1475 East  
 Salt Lake City, Utah 84121

LIMITS:  
 lower \_\_\_\_\_  
 upper \_\_\_\_\_



WATER QUALITY SAMPLING LOCATIONS  
 HUNTINGTON CREEK MINE 4  
 SWISHER COAL COMPANY



Parameter Manganese  
 Date November 8-12, 1976

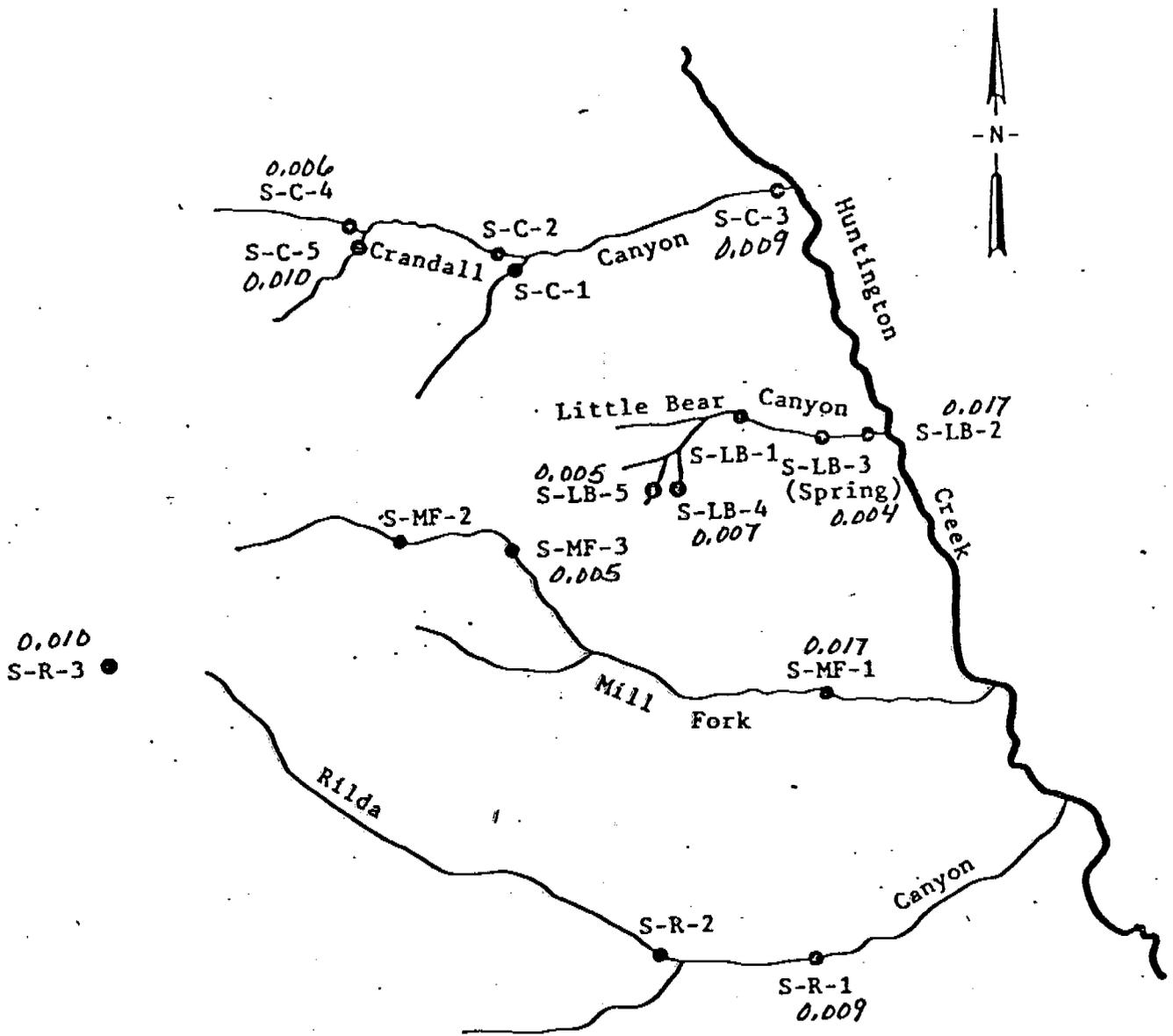
NOTE: Stations marked in red are outside of state limits for the sample taken during the above sampling period.

