BASELINE HYDROGEOLOGIC DATA AND IMPACT EVALUATION

DRAFT

Blue Blaze Coal Company

January 7, 1992

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EXECUTIVE SUMMARY

Baseline data from existing drill holes, historical mining operations, and surface water information has been used to analyze the impacts to the hydrologic balance associated with the proposed mining in the Blackhawk Formation, Carbon County, Utah. Extensive mining has been conducted within and adjacent to the proposed permit area, resulting in over 50% of the proposed permit area having been previously mined in the Castlegate 'A' and Hiawatha coal seams.

Existing data indicates that mining in the Castlegate 'A' seam (Blue Blaze Mine No. 2) should not adversely impact the hydrologic balance within or adjacent to the proposed permit area. The permitting process may be simplified for the Castlegate 'A' seam mine due to: (1) the availability and quality of existing baseline data, (2) knowledge of extensive previous mining operations within and adjacent to the proposed permit area, and (3) the conservative size of the No. 2 Mine. The Castlegate 'A' seam is situated below, and separated from, small isolated perched water zones in the area. Previous mining operations in the Castlegate 'A' seam have not encountered significant groundwater flows or had any apparent effects on the surface water hydrology.

Mining of the Hiawatha coal seam (Blue Blaze No. 1 Mine) should have minimal incremental impact to the regional hydrologic balance due to the extensive historical mining operations in and adjacent to the proposed permit area. Groundwater flows have been encountered where mining has crossed a fault hydrologically connected to a water source. However, previous mining of the Hiawatha coal seam has intersected numerous faults and only one has produced significant amounts of water when mined through. This fault is likely transmitting water from surface sources and local perched zones. Minor inflows issuing from below the Hiawatha seam have not been significant and if encountered should have very minor incremental impact to the hydrologic balance.

1.0 INTRODUCTION

This section of the permit application was prepared by EnviroSearch Inc. for Mr. Roger Skaggs of Blue Blaze Coal pursuant to R614-301-132. Specifically, this section addresses regulations R614-301-724.100 (Baseline Information: Ground Water) and R614-301-728.310 (Probable Hydrologic Consequences (PHC); whether adverse impacts may occur to the hydrologic balance).

This section also addresses page 7, item 728, of the second technical deficiencies document prepared by the State of Utah, Department of Natural Resources, Division of Oil, Gas, and Mining, dated October 11, 1991.

1.1 Purpose

The purpose of this report is to analyze the existing baseline data and determine whether adverse impacts may occur to the hydrologic balance due to coal mining in and adjacent to the proposed Blue Blaze Coal Co. permit area.

1.2 Summary

Two mines are proposed within the permit area; the Blue Blaze No. 1 Mine and Blue Blaze No. 2 Mine. The No. 1 Mine is proposed for the Hiawatha coal seam, while the No. 2 Mine is for the Castlegate 'A' coal seam.

The following sources of information were used to analyze the baseline conditions and develop the PHC determination for the proposed permit area.

(1) On-site measurement of water levels, by Blue Blaze Coal Co., in existing open drill holes.

(2) Drill logs, cross-sections, outcrop logs, and downhole geophysical survey logs.

(3) Investigation of historical mining operations in and adjacent to the proposed permit area. Particularly, previous mining operations which did and did not

encounter significant water.

(4) Review of surface water features.

(5) Review of available groundwater information.

(6) BLM Coal Drill Hole Data.

(7) USGS geological maps.

(8) Literature search.

The Blue Blaze No. 1 and No. 2 Mines are significantly different with respect to their size, previous mining operations, and available data. Because of these differences, the baseline data, historical review, and PHC determination for each mine are presented separately. The following is a summary of this investigation; supporting data and conditions for these conclusions are included in the following sections.

Blue Blaze No. 2 Mine (Castlegate 'A' Coal Seam)

Existing baseline data indicates that the proposed coal mining in the Castlegate 'A' seam should not impact the hydrologic balance in or adjacent to the proposed permit area. The permitting process for the No. 2 Mine should be simplified due to the following:

1) Four drill holes in the permit area produced very little water when drilled. Two of these drill holes do not currently contain any measurable or reported water. - NOT DOCUMENTED
2) Groundwater above and below the Castlegate 'A' coal seam is typically perched and does not represent a major regional aquifer. REGIONALLY DOCUMENTED
3) Due to extensive historic mining of the Castlegate 'A' seam the proposed No. 2 Mine should not have any incremental impact to the hydrologic balance in or adjacent to the proposed permit area.

Blue Blaze No. 1 Mine (Hiawatha Coal Seam)

Previous extensive mining of the Hiawatha coal seam, in and adjacent to the proposed permit area, indicates that mining in the No. 1 Mine should have minimal incremental impacts on the hydrologic balance. Historic mining of the Hiawatha coal seam has only produced significant quantities of water when a fault hydrologically connected to a source of water was encountered. Undesirable flows have not been reported from mining into units immediately below the Hiawatha coal seam.

The proposed permit area, No. 1 and No. 2 Mines, and historic mining operations are discussed in section 2.0. Baseline conditions based on: existing data, regional hydrogeology, fault characteristics, surface water features, recharge areas, and local hydrogeology are provided in section 3.0. Possible impacts to the local and regional hydrologic systems, due to the proposed mining are addressed in section 4.0

2.0 BACKGROUND

The proposed permit area, and property boundaries of existing leases, applied for by Blue Blaze Coal Co. are shown on Map 1. The Blue Blaze No.1 and No. 2 mines are shown on Map 2.

The surface area of the No. 1 and No. 2 Mines represent a small percentage of the total proposed permit area. The No. 2 Mine (Castlegate 'A' coal seam) comprises approximately 15% of the total permit area, the No. 1 Mine (Hiawatha coal seam) approximately 42% of the total permit area. Collectively, the No. 1 and 2 Mines represent less than 50% of the total surface area proposed to be permitted.

Prior to 1950, conventional drilling and blasting was used as the standard mining method in the area. Since 1950, conventional continuous miners have been used to mine coal in the Castlegate and Hiawatha seams. The proposed mining in the Castlegate 'A' and Hiawatha seams will also be conducted using conventional continuous miners.

Over 50% of the proposed permit area has been previously mined in the Castlegate 'A' and Hiawatha coal seams. The following is a summary of this historical mining within and adjacent to the proposed permit area for the Castlegate 'A' and Hiawatha coal seams.

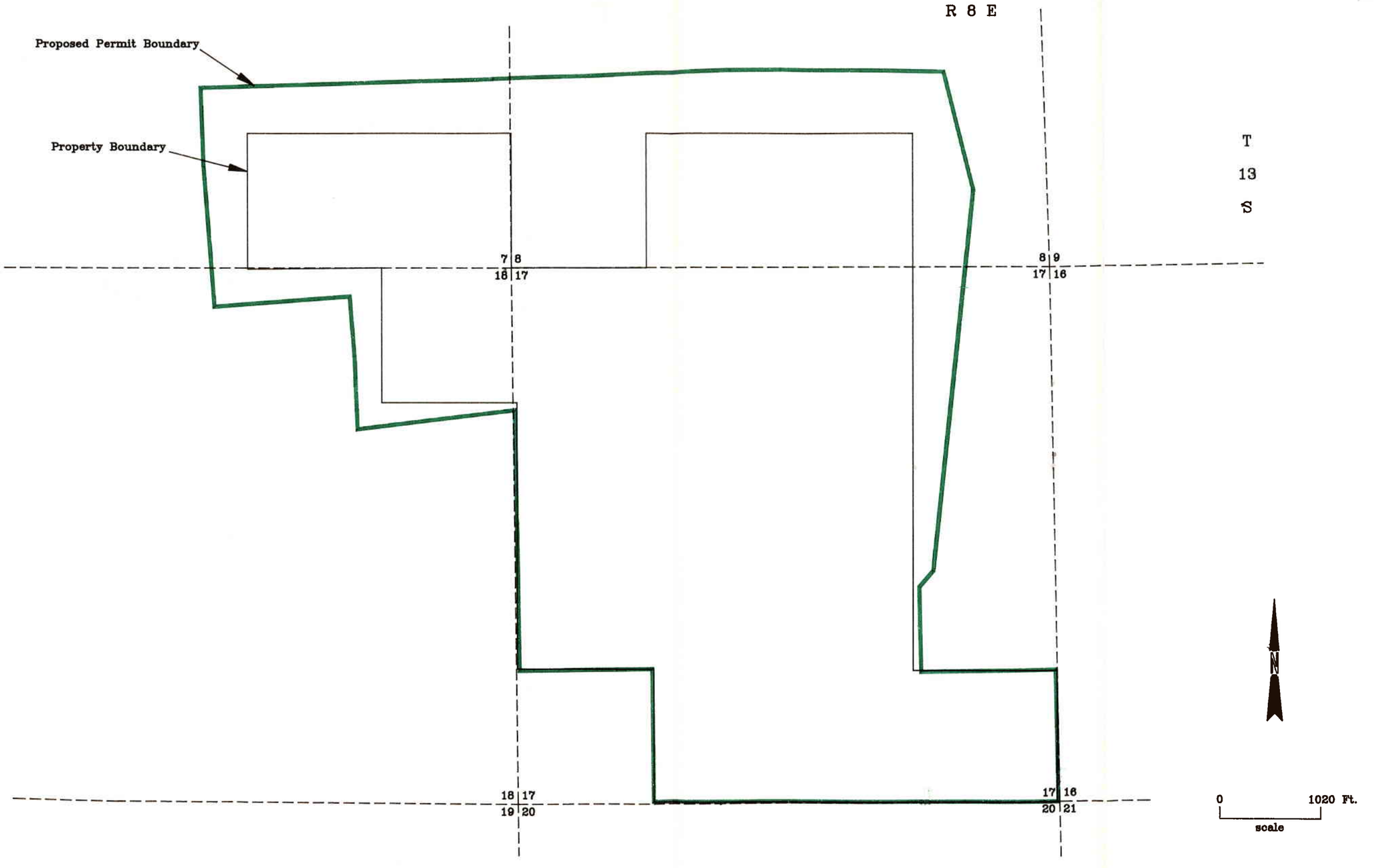
2.1 Historical Mining of the Castlegate 'A' Coal Seam

The extent and location of previous mining operations in the Castlegate 'A' coal seam are shown on Map 3 with the proposed No. 2 Mine.

Extensive mining of the Castlegate 'A' coal seam within and adjacent to the proposed permit area has been conducted by Beaver Creek Coal Co. (Gordon Creek No. 2 Mine), Blue Blaze Coal Co. (No. 3 Mine), and Swisher Coal Co. (Gordon Creek No. 6 Mine).

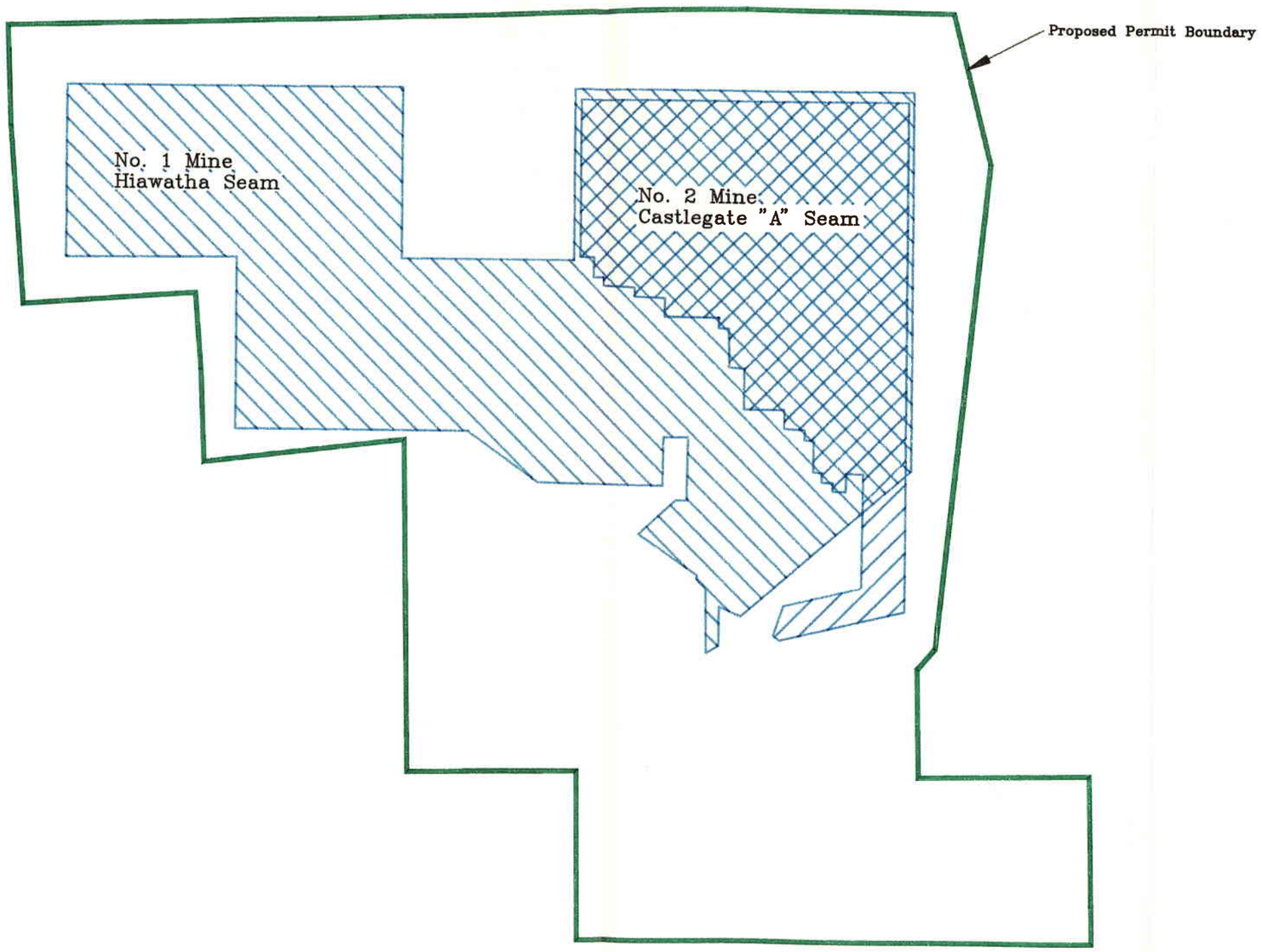
None of the previous mining operations shown on Map 3 have reportedly encountered any significant amounts of water during mining of the Castlegate 'A' coal seam. Both the Blue Blaze No. 3 Mine and Gordon Creek No. 2 Mine were mined and pillared below the Beaver Creek without any documented apparent incremental impact to the hydrologic balance. The Blue Blaze No. 3 Mine was mined out prior to 1950 when drilling and blasting was used to extract the coal. The Gordon Creek No. 2 Mine was mined out with conventional continuous miners. The proposed No. 2 Mine will be mined using conventional continuous miners; the same method used in more recent mining operations.