LIMITS:  
 lower  
 upper 0.05 mg/l Recommended

Vaughn Hansen Associates  
 5620 South 1475 East  
 Salt Lake City, Utah 84121



WATER QUALITY SAMPLING LOCATIONS  
HUNTINGTON CREEK MINE 4  
SWISHER COAL COMPANY



Parameter Manganese  
Date May 31 to June 4, 1977

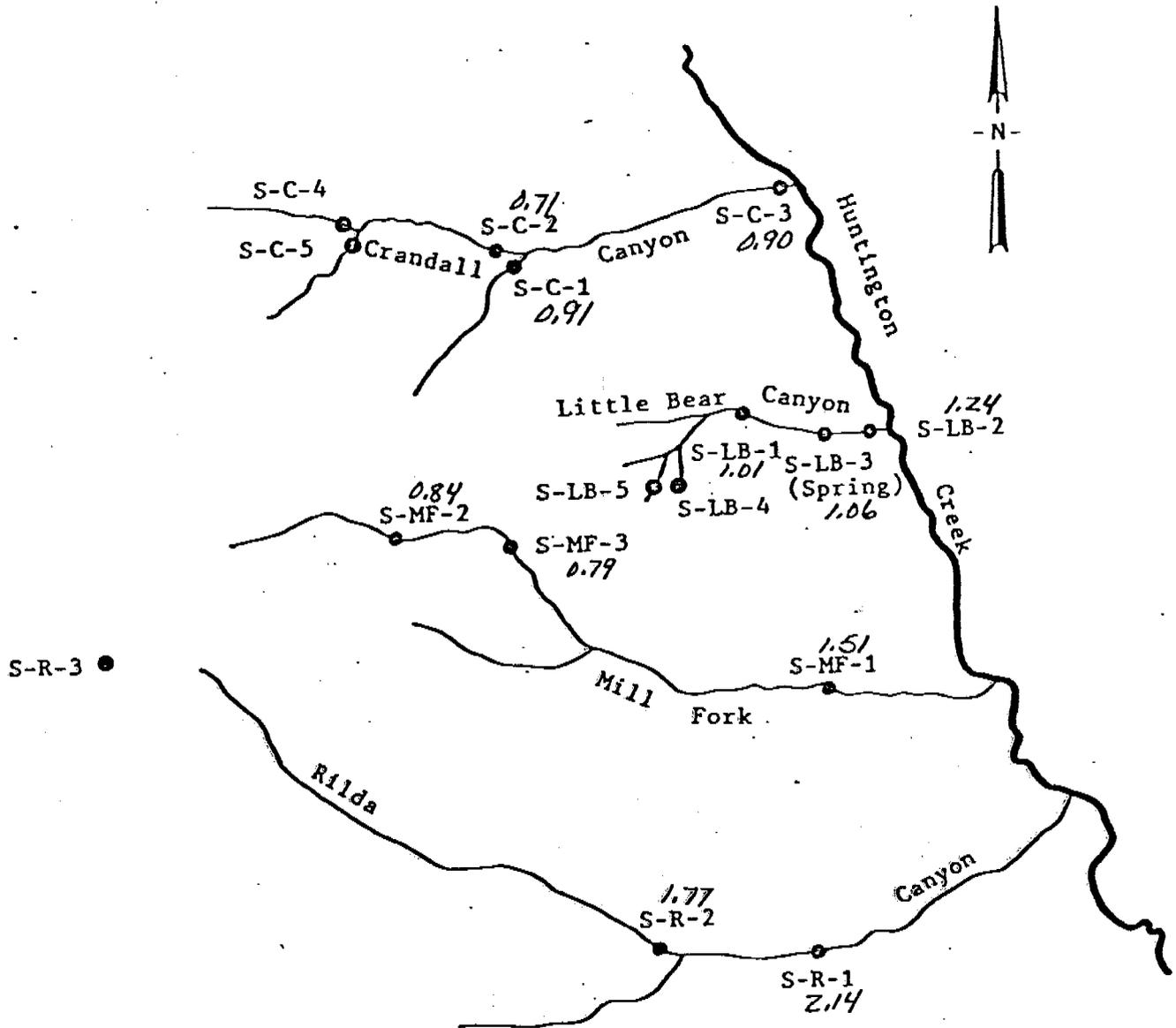
NOTE: Stations marked in red are outside of state limits for the sample taken during the above sampling period.

LIMITS:  
lower \_\_\_\_\_  
upper 0.05 mg/l Recommended

Vaughn Hansen Associates  
5620 South 1475 East  
Salt Lake City, Utah 84121



WATER QUALITY SAMPLING LOCATIONS  
 HUNTINGTON CREEK MINE 4  
 SWISHER COAL COMPANY



Parameter Potassium  
 Date November 8-12, 1976

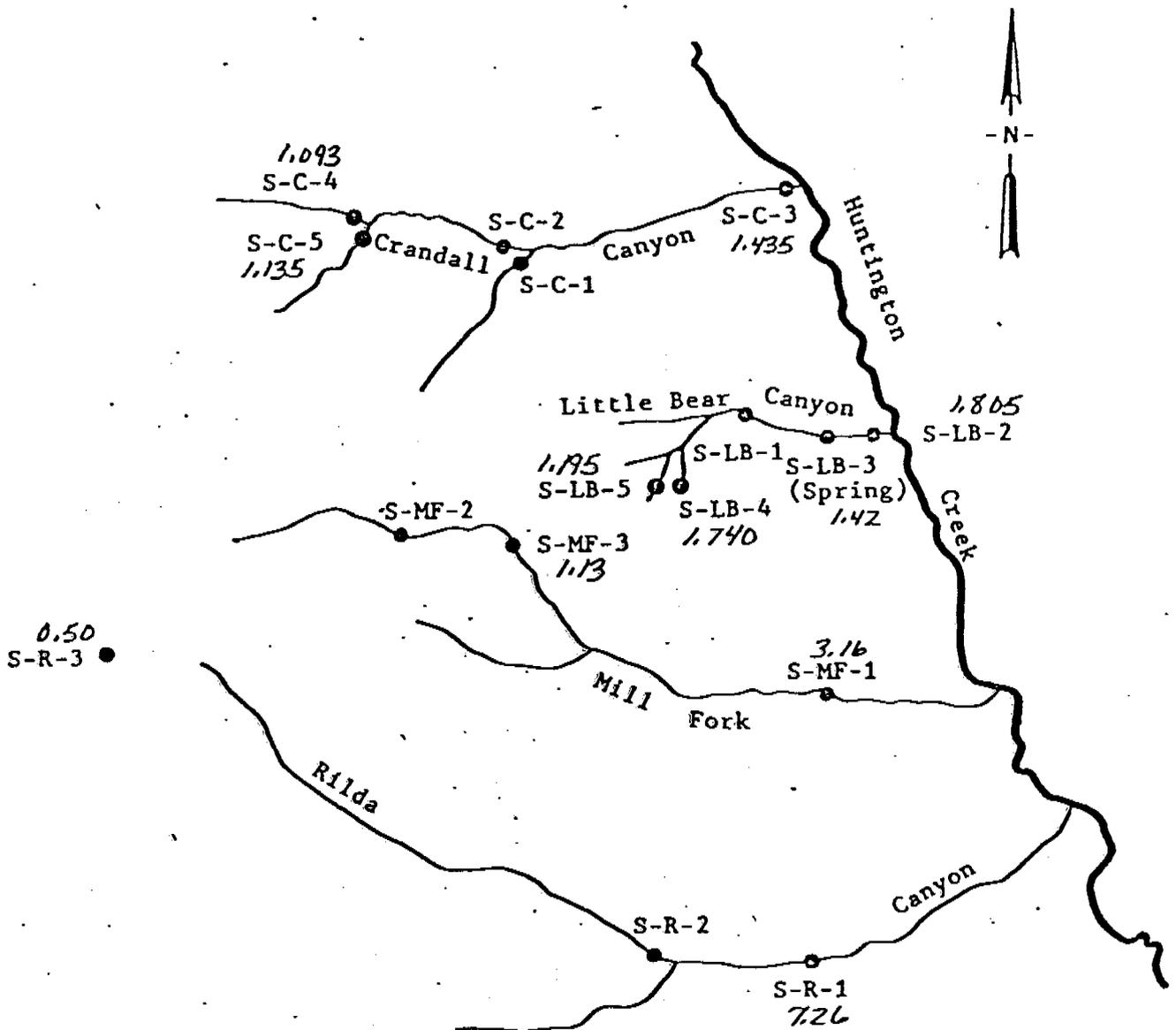
NOTE: Stations marked in red are outside of state limits for the sample taken during the above sampling period.