MAP 1 : PROPOSED PERMIT AREA
BLUE BLAZE COAL



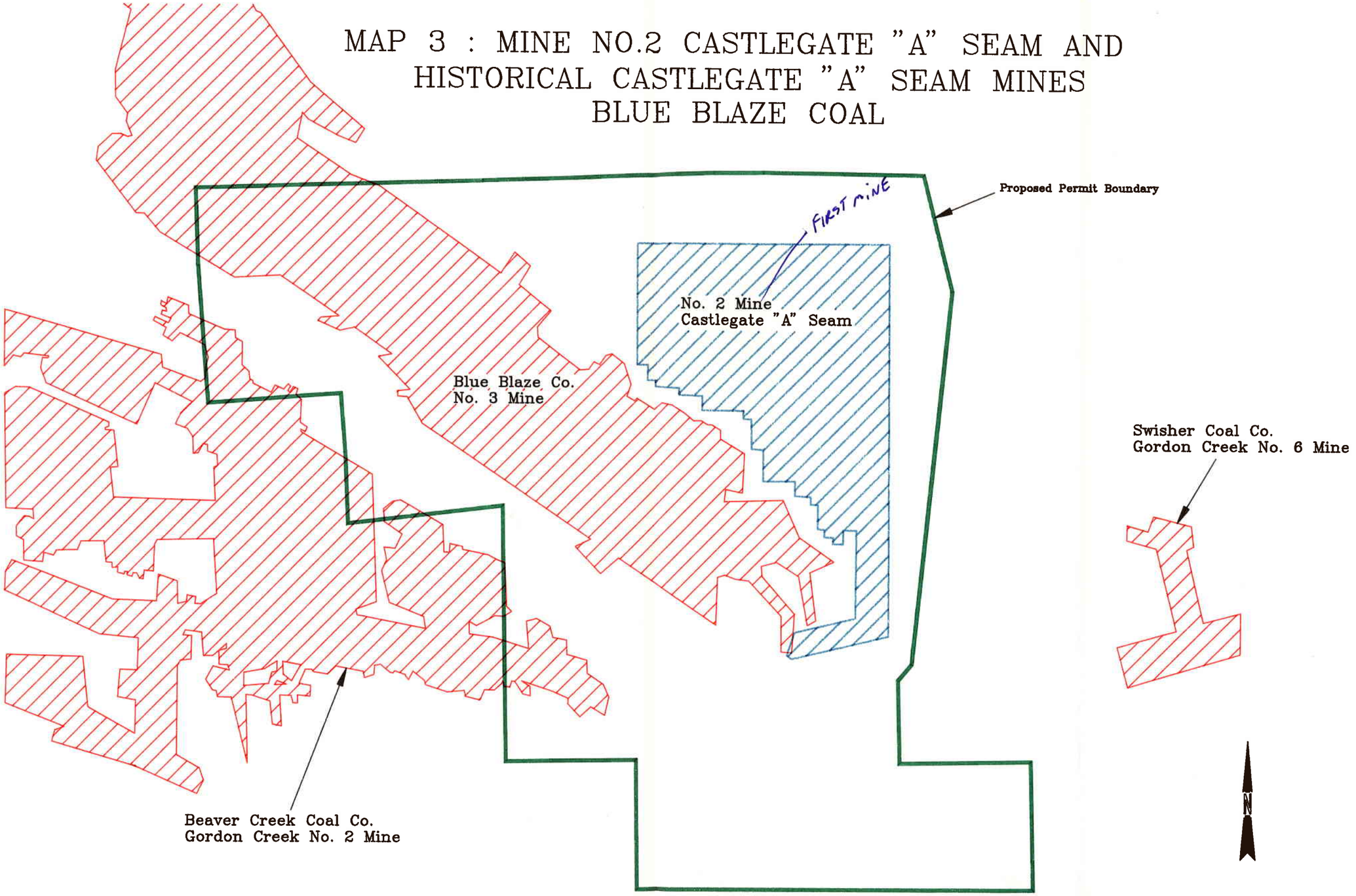
(HP)

MAP 2 : BLUE BLAZE No. 1 and No. 2 MINE AREAS
BLUE BLAZE COAL



(HQ)

MAP 3 : MINE NO.2 CASTLEGATE "A" SEAM AND HISTORICAL CASTLEGATE "A" SEAM MINES BLUE BLAZE COAL



RED MINED OUT

BLUE CASTLEGATE "A"

(HR)

2.2 Historical Mining of the Hiawatha Coal Seam

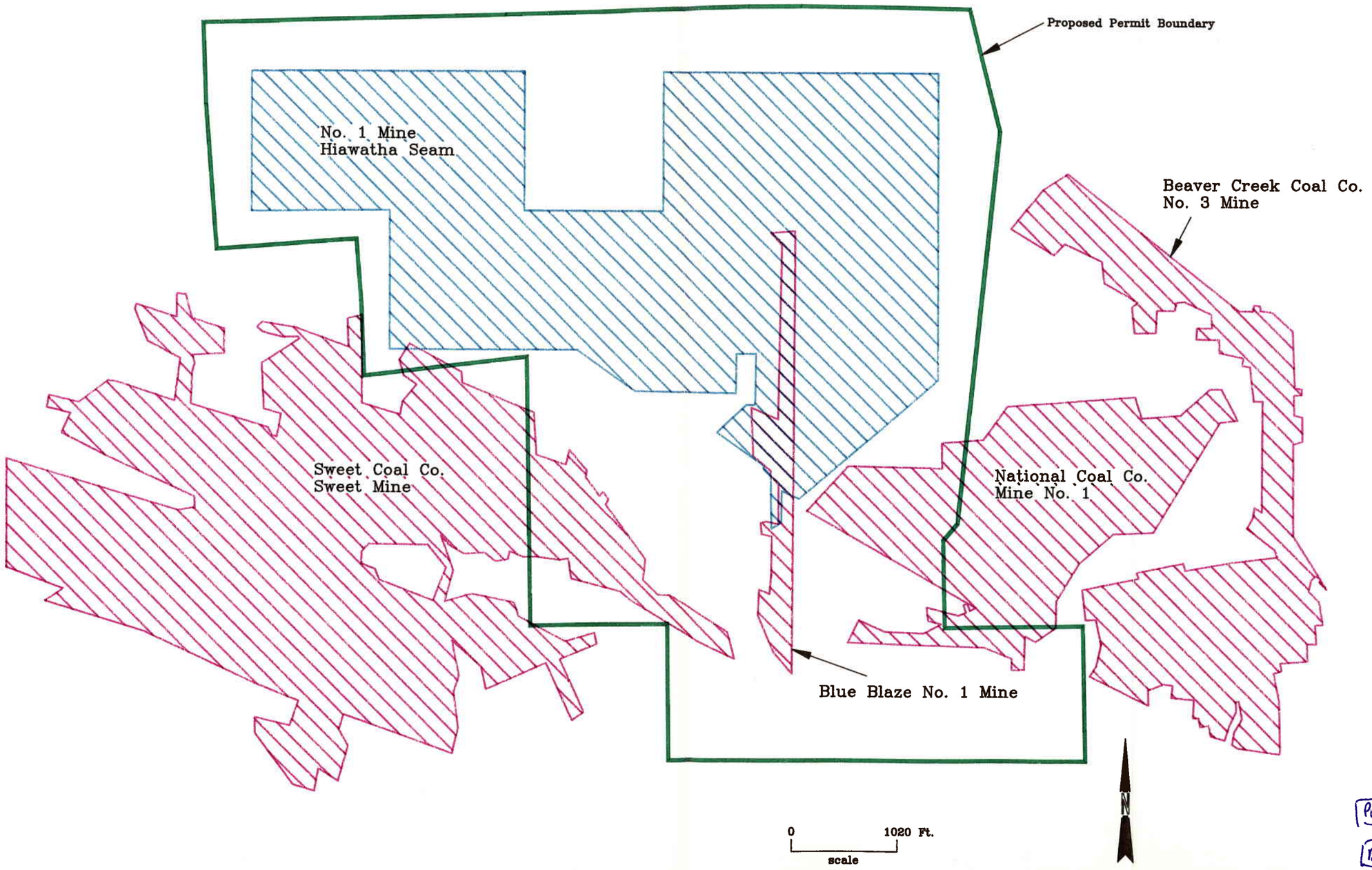
Historical mining of the Hiawatha coal is less extensive within the proposed permit area than the Castlegate 'A' coal seam. However, large areas have been mined out to the southeast and southwest by several companies: Sweet Coal Co. (Sweet Mine), Blue Blaze Coal Co. (No. 1 Mine), National Coal Co. (Mine No. 1) and Beaver Creek Coal Co. (No. 3 Mine). The location and extent of historical mining in the Hiawatha coal seam is shown on Map 4.

One occurrence of water during mining of the Hiawatha coal seam was due to mining activities through a fault which appeared to be hydrologically connected to a source of water. Many other faults have been mined through during previous mining in the Hiawatha coal seam and insignificant amounts of water were produced. Water occurrences during fault probing are apparently source driven and are discussed in more detail in section 3.2.

Significant flows have not been reported from mining into units immediately below the Hiawatha coal seam. Minor inflows may be encountered while mining in the Hiawatha seam, but these flows are typically easily controlled with standard mine dewatering practices.

Much of this historic information was provided by Mr. Roger Skaggs, of Blue Blaze Coal Co., who has worked as a coal miner in and near the proposed permit area for 20 years. In 1965, Mr. Skaggs and his father opened the Gordon Creek No. 2 Mine which was in operation until November of 1990. In 1974 Mr. Skaggs and his father also opened the Beaver Creek No. 3 Mine which was in operation until 1982.

MAP 4 : MINE NO. 1 HIAWATHA SEAM AND HISTORICAL HIAWATHA SEAM MINES
BLUE BLAZE COAL



PURPLE HISTORICAL
BLUE PROPOSED

(HS)

3.0 BASELINE DATA

Baseline hydrologic and geologic data has been compiled and evaluated to determine whether adverse impacts may occur to the hydrologic balance due to mining in the proposed permit area. The following is an examination of the existing baseline data with respect to the regional hydrogeology, faulting, and local hydrogeology.

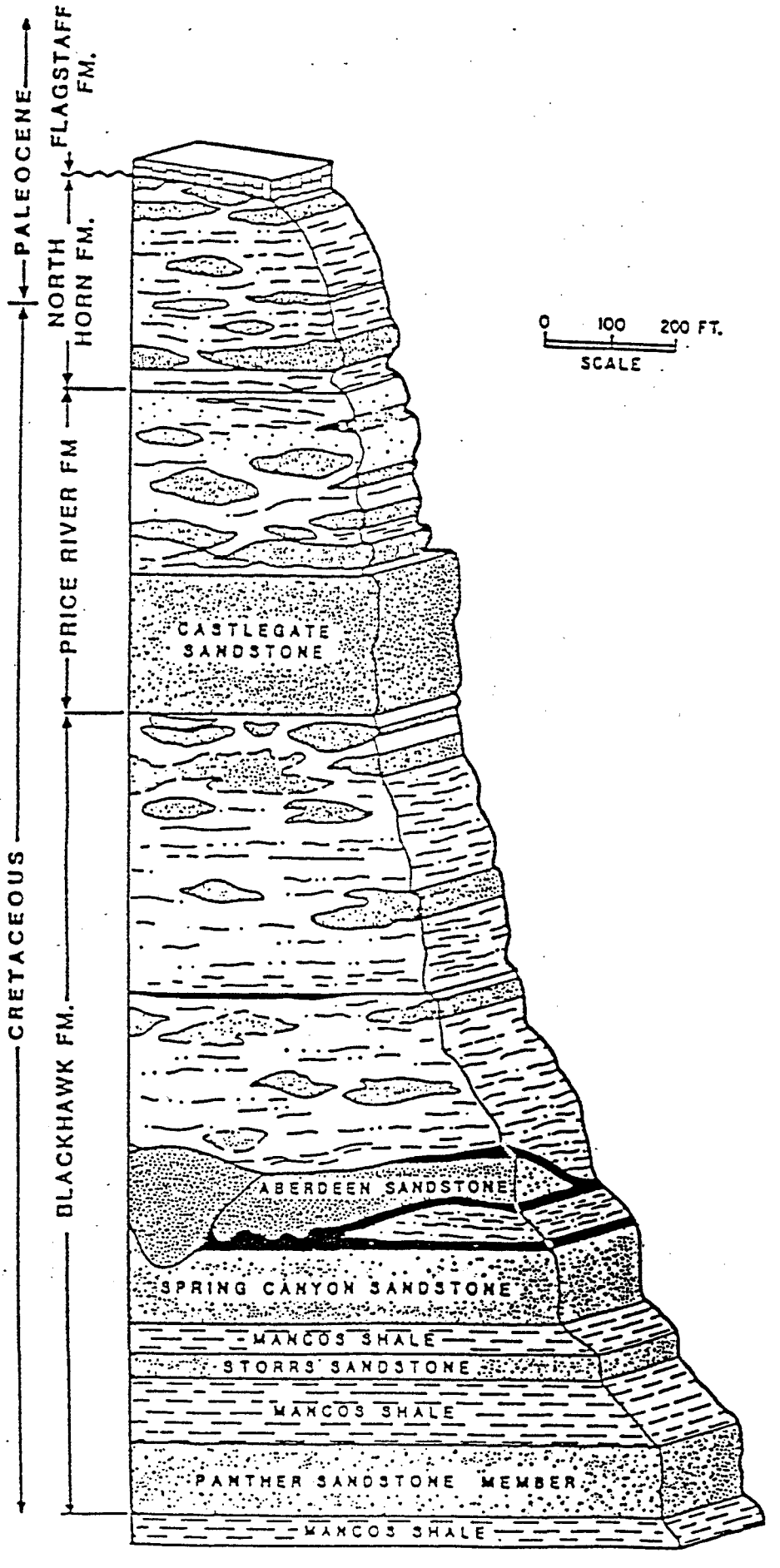
3.1 Regional Hydrogeology

The regional hydrogeology is largely controlled by the regional geology. A generalized stratigraphic column for the region is shown in Figure 1. The Blackhawk Formation, of the Mesaverde Group, contains the Castlegate 'A' and Hiawatha coal seams. The Blackhawk Formation has a mixed lithology of sandstones, shales, and coals which produces alternating perched aquifers and impermeable beds (Doelling 1972). Below the Blackhawk is the Star Point Sandstone, the lower most unit of the Mesaverde Group. This unit consists of several littoral sandstone tongues separated by Mancos shales (Doelling 1972).