LIMITS:  
 lower \_\_\_\_\_  
 upper \_\_\_\_\_

Vaughn Hansen Associates  
 5620 South 1475 East  
 Salt Lake City, Utah 84121



WATER QUALITY SAMPLING LOCATIONS  
HUNTINGTON CREEK MINE 4  
SWISHER COAL COMPANY



Parameter Potassium  
Date May 31 to June 4, 1977

NOTE: Stations marked in red are outside of state limits for the sample taken during the above sampling period.

LIMITS:

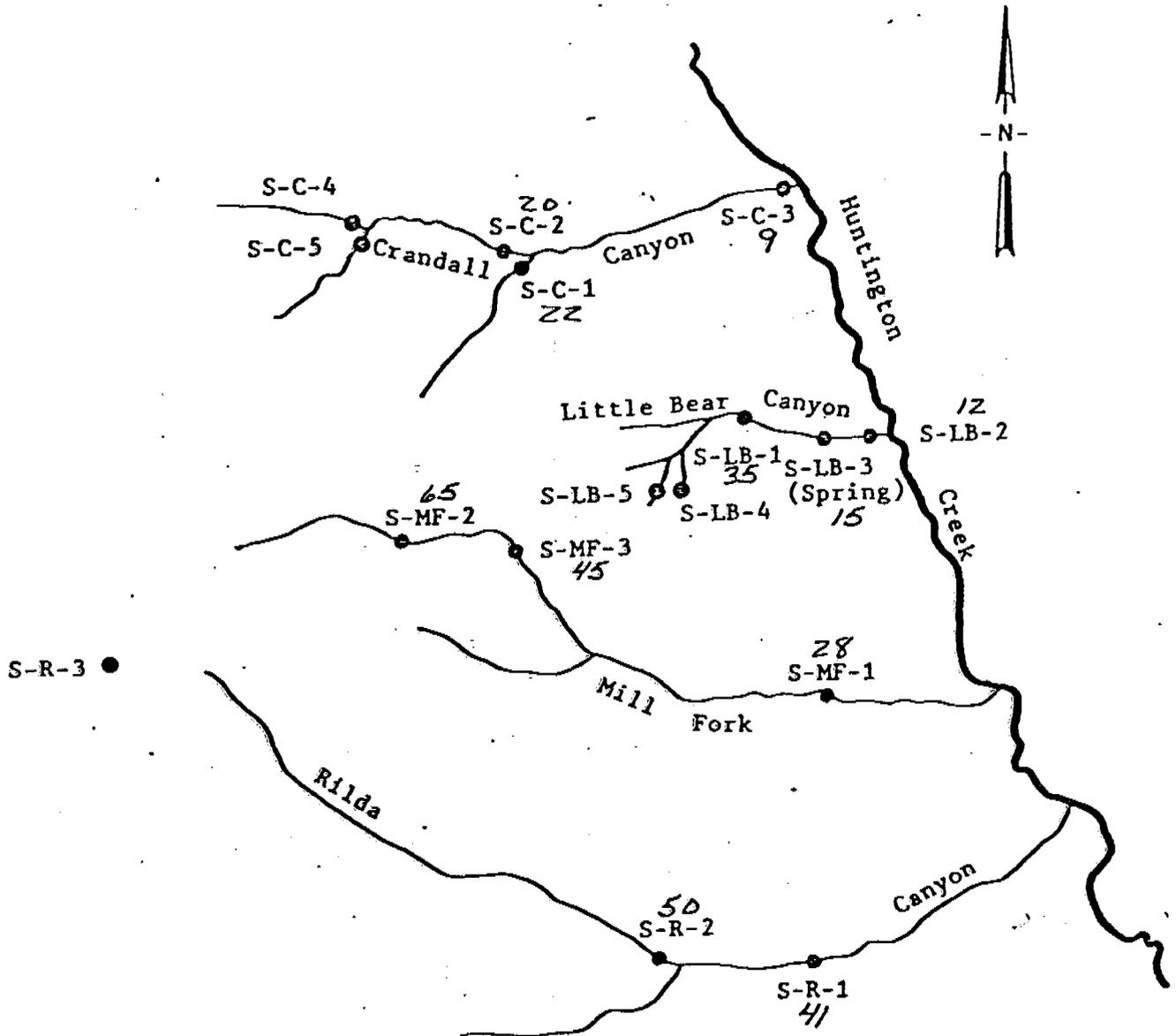
lower \_\_\_\_\_

upper \_\_\_\_\_

Vaughn Hansen Associates  
5620 South 1475 East  
Salt Lake City, Utah 84121



WATER QUALITY SAMPLING LOCATIONS  
HUNTINGTON CREEK MINE 4  
SWISHER COAL COMPANY



Parameter Sodium  
Date November 8-12, 1976

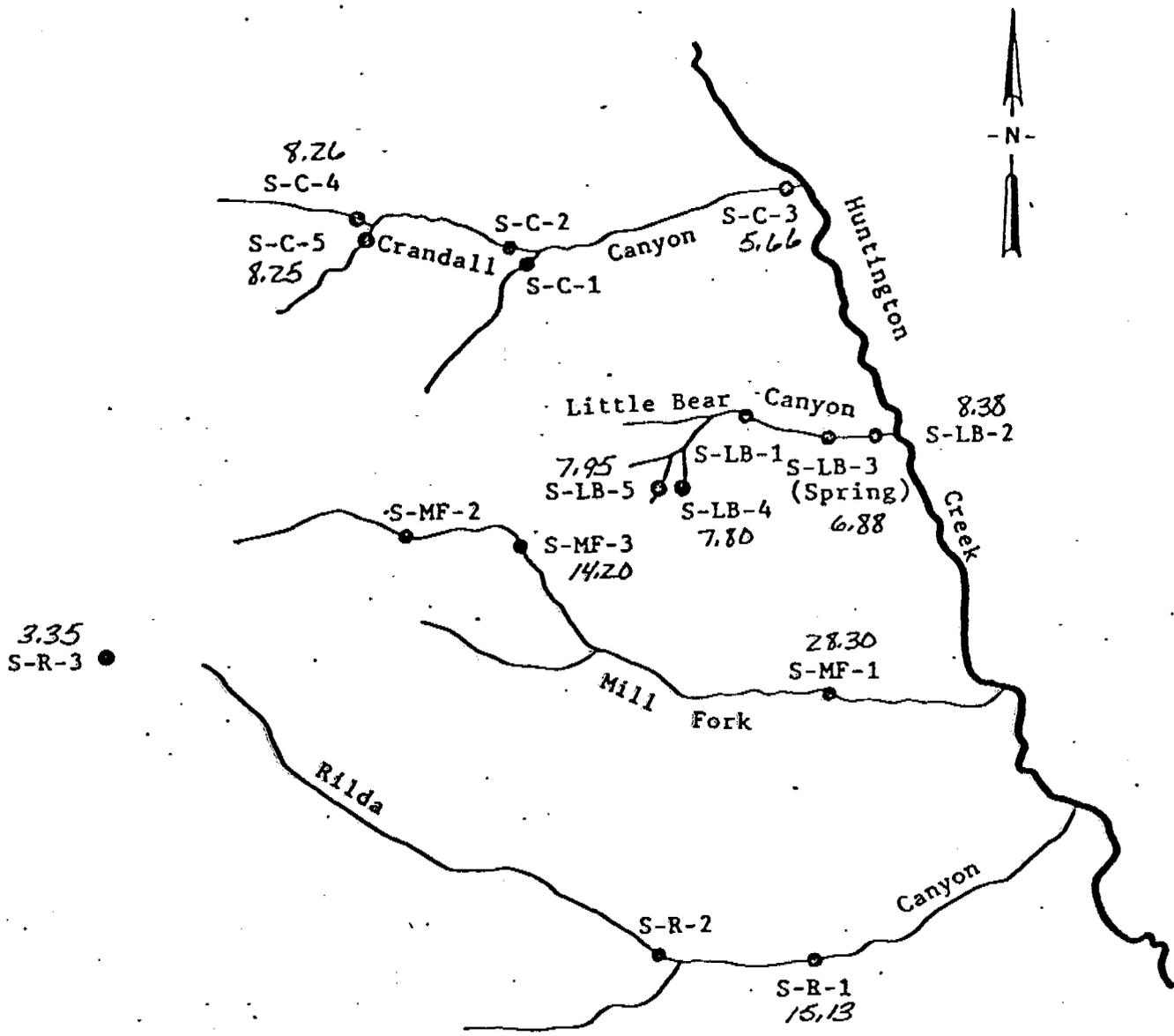
NOTE: Stations marked in red are outside of state limits for the sample taken during the above sampling period.