The main hydrogeological issue associated within and adjacent to the proposed permit area is the relation of the regional aquifer to the Castlegate 'A' and Hiawatha coal seams and adjacent units. The depth of the major regional aquifer beneath the permit area is uncertain; it is possible that the Star Point Sandstone may be connected to the regional aquifer, although some literature suggests the major regional aquifer is much deeper in the Emery Sandstone or the Ferron Sandstone Members (Doelling, 1972, Price and Arnow, 1974).

The groundwater in the region most probably flows in a northeast direction following the dip of the strata (2° to 3° to the northeast).

FIGURE 1. GENERAL STRATIGRAPHY



3.2 Faults

Faulting throughout the permit area may play an important role in the regional hydrology. At the present time, it is unknown if these faults act as conduits or barriers to the movement of ground water. Historical mining indicates that the water in some of these faults may be source driven from surface runoff and that only some faults have sources. Other faults may not have sources or may be healed with swelling clays common to the area. Certainly, faults in the permit area have different characteristics, some acting as conduits and others acting as barriers. This is indicated by the occurrence or absence of water when faults were mined through during previous mining operations.

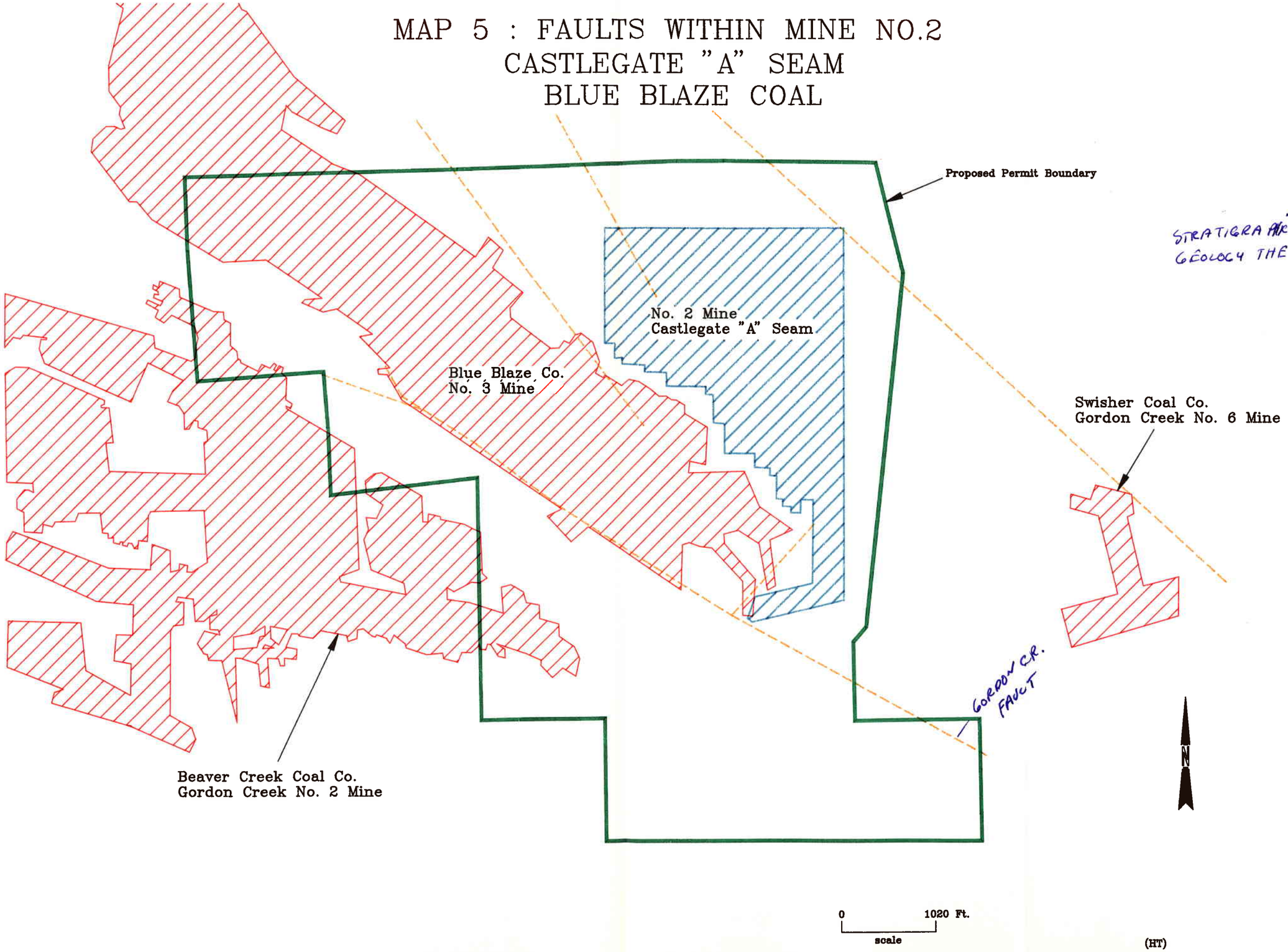
Numerous faults in the area have been crossed by previous mining activities. Faulting associated with the No. 2 Mine (Castlegate 'A' seam) is much less frequent than in the surrounding area due the small areal coverage of the No. 2 Mine and the location of the faults. Map 5 shows only those faults possibly impacting the No. 2 mine in the Castlegate 'A' coal seam. Map 6 illustrates historical mining activities in the Castlegate 'A' seam which encountered faults. Historically when faults have been crossed in the Castlegate 'A' seam, little or no water has been produced. Therefore, mining through faults in the No. 2 Mine should not produce significant quantities of water or cause adverse impacts to the hydrologic balance.

Previous mining of the Hiawatha coal seam has also crossed many faults (Map 7). However, only one fault has produced significant quantities of water when mined through. This fault to the east of the permit area, was intersected during mining of the Hiawatha coal seam at the Beaver Creek Coal Co. #3 Mine, and caused inflows of approximately 600 gallons per minute (Map 8). It is likely that this fault is acting as a conduit, transmitting water from upland recharge sources and the Beaver Creek to the north (Map 8). Flow rates for the Beaver Creek measured by Blue Blaze Coal in 1991 were reported to average 420 gpm (sampling point #8, Map 8). Downstream of this

sampling point, near the intersection of the previously mentioned fault and the Beaver Creek, the creek is typically dry. Further downstream, the Beaver Creek is recharged by the springs in Sand Gulch and other tributaries (Map 8).

Due to the high flows measured in the Beaver Creek upstream of the fault, and a substantial decrease in flow on the down gradient side of the fault, water is most likely draining into the fault. As a conduit this fault could then transmit water south along the fault and into the Beaver Creek No. 3 Mine where the significant flows were encountered (Map 8).

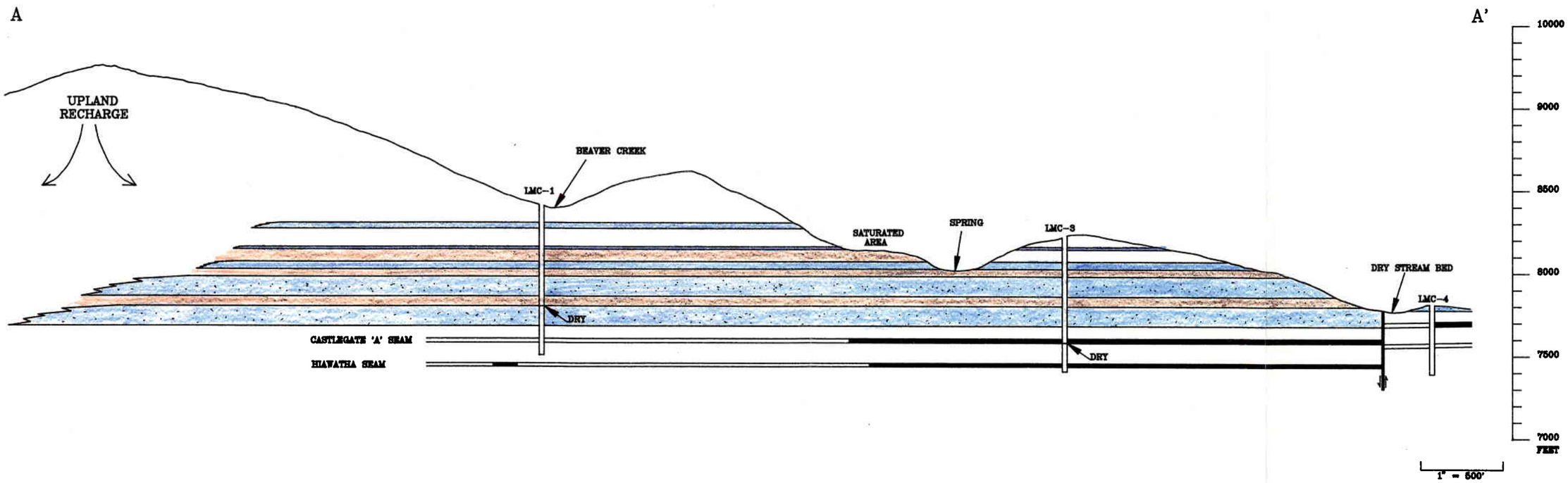
MAP 5 : FAULTS WITHIN MINE NO.2
CASTLEGATE "A" SEAM
BLUE BLAZE COAL



STRATIGRAPHICALLY GEOLOGY THE SAME

(HT)

FIGURE 2: CROSS-SECTION A-A'
BLUE BLAZE COAL

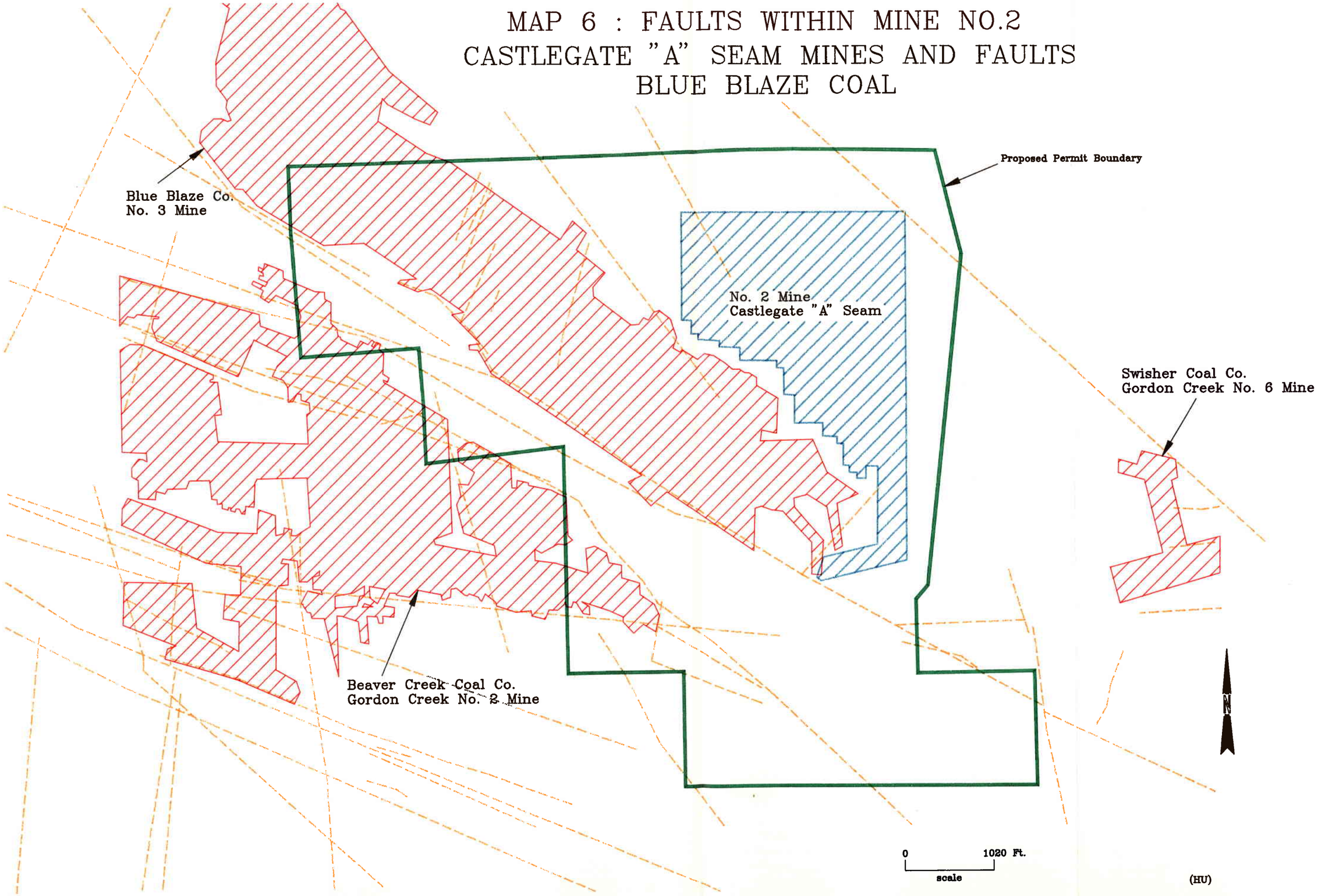


LEGEND

- SHALE
- SHALE WITH SAND LENSES
- PREVIOUSLY MINED COAL (BLANK), No. 1 & 2 MINES (SOLID)
- SAND
- SAND WITH SHALE LENSES
- MIXED SANDS AND SHALES