LIMITS:  
lower \_\_\_\_\_  
upper \_\_\_\_\_

Vaughn Hansen Associates  
5620 South 1475 East  
Salt Lake City, Utah 84121



WATER QUALITY SAMPLING LOCATIONS  
HUNTINGTON CREEK MINE 4  
SWISHER COAL COMPANY



Parameter Sodium  
Date May 31 to June 4, 1977

NOTE: Stations marked in red are outside of state limits for the sample taken during the above sampling period.

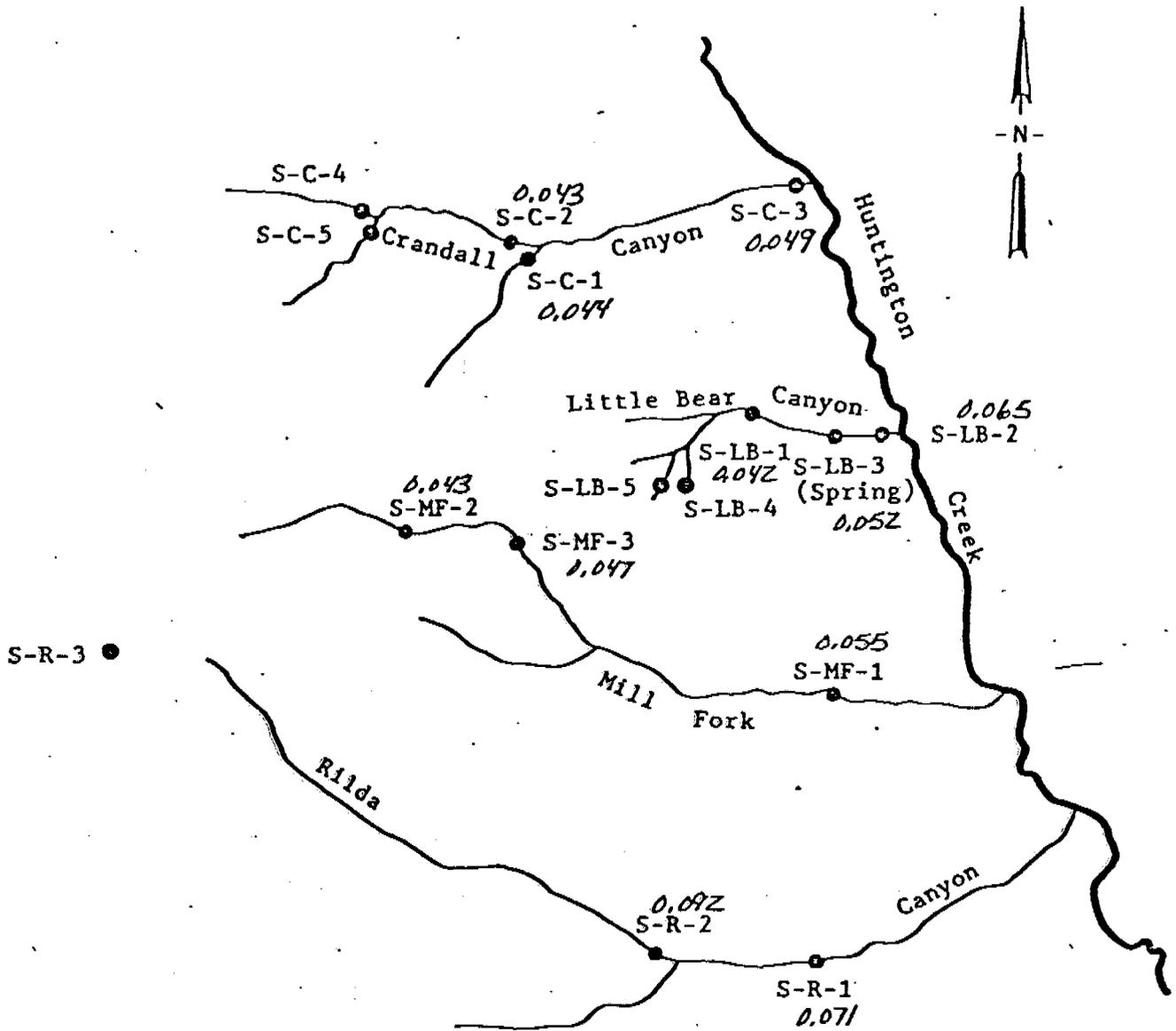
LIMITS:  
lower \_\_\_\_\_  
upper \_\_\_\_\_

Vaughn Hansen Associates  
5620 South 1475 East  
Salt Lake City, Utah 84121



D-27

WATER QUALITY SAMPLING LOCATIONS  
HUNTINGTON CREEK MINE 4  
SWISHER COAL COMPANY



Parameter Zinc  
Date November 8-12, 1976

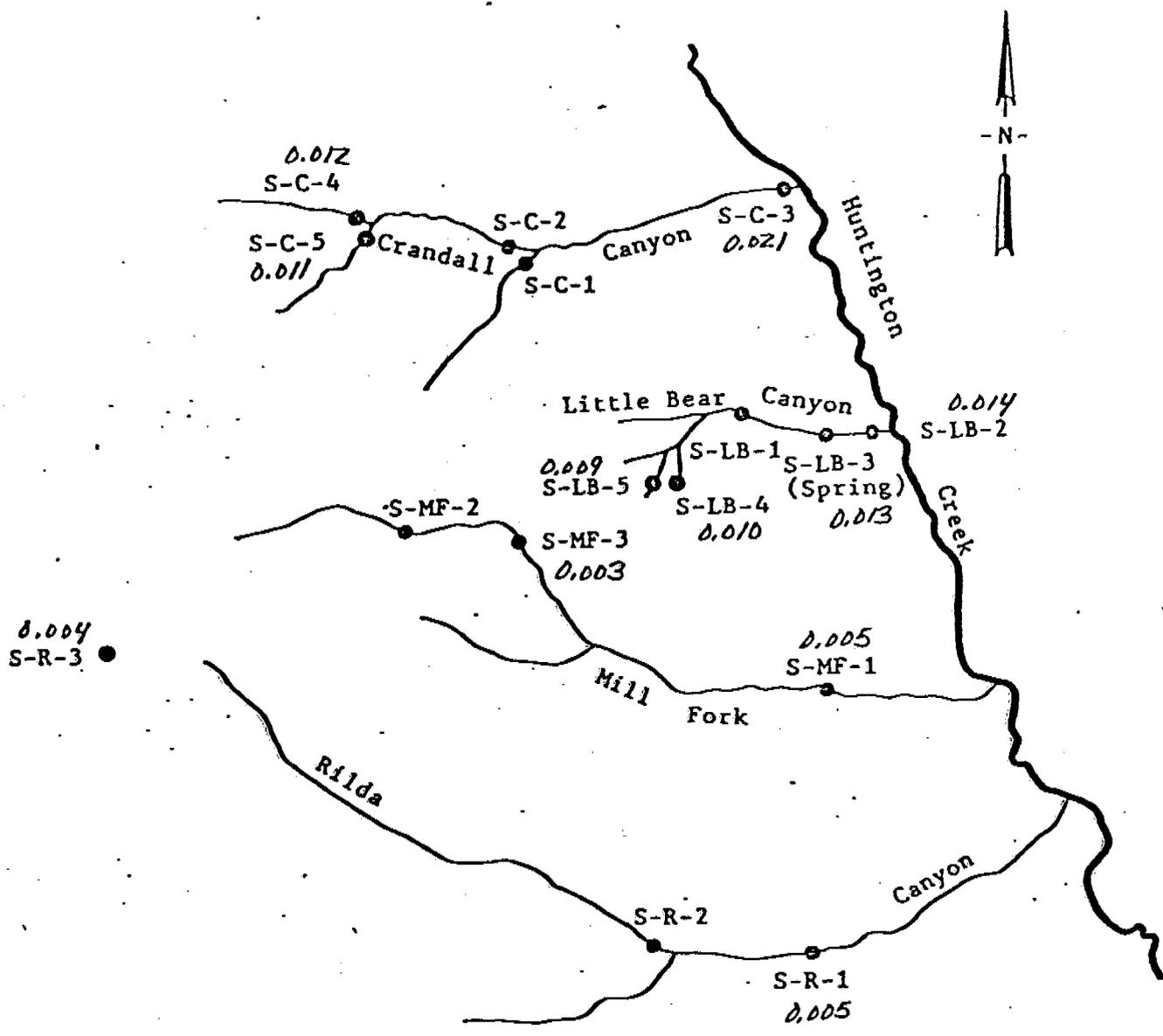
NOTE: Stations marked in red are outside of state limits for the sample taken during the above sampling period.