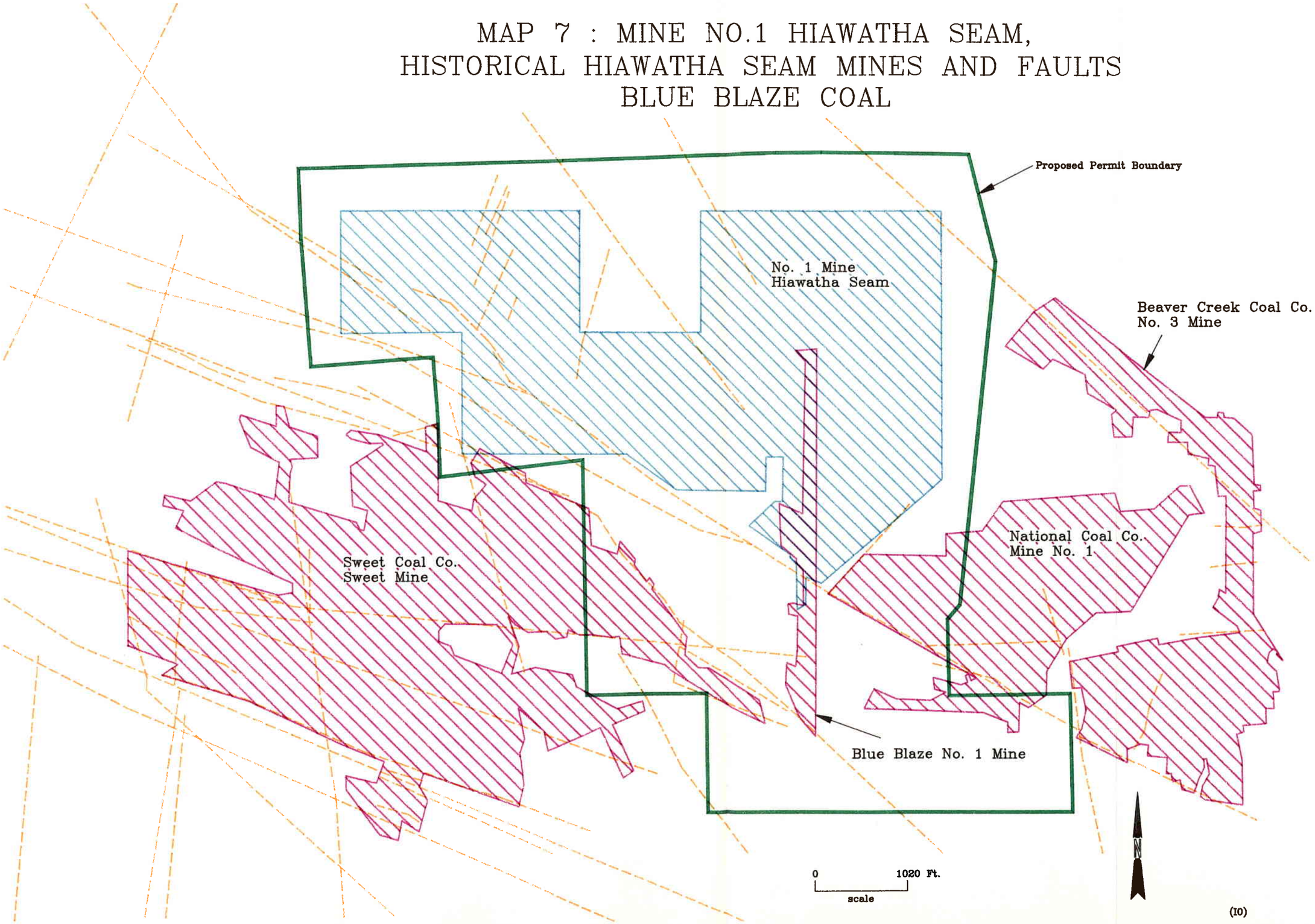
(17)

MAP 6 : FAULTS WITHIN MINE NO.2
CASTLEGATE "A" SEAM MINES AND FAULTS
BLUE BLAZE COAL



(HU)

MAP 7 : MINE NO.1 HIAWATHA SEAM, HISTORICAL HIAWATHA SEAM MINES AND FAULTS BLUE BLAZE COAL



3.3 Local Hydrogeology

The local hydrogeology of the Blue Blaze permit area consists of springs, perched zones, seasonal recharge and naturally occurring surface water (Map 9). Naturally occurring surface water includes seasonal runoff and intermittent stream flow. Surface water in the permit area appears to be mostly seasonal. Intermittent streams, such as the North Fork of Gordon Creek, flow during times of spring snowmelt and high precipitation. The intermittent streams are not in direct communication with the regional water table and are probably losing water due to infiltration. These type of intermittent streams tend to have decreasing flows down gradient. This assumption is supported by stream flow data measured by Blue Blaze Coal which shows that the flows in Gordon Creek decrease downstream.

The region is also a net evaporation zone since evapotranspiration is greater than precipitation. Potential evapotranspiration in the area is estimated to average 35 inches per year (Kohler, Nordenson and Baker, 1959) while the average annual precipitation is 7 to 9 inches per year. Using the above estimates of precipitation and evapotranspiration, the surface recharge in the area is expected to be minimal. Since surface recharge in the area is likely minor and limited to the upper sediments, springs in the area are seasonally controlled and have low flow rates. The perched water zones, which likely feed the springs, will also have low flow rates. Therefore, recharge from precipitation is not a major factor across the mining area and will not produce sustained quantities of water.

The local hydrology is most likely dominated by the varying hydrogeologic properties associated with the sand-shale-coal sequence of the Blackhawk Formation. Numerous permeability and porosity contrasts in the sands and shales have the potential to cause a series of distinct perched water zones. In this type of sequence the sands act as water saturated zones and the shales act as confining layers that do not allow water to communicate between the sands. A cross-section (Fig. 2) through the

proposed permit area was developed to show these perched zones and the relation of the local recharge to the springs in the area. This cross-section extends from the highlands in the northwest, through LMC-1, a spring and saturated area, LMC-3 and LMC-4 (Map 10).

Geophysical logs, interpreted by Century Geophysical Corp., provided lithologic control for the drill holes and construction of the cross-section. Coal seams and major sand and clay units correlate very well between drill holes and with BLM coal data base logs. NOT INCLUDED

The cross-section (Fig. 2) is representative of typical surface and subsurface geological conditions in the permit area, and illustrates the perched water zones characteristic of the Blackhawk Formation. The water source for these perched zones is most likely from a limited, nearby, seasonal recharge source. The spring and saturated area, shown on Figure 2, are most likely caused by recharge in nearby uplands. The Blackhawk Formation (and its associated sand and shale units) is known to pinch out to the west in a sequence of interfingering sand and shale units (Doelling 1972). Therefore, water infiltrating from the highlands would be distributed in the sandy units and perched between shale layers down gradient. Where the overlying shales are eroded away the water is allowed to flow to the surface and produce springs and saturated zones.

The Markis Spring (Map 10) is another good example of a spring from a small perched water table. Flow rates measured from the spring indicate a significant seasonal variation in discharge. These seasonal fluctuations in discharge is evidence that the spring is part of a limited local seasonal recharge source. Springs that discharge from a larger, more regional flow system would most likely have less seasonal variation.

The Castlegate "A" seam has been mined below the Beaver Creek in the northwestern section of the permit area with minor water inflows. This mining was done

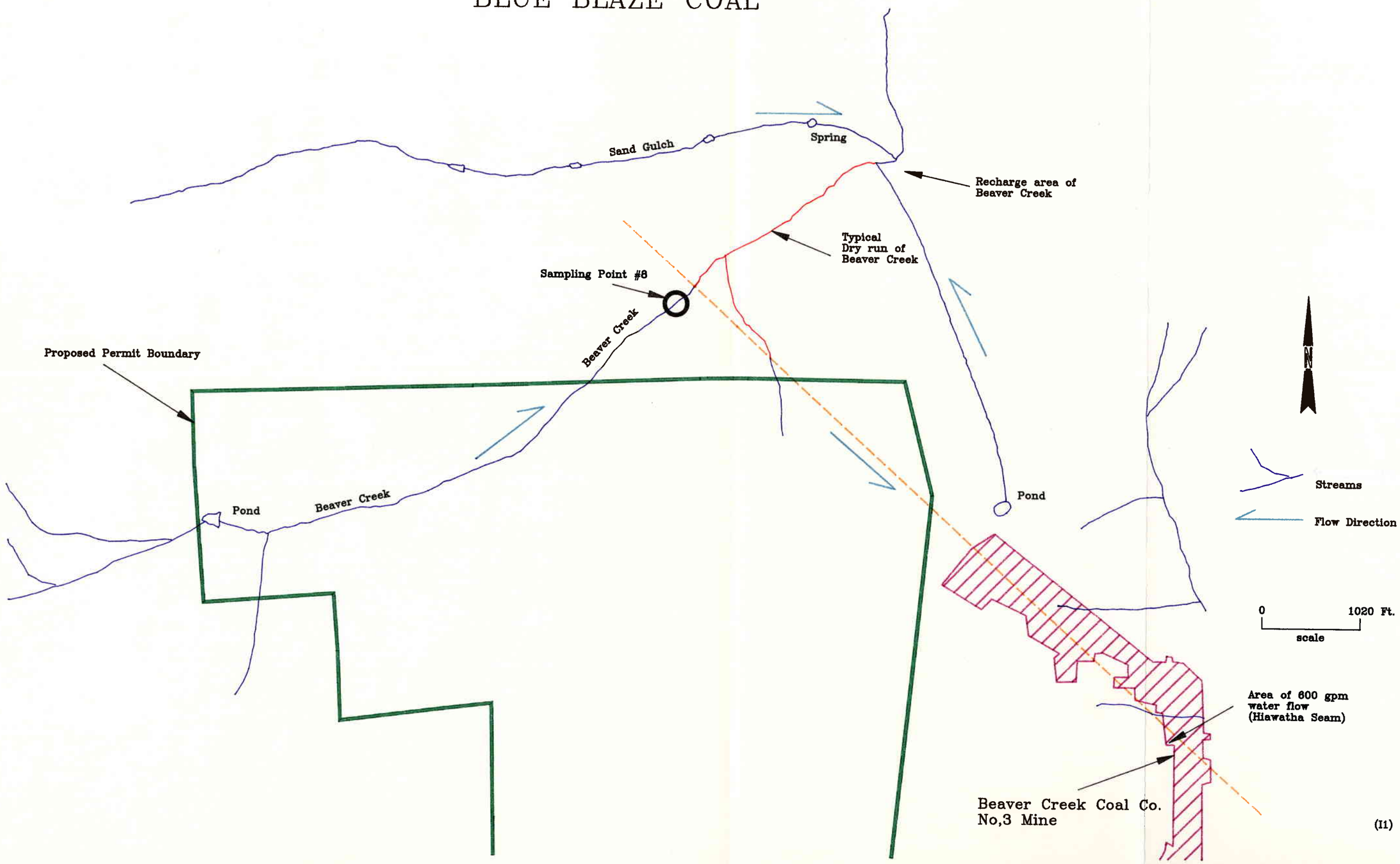
in the Blue Blaze No. 3 Mine and Gordon Creek No. 2 Mine which was mined and pillared and did not cause any documented adverse impacts to the hydrologic balance. Proposed mining in the Castlegate 'A' coal seam appears similar to other previously mined areas with respect to structural and hydrogeologic features.

If this area was mined with only minor inflows, it can be assumed that the Castlegate "A" seam is above the regional water table. Mine workings approximately 650 feet lower then the elevations of the previously mentioned springs is further evidence that the perched zones are above the regional water table. There is a possibility that during mining of the Castlegate "A" seam, perched zones may be intersected. These types of inflow have been observed in previous mining operations and are easily controlled and should be limited. The presence of perched conditions should provide hydraulic separation from the surface and deeper proposed mining activity.

Water levels have been measured in two open drill holes (LMC-1 and LMC-3) in December 1991, within the proposed permit area by Blue Blaze Coal. LMC-1 is reported to be open to 600 feet and does not contain any measurable water. Similarly, LMC-3 is reported to be a dry hole and open to 650 feet. Both of these holes are shown on cross-section A-A' (Figure 2). Inspection of section A-A' shows that LMC-3 is open below the Castlegate 'A' coal seam and intersects several possible saturated perched zones. Since the hole is dry, it can be assumed that it does not intersect a confined aquifer which is under pressure. LMC-1 is not open to the Castlegate 'A' coal seam but is dry to 600 feet .

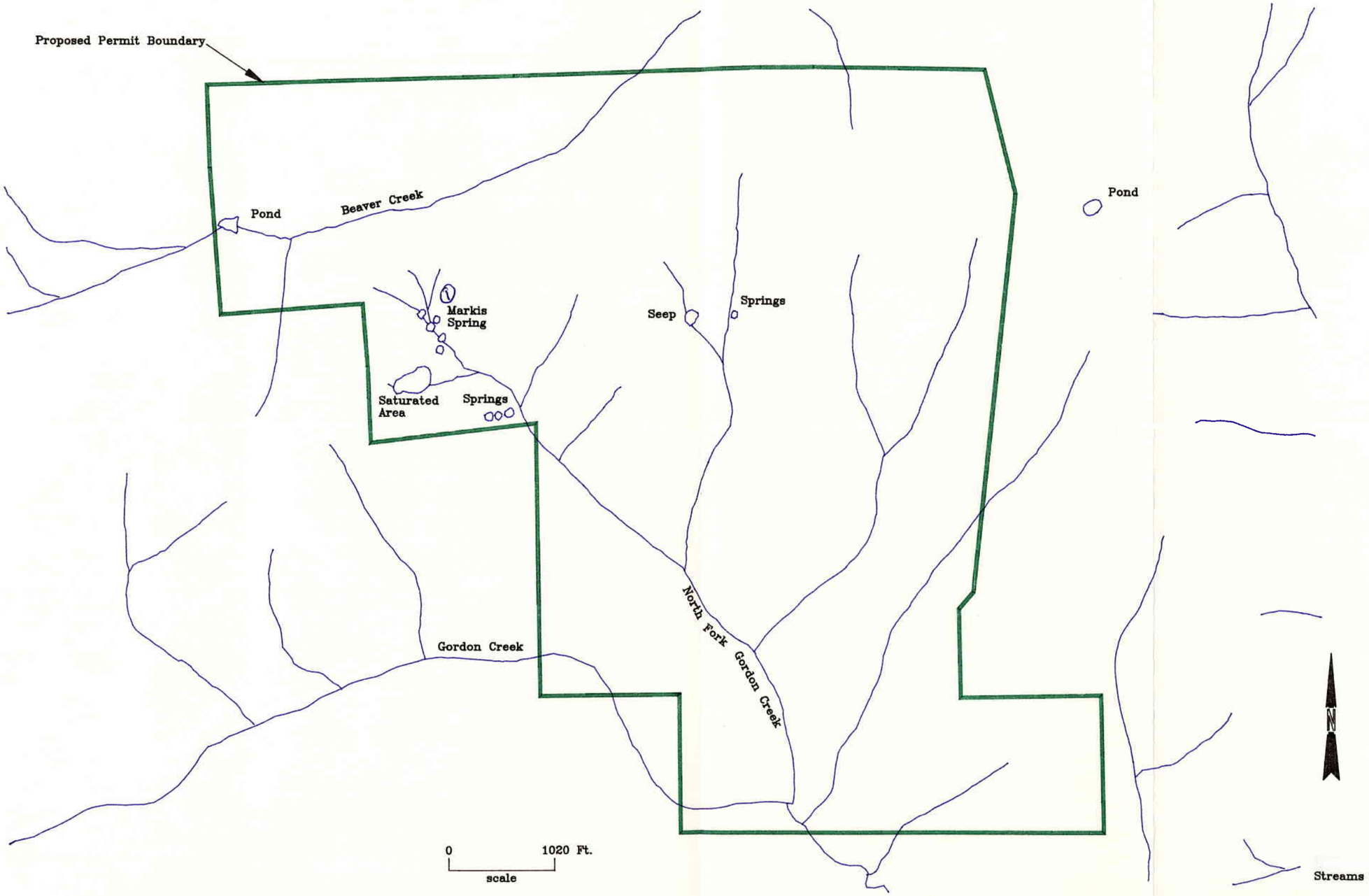
Furthermore, drill holes LMC-1, LMC-3 and LMC-4 produced very little water when drilled, LMC-2 was dry (Harvey, 1991). Joseph A. Harvey, a mining consultant, supervised the construction of these drill holes and tested them during drilling by blowing at various intervals and measuring water production.

MAP 8 : EFFECT OF FAULT ON BEAVER CREEK AND BEAVER CREEK No.3 MINE
BLUE BLAZE COAL



(I1)

MAP 9 : SURFACE WATER AND SPRINGS
BLUE BLAZE COAL



MAP 10 : POSITION OF CROSS-SECTION A-A'
BLUE BLAZE COAL

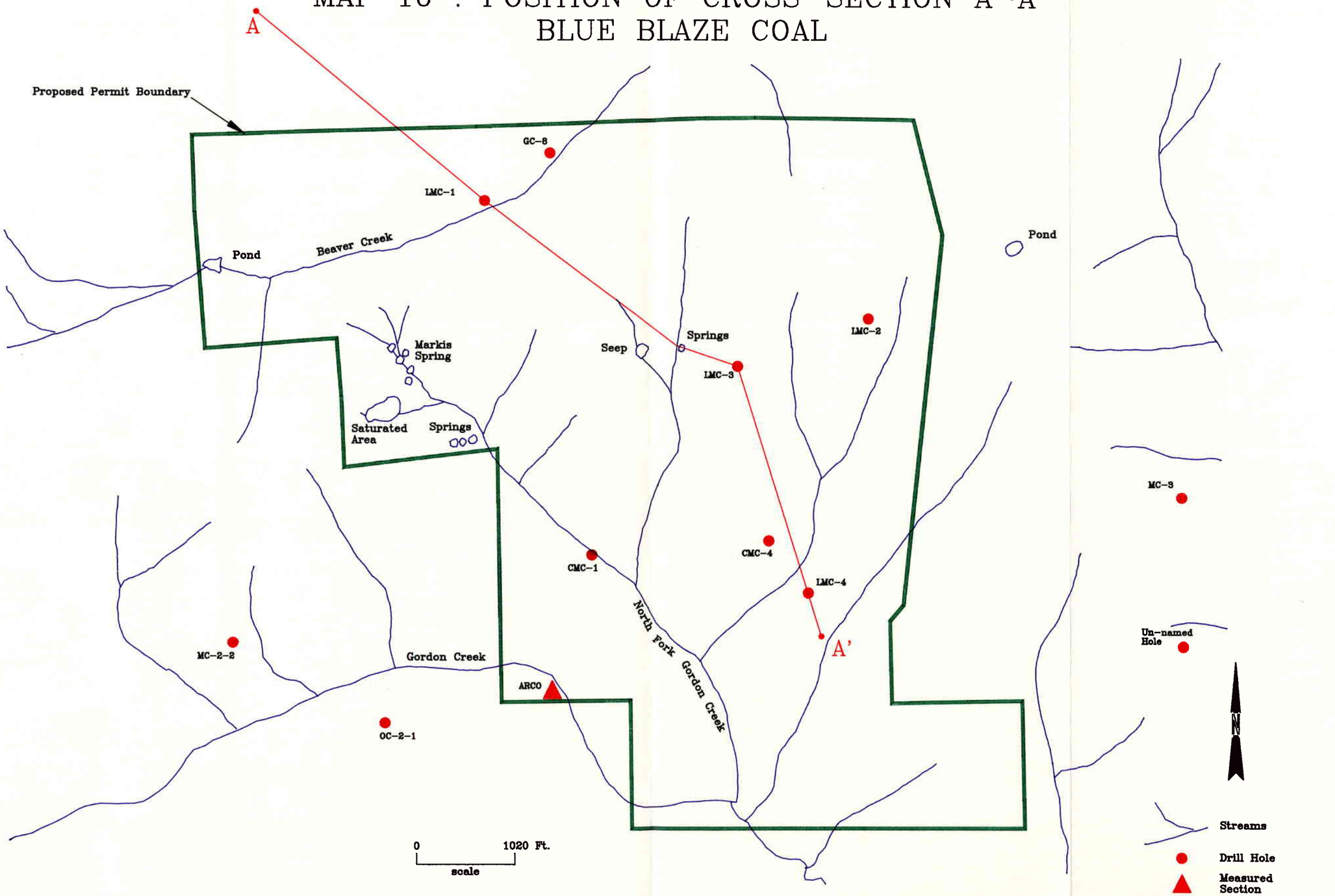


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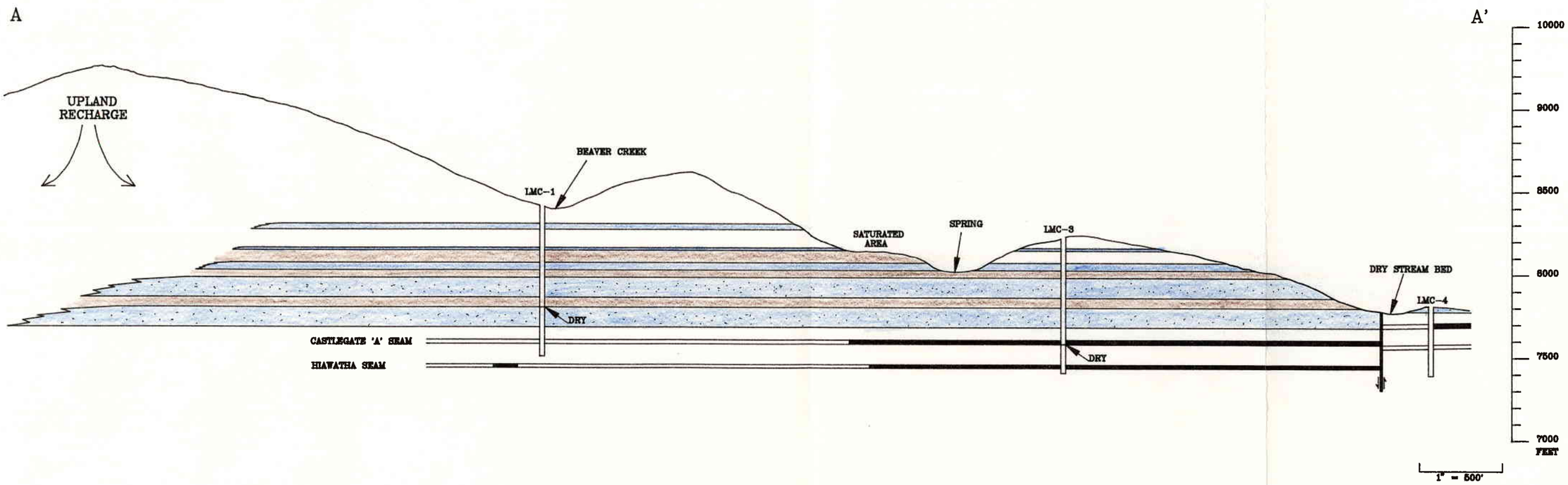
FIGURE 2: CROSS-SECTION A-A'
BLUE BLAZE COAL



LEGEND

- SHALE
- SHALE WITH SAND LENSES
- PREVIOUSLY MINED COAL (BLANK), No. 1 & 2 MINES (SOLID)
- SAND
- SAND WITH SHALE LENSES
- MIXED SANDS AND SHALES

4.0 PROBABLE HYDROLOGIC CONSEQUENCES

The hydrologic consequences are presented below with supporting data and conditions potentially affecting the hydrologic balance in and adjacent to the permit area. Due to their individual distinct characteristics, of the proposed No. 1 and No. 2 Mines, the possible impacts on the hydrologic balance are presented separately.

4.1 Blue Blaze No. 2 Mine (Castlegate 'A' Coal Seam)

Existing baseline data indicates that coal mining in the proposed Castlegate 'A' seam should have no impact on the hydrologic balance. The Castlegate "A" seam appears to be above the regional water table. This assumption is based on the following information; (1) four drill holes in the permit area produced very little water when drilled. Two of these drill holes do not currently contain any measurable or reported water, (2) previous mining in the Castlegate "A" seam, in and adjacent to the proposed permit area, has not produced significant groundwater flows, (3) the presence of perched water zones in the area, and (4) the occurrence of springs at higher elevations then previous dry mine workings.

Joe Harvey

If upper perched zones are distinct zones, and not hydraulically connected, mining below them should not be effected. Similarly, the perched zones should not be effected by mining below the confining layers. Lithologic drill logs show that the Blackhawk Formation consists of interfingering sands, silts and shales which produce perched water zones that are not areally consistent. Water in these perched zones would result from an upland source outside the proposed permit area (Fig. 2)

Adverse effects on the hydrologic balance due to mining in the Castlegate "A" seam contains much less uncertainty than that related to the Hiawatha coal seam.

4.2 Blue Blaze No. 1 Mine (Hiawatha Coal Seam)

At the present time there are a number of possible effects to the hydrologic balance due to mining of the Hiawatha coal seam in the proposed permit area.

If the Hiawatha coals lie above the regional aquifer then mining in the No. 1 mine may not adversely effect the regional hydrology. This scenario implies that the Starpoint sandstone is not a regional aquifer. Doelling (1972), states that the Starpoint Sandstone in this area is generally a poor aquifer. The Lower Emery and Ferron sandstones are believed to be the major regional aquifers in this area (Doelling, 1972, Price and Arnow, 1974).

Historically mining of the Hiawatha coal has not produced significant amounts of water except near the previously discussed fault. Hydrologic impacts due to mining of the Hiawatha coal in the No. 1 Mine would be source driven.

4.3 References

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Harvey, J.A., 1991, personal communication

Kohler, M.A., Nordenson, T.J., and Baker D.R., 1959, Evaporation Maps for the United States: Department of Commerce, Hydrologic Services Division, Technical Paper no. 37.

Price, D., and Arnow, T., 1974, Summary appraisals of the Nations Groundwater Resources--Upper Colorado Region: U.S. Geological Survey Professional Paper 813-C, 40p.

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Existing data indicates that mining in the Castlegate 'A' seam (Blue Blaze Mine No. 2) should not adversely impact the hydrologic balance within or adjacent to the proposed permit area. The permitting process may be simplified for the Castlegate 'A' seam mine due to: (1) the availability and quality of existing baseline data, (2) knowledge of extensive previous mining operations within and adjacent to the proposed permit area, and (3) the conservative size of the No. 2 Mine. The Castlegate 'A' seam is situated below, and separated from, small isolated perched water zones in the area. Previous mining operations in the Castlegate 'A' seam have not encountered significant groundwater flows or had any apparent effects on the surface water hydrology.

Mining of the Hiawatha coal seam (Blue Blaze No. 1 Mine) should have minimal incremental impact to the regional hydrologic balance due to the extensive historical mining operations in and adjacent to the proposed permit area. Groundwater flows have been encountered where mining has crossed a fault hydrologically connected to a water source. However, previous mining of the Hiawatha coal seam has intersected numerous faults and only one has produced significant amounts of water when mined through. This fault is likely transmitting water from surface sources and local perched zones. Minor inflows issuing from below the Hiawatha seam have not been significant and if encountered should have very minor incremental impact to the hydrologic balance.

1.0 INTRODUCTION

This section of the permit application was prepared by EnviroSearch Inc. for Mr. Roger Skaggs of Blue Blaze Coal pursuant to R614-301-132. Specifically, this section addresses regulations R614-301-724.100 (Baseline Information: Ground Water) and R614-301-728.310 (Probable Hydrologic Consequences (PHC); whether adverse impacts may occur to the hydrologic balance).

This section also addresses page 7, item 728, of the second technical deficiencies document prepared by the State of Utah, Department of Natural Resources, Division of Oil, Gas, and Mining, dated October 11, 1991.

1.1 Purpose

The purpose of this report is to analyze the existing baseline data and determine whether adverse impacts may occur to the hydrologic balance due to coal mining in and adjacent to the proposed Blue Blaze Coal Co. permit area.

1.2 Summary

Two mines are proposed within the permit area; the Blue Blaze No. 1 Mine and Blue Blaze No. 2 Mine. The No. 1 Mine is proposed for the Hiawatha coal seam, while the No. 2 Mine is for the Castlegate 'A' coal seam.

The following sources of information were used to analyze the baseline conditions and develop the PHC determination for the proposed permit area.

(1) On-site measurement of water levels, by Blue Blaze Coal Co., in existing open drill holes.

(2) Drill logs, cross-sections, outcrop logs, and downhole geophysical survey logs.

(3) Investigation of historical mining operations in and adjacent to the proposed permit area. Particularly, previous mining operations which did and did not

encounter significant water.

(4) Review of surface water features.

(5) Review of available groundwater information.

(6) BLM Coal Drill Hole Data.

(7) USGS geological maps.

(8) Literature search.

The Blue Blaze No. 1 and No. 2 Mines are significantly different with respect to their size, previous mining operations, and available data. Because of these differences, the baseline data, historical review, and PHC determination for each mine are presented separately. The following is a summary of this investigation; supporting data and conditions for these conclusions are included in the following sections.

Blue Blaze No. 2 Mine (Castlegate 'A' Coal Seam)

Existing baseline data indicates that the proposed coal mining in the Castlegate 'A' seam should not impact the hydrologic balance in or adjacent to the proposed permit area. The permitting process for the No. 2 Mine should be simplified due to the following:

1) Four drill holes in the permit area produced very little water when drilled. Two of these drill holes do not currently contain any measurable or reported water.
2) Groundwater above and below the Castlegate 'A' coal seam is typically perched and does not represent a major regional aquifer.
3) Due to extensive historic mining of the Castlegate 'A' seam the proposed No. 2 Mine should not have any incremental impact to the hydrologic balance in or adjacent to the proposed permit area.

Blue Blaze No. 1 Mine (Hiawatha Coal Seam)

Previous extensive mining of the Hiawatha coal seam, in and adjacent to the proposed permit area, indicates that mining in the No. 1 Mine should have minimal incremental impacts on the hydrologic balance. Historic mining of the Hiawatha coal seam has only produced significant quantities of water when a fault hydrologically connected to a source of water was encountered. Undesirable flows have not been reported from mining into units immediately below the Hiawatha coal seam.

The proposed permit area, No. 1 and No. 2 Mines, and historic mining operations are discussed in section 2.0. Baseline conditions based on: existing data, regional hydrogeology, fault characteristics, surface water features, recharge areas, and local hydrogeology are provided in section 3.0. Possible impacts to the local and regional hydrologic systems, due to the proposed mining are addressed in section 4.0

2.0 BACKGROUND

The proposed permit area, and property boundaries of existing leases, applied for by Blue Blaze Coal Co. are shown on Map 1. The Blue Blaze No.1 and No. 2 mines are shown on Map 2.

The surface area of the No. 1 and No. 2 Mines represent a small percentage of the total proposed permit area. The No. 2 Mine (Castlegate 'A' coal seam) comprises approximately 15% of the total permit area, the No. 1 Mine (Hiawatha coal seam) approximately 42% of the total permit area. Collectively, the No. 1 and 2 Mines represent less than 50% of the total surface area proposed to be permitted.

Prior to 1950, conventional drilling and blasting was used as the standard mining method in the area. Since 1950, conventional continuous miners have been used to mine coal in the Castlegate and Hiawatha seams. The proposed mining in the Castlegate 'A' and Hiawatha seams will also be conducted using conventional continuous miners.

Over 50% of the proposed permit area has been previously mined in the Castlegate 'A' and Hiawatha coal seams. The following is a summary of this historical mining within and adjacent to the proposed permit area for the Castlegate 'A' and Hiawatha coal seams.

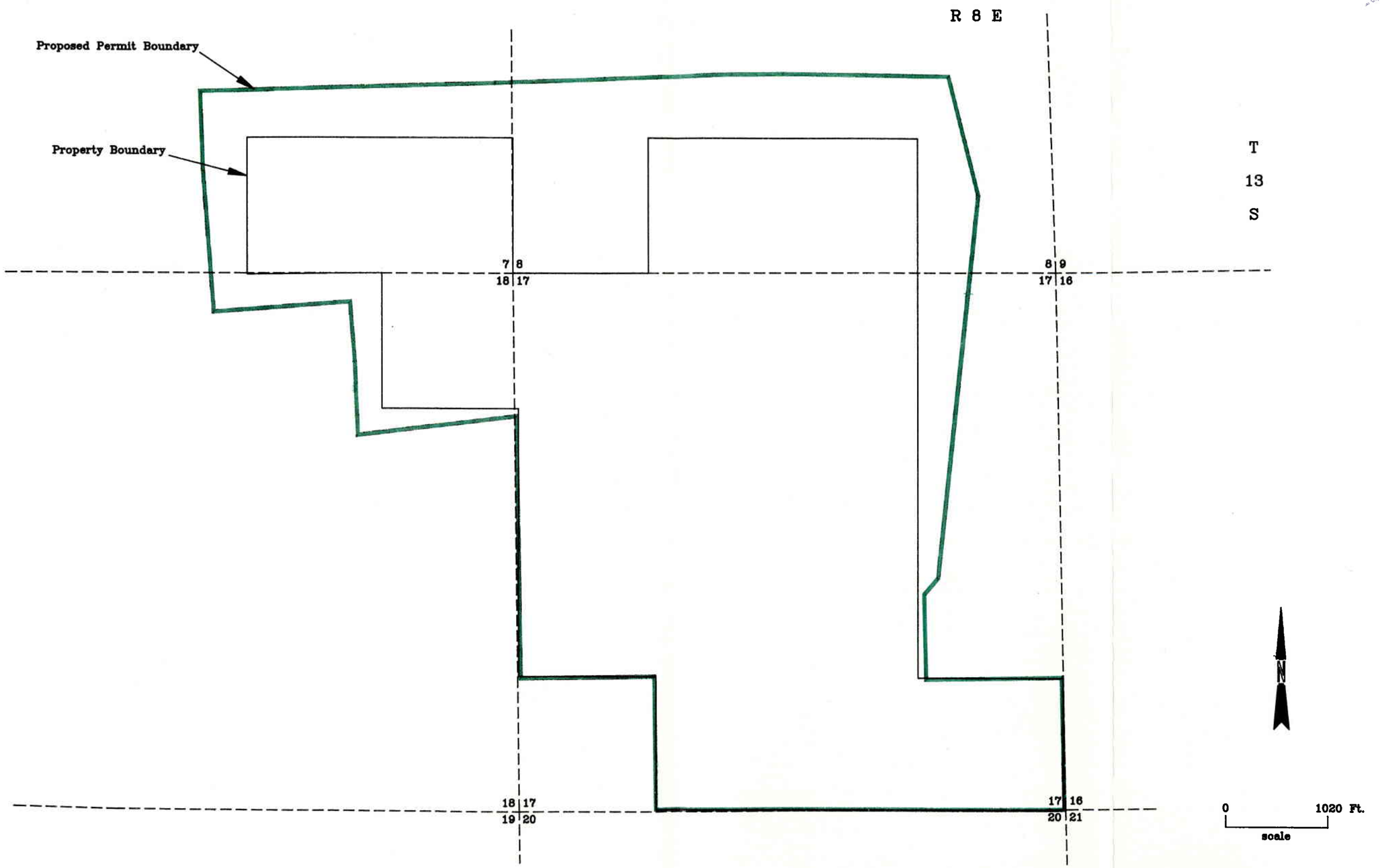
2.1 Historical Mining of the Castlegate 'A' Coal Seam

The extent and location of previous mining operations in the Castlegate 'A' coal seam are shown on Map 3 with the proposed No. 2 Mine.

Extensive mining of the Castlegate 'A' coal seam within and adjacent to the proposed permit area has been conducted by Beaver Creek Coal Co. (Gordon Creek No. 2 Mine), Blue Blaze Coal Co. (No. 3 Mine), and Swisher Coal Co. (Gordon Creek No. 6 Mine).

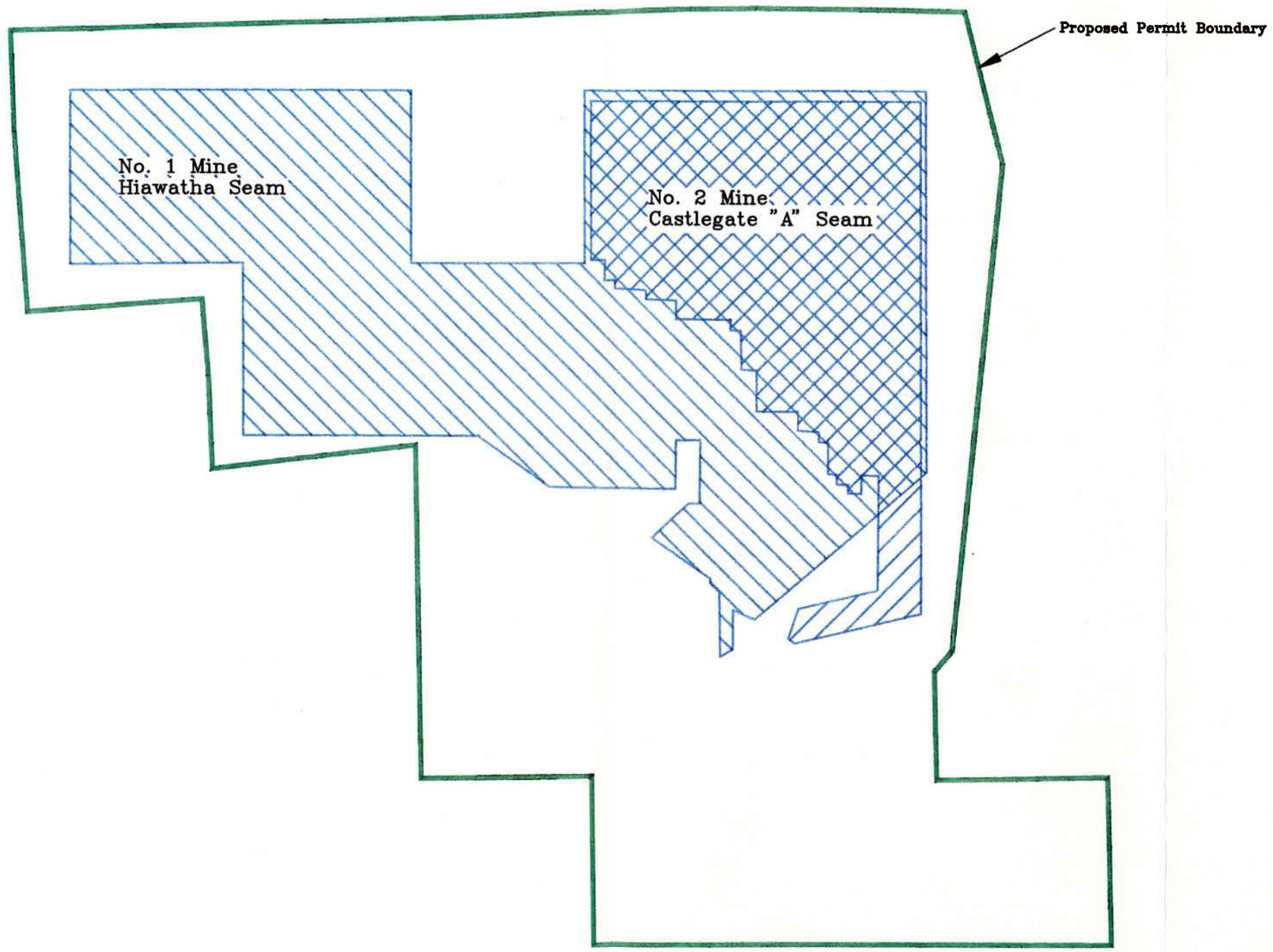
None of the previous mining operations shown on Map 3 have reportedly encountered any significant amounts of water during mining of the Castlegate 'A' coal seam. Both the Blue Blaze No. 3 Mine and Gordon Creek No. 2 Mine were mined and pillared below the Beaver Creek without any documented apparent incremental impact to the hydrologic balance. The Blue Blaze No. 3 Mine was mined out prior to 1950 when drilling and blasting was used to extract the coal. The Gordon Creek No. 2 Mine was mined out with conventional continuous miners. The proposed No. 2 Mine will be mined using conventional continuous miners; the same method used in more recent mining operations.

MAP 1 : PROPOSED PERMIT AREA
BLUE BLAZE COAL



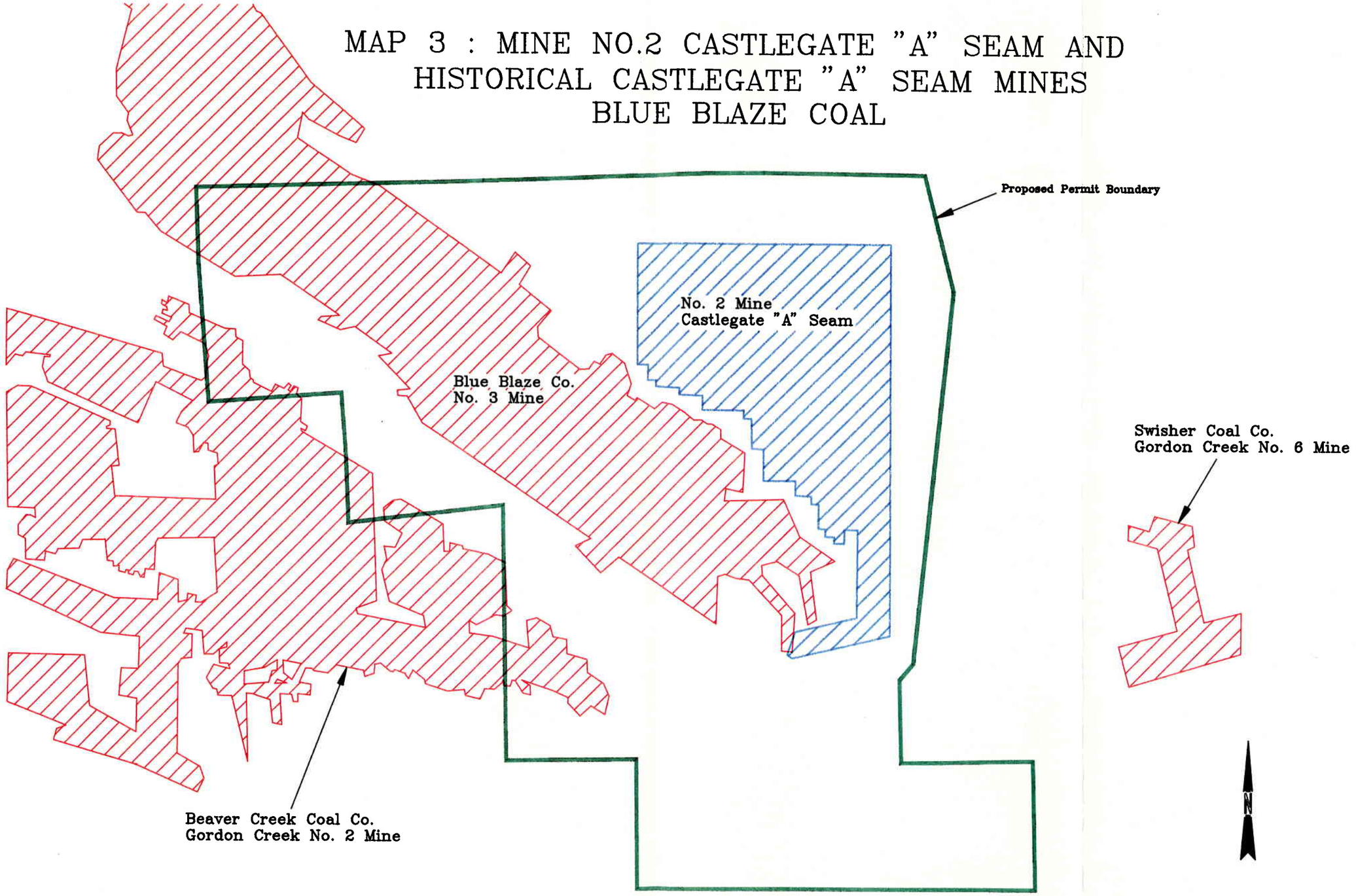
(HP)

MAP 2 : BLUE BLAZE No. 1 and No. 2 MINE AREAS
BLUE BLAZE COAL



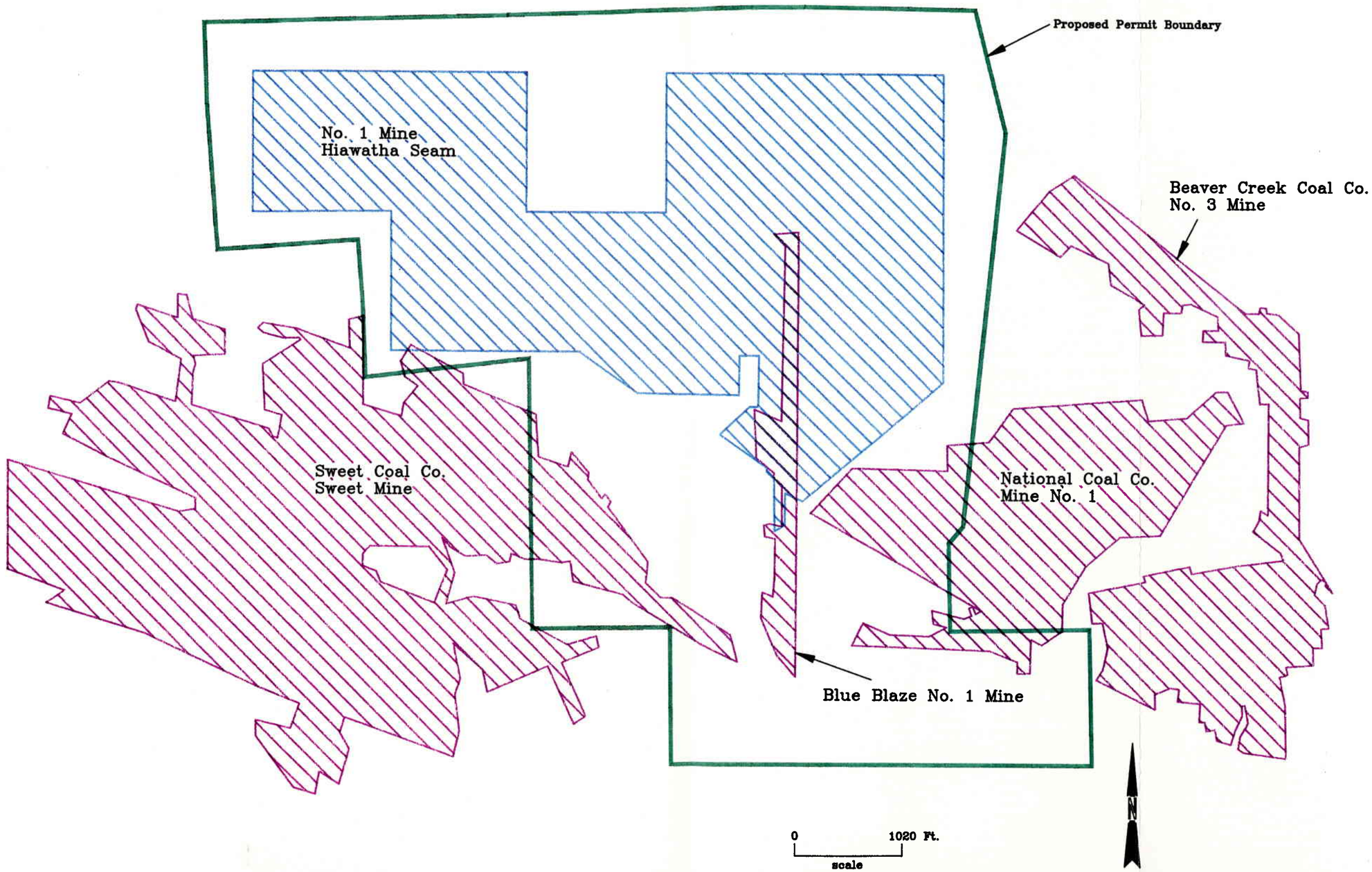
(HQ)

MAP 3 : MINE NO.2 CASTLEGATE "A" SEAM AND HISTORICAL CASTLEGATE "A" SEAM MINES BLUE BLAZE COAL



(HR)

MAP 4 : MINE NO. 1 HIAWATHA SEAM AND HISTORICAL HIAWATHA SEAM MINES BLUE BLAZE COAL



(HS)

3.0 BASELINE DATA

Baseline hydrologic and geologic data has been compiled and evaluated to determine whether adverse impacts may occur to the hydrologic balance due to mining in the proposed permit area. The following is an examination of the existing baseline data with respect to the regional hydrogeology, faulting, and local hydrogeology.

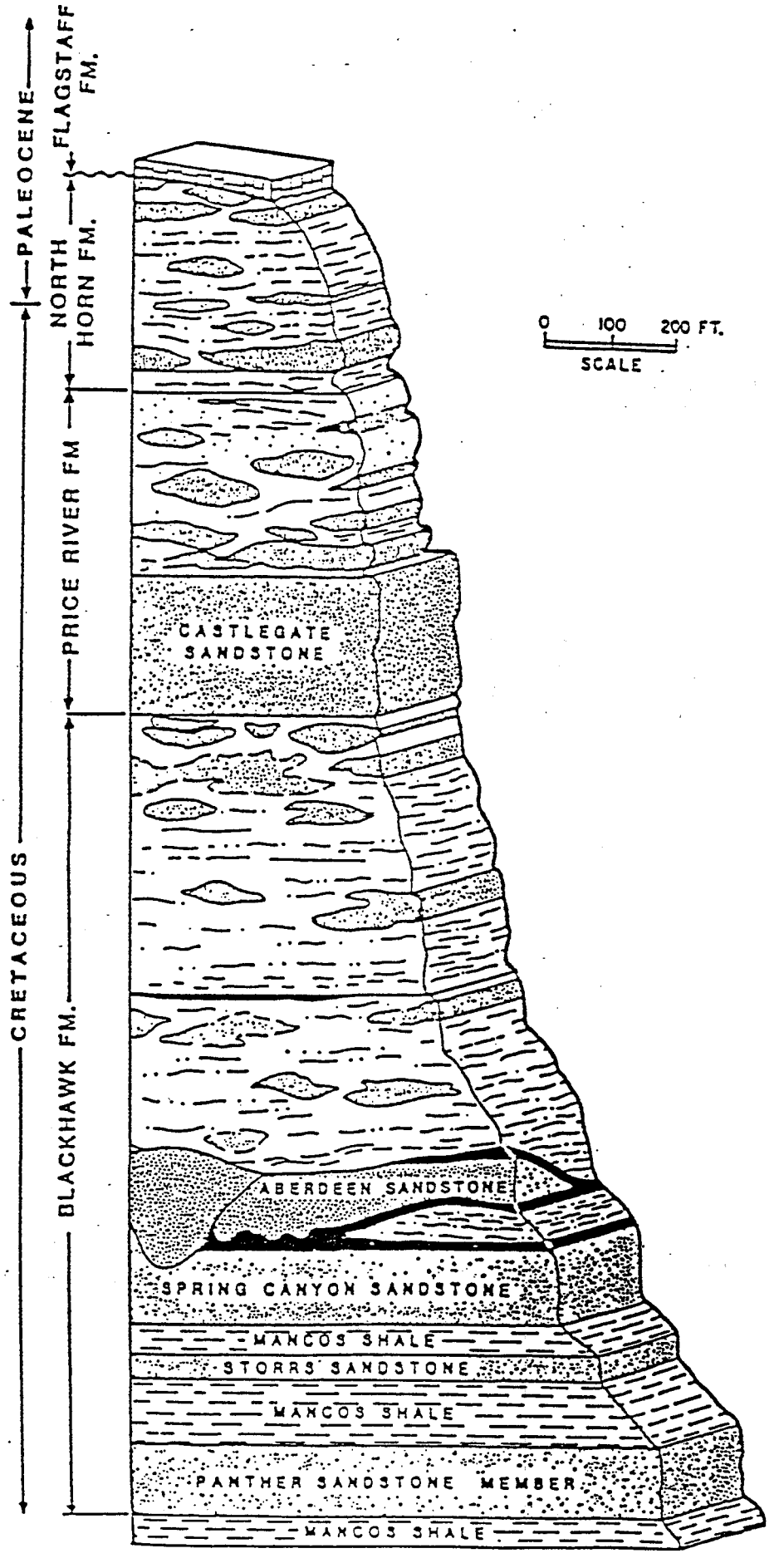
3.1 Regional Hydrogeology

The regional hydrogeology is largely controlled by the regional geology. A generalized stratigraphic column for the region is shown in Figure 1. The Blackhawk Formation, of the Mesaverde Group, contains the Castlegate 'A' and Hiawatha coal seams. The Blackhawk Formation has a mixed lithology of sandstones, shales, and coals which produces alternating perched aquifers and impermeable beds (Doelling 1972). Below the Blackhawk is the Star Point Sandstone, the lower most unit of the Mesaverde Group. This unit consists of several littoral sandstone tongues separated by Mancos shales (Doelling 1972).

The main hydrogeological issue associated within and adjacent to the proposed permit area is the relation of the regional aquifer to the Castlegate 'A' and Hiawatha coal seams and adjacent units. The depth of the major regional aquifer beneath the permit area is uncertain; it is possible that the Star Point Sandstone may be connected to the regional aquifer, although some literature suggests the major regional aquifer is much deeper in the Emery Sandstone or the Ferron Sandstone Members (Doelling, 1972, Price and Arnow, 1974).

The groundwater in the region most probably flows in a northeast direction following the dip of the strata (2° to 3° to the northeast).

FIGURE 1. GENERAL STRATIGRAPHY



3.2 Faults

Faulting throughout the permit area may play an important role in the regional hydrology. At the present time, it is unknown if these faults act as conduits or barriers to the movement of ground water. Historical mining indicates that the water in some of these faults may be source driven from surface runoff and that only some faults have sources. Other faults may not have sources or may be healed with swelling clays common to the area. Certainly, faults in the permit area have different characteristics, some acting as conduits and others acting as barriers. This is indicated by the occurrence or absence of water when faults were mined through during previous mining operations.

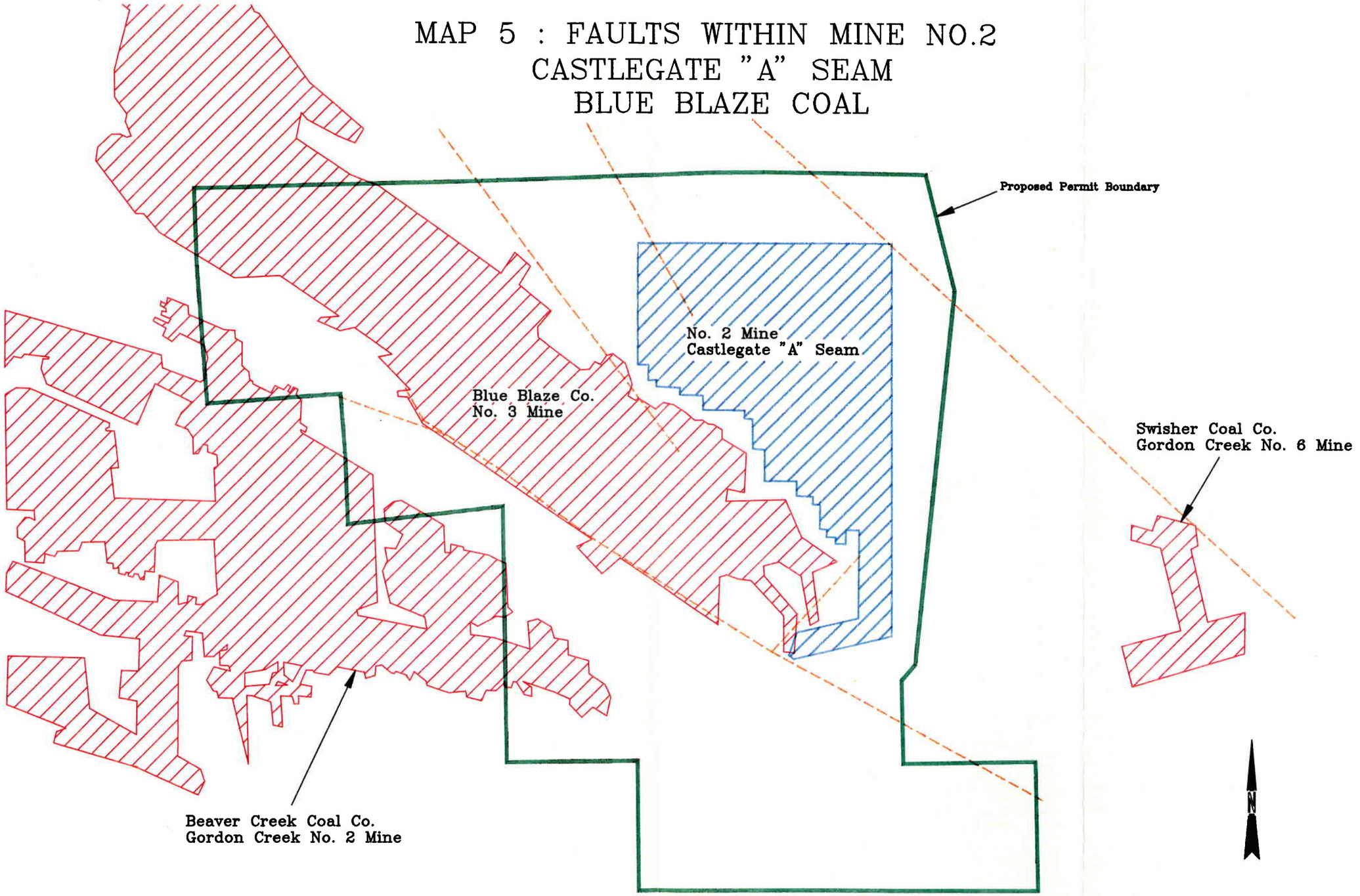
Numerous faults in the area have been crossed by previous mining activities. Faulting associated with the No. 2 Mine (Castlegate 'A' seam) is much less frequent than in the surrounding area due the small areal coverage of the No. 2 Mine and the location of the faults. Map 5 shows only those faults possibly impacting the No. 2 mine in the Castlegate 'A' coal seam. Map 6 illustrates historical mining activities in the Castlegate 'A' seam which encountered faults. Historically when faults have been crossed in the Castlegate 'A' seam, little or no water has been produced. Therefore, mining through faults in the No. 2 Mine should not produce significant quantities of water or cause adverse impacts to the hydrologic balance.

Previous mining of the Hiawatha coal seam has also crossed many faults (Map 7). However, only one fault has produced significant quantities of water when mined through. This fault to the east of the permit area, was intersected during mining of the Hiawatha coal seam at the Beaver Creek Coal Co. #3 Mine, and caused inflows of approximately 600 gallons per minute (Map 8). It is likely that this fault is acting as a conduit, transmitting water from upland recharge sources and the Beaver Creek to the north (Map 8). Flow rates for the Beaver Creek measured by Blue Blaze Coal in 1991 were reported to average 420 gpm (sampling point #8, Map 8). Downstream of this

sampling point, near the intersection of the previously mentioned fault and the Beaver Creek, the creek is typically dry. Further downstream, the Beaver Creek is recharged by the springs in Sand Gulch and other tributaries (Map 8).

Due to the high flows measured in the Beaver Creek upstream of the fault, and a substantial decrease in flow on the down gradient side of the fault, water is most likely draining into the fault. As a conduit this fault could then transmit water south along the fault and into the Beaver Creek No. 3 Mine where the significant flows were encountered (Map 8).

MAP 5 : FAULTS WITHIN MINE NO.2
CASTLEGATE "A" SEAM
BLUE BLAZE COAL



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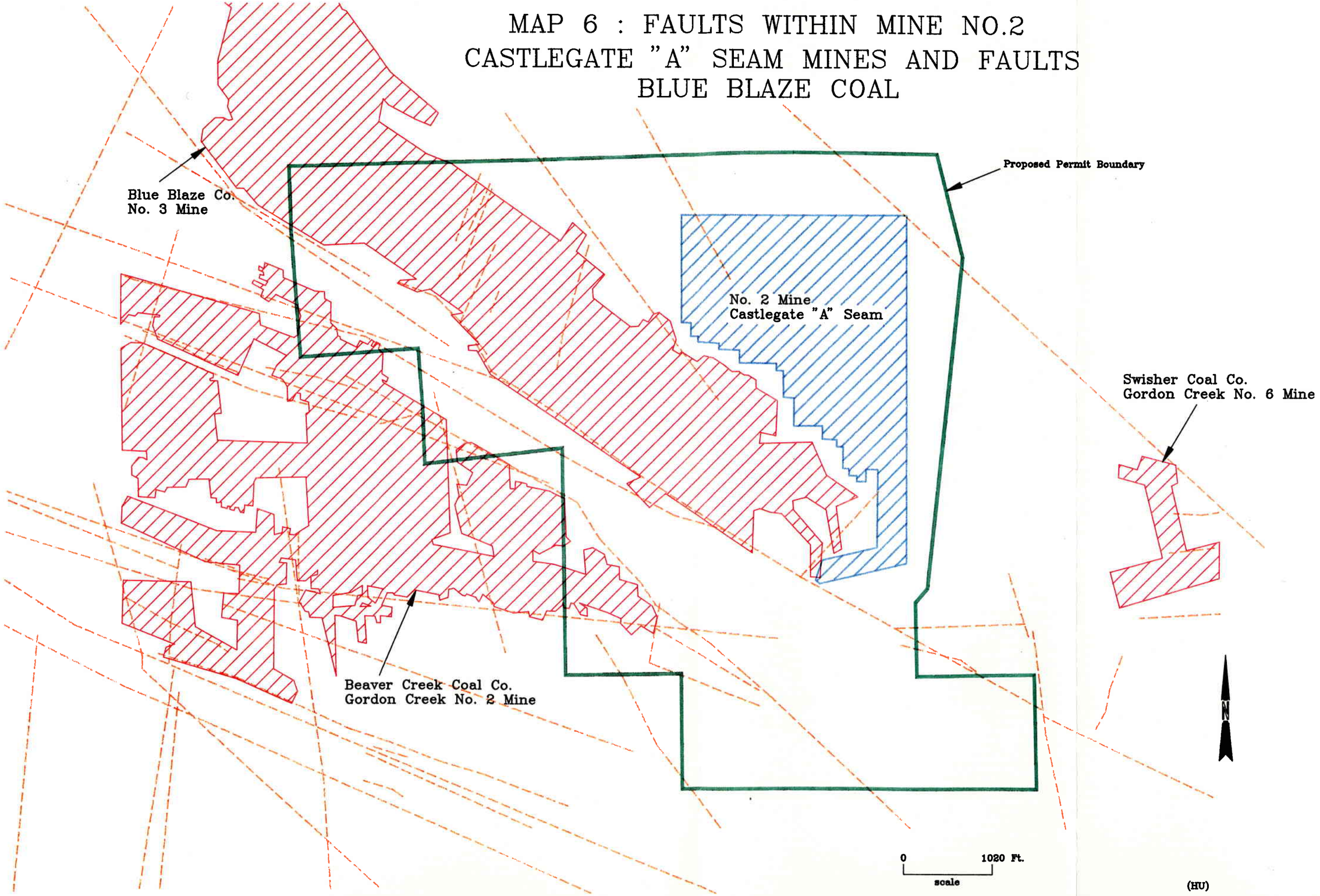
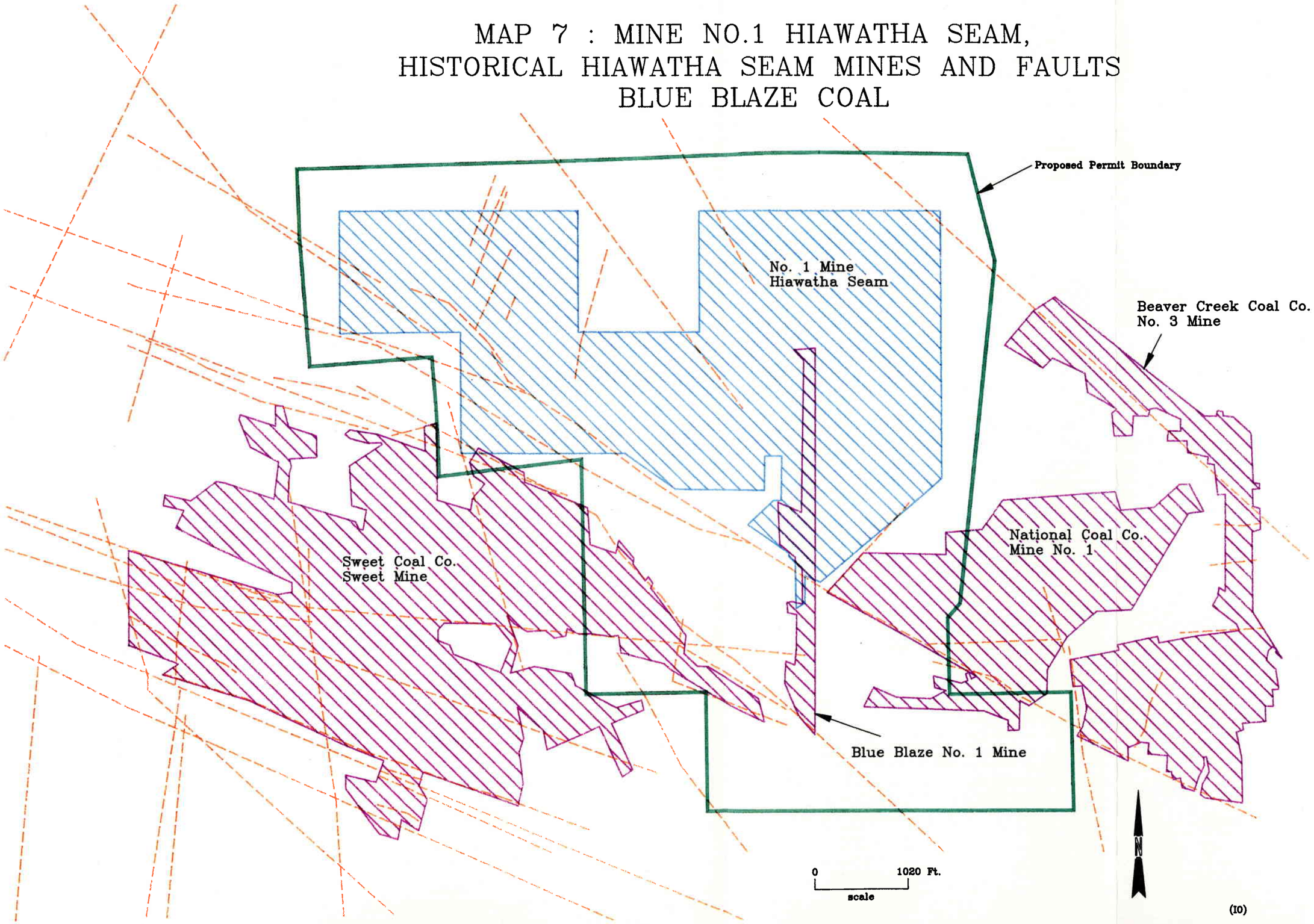
MAP 6 : FAULTS WITHIN MINE NO.2
CASTLEGATE "A" SEAM MINES AND FAULTS
BLUE BLAZE COAL

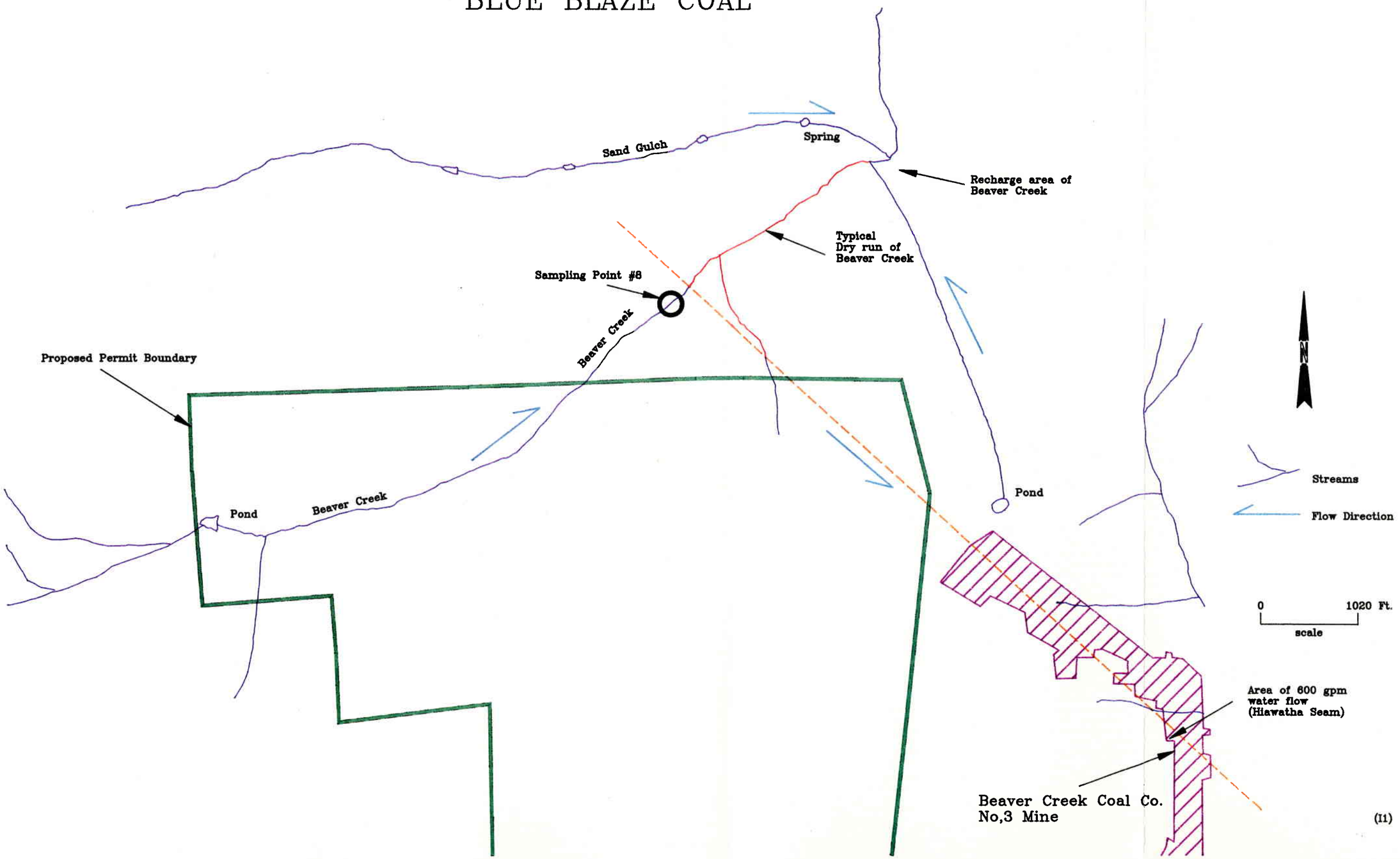


(HU)

MAP 7 : MINE NO.1 HIAWATHA SEAM, HISTORICAL HIAWATHA SEAM MINES AND FAULTS BLUE BLAZE COAL



MAP 8 : EFFECT OF FAULT ON BEAVER CREEK AND BEAVER CREEK No.3 MINE
BLUE BLAZE COAL



(I1)

3.3 Local Hydrogeology

The local hydrogeology of the Blue Blaze permit area consists of springs, perched zones, seasonal recharge and naturally occurring surface water (Map 9). Naturally occurring surface water includes seasonal runoff and intermittent stream flow. Surface water in the permit area appears to be mostly seasonal. Intermittent streams, such as the North Fork of Gordon Creek, flow during times of spring snowmelt and high precipitation. The intermittent streams are not in direct communication with the regional water table and are probably losing water due to infiltration. These type of intermittent streams tend to have decreasing flows down gradient. This assumption is supported by stream flow data measured by Blue Blaze Coal which shows that the flows in Gordon Creek decrease downstream.

The region is also a net evaporation zone since evapotranspiration is greater than precipitation. Potential evapotranspiration in the area is estimated to average 35 inches per year (Kohler, Nordenson and Baker, 1959) while the average annual precipitation is 7 to 9 inches per year. Using the above estimates of precipitation and evapotranspiration, the surface recharge in the area is expected to be minimal. Since surface recharge in the area is likely minor and limited to the upper sediments, springs in the area are seasonally controlled and have low flow rates. The perched water zones, which likely feed the springs, will also have low flow rates. Therefore, recharge from precipitation is not a major factor across the mining area and will not produce sustained quantities of water.

The local hydrology is most likely dominated by the varying hydrogeologic properties associated with the sand-shale-coal sequence of the Blackhawk Formation. Numerous permeability and porosity contrasts in the sands and shales have the potential to cause a series of distinct perched water zones. In this type of sequence the sands act as water saturated zones and the shales act as confining