LIMITS:  
lower \_\_\_\_\_  
upper 5.0 mg/l Recommended

Vaughn Hansen Associates  
5620 South 1475 East  
Salt Lake City, Utah 84121



WATER QUALITY SAMPLING LOCATIONS  
HUNTINGTON CREEK MINE 4  
SWISHER COAL COMPANY



Parameter Zinc  
Date May 31 to June 4, 1977

NOTE: Stations marked in red are outside of state limits for the sample taken during the above sampling period.

LIMITS:  
lower \_\_\_\_\_  
upper 5.0 mg/l Recommended

Vaughn Hansen Associates  
5620 South 1475 East  
Salt Lake City, Utah 84121





STATE OF UTAH  
NATURAL RESOURCES  
Oil, Gas & Mining

Norman H. Bangerter, Governor  
Dee C. Hansen, Executive Director  
Dianne R. Nielson, Ph.D., Division Director

355 W. North Temple • 3 Triad Center • Suite 350 • Salt Lake City, UT 84180-1203 • 801-538-5340

July 3, 1986

Mr. Henry Austin  
Office of Surface Mining  
219 Central Avenue, NW  
Albuquerque, New Mexico 87102

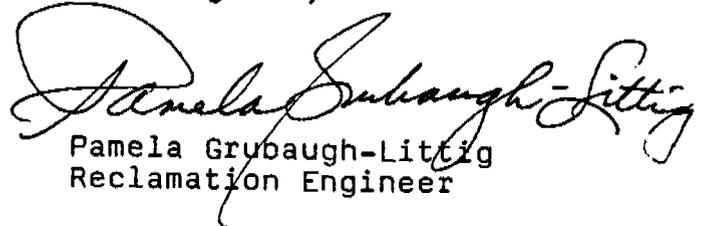
Dear Mr. Austin:

RE: All Stipulation Responses Submitted and Approved for  
Huntington #4 Mine, INA/015/004 #2 and #4, Emery  
County, Utah

Attached is a copy of a memo from John Whitehead documenting that all of the Stipulation Responses for the Huntington #4 Mine have been submitted and approved.

If you have any other questions, please call me.

Best regards,

  
Pamela Grubaugh-Littig  
Reclamation Engineer

Attachment(s)  
djh  
cc: John Whitehead  
8808R-40

March 24, 1986

TO: Coal File

FROM: *gn* John J. Whitehead, Permit Supervisor/Reclamation  
Hydrologist

RE: Beaver Creek Coal Company Response to Special  
Condition #4, Huntington #4 Mine, INA/015/004, #2,  
Emery County, Utah

This memo is to document the receipt of Beaver Creek Coal Company's response to Special Condition #4 on the Huntington Canyon #4 Mine permit. Attached to their March 3, 1986 memo was a water rights certificate for 800 shares issued in the name of Beaver Creek Coal Company. This submittal completes the stipulation responses required for the Huntington #4 Mine.

btb  
cc: Allen Klein  
Tom Munson  
Tom Wright  
9291R-10

**FILE COPY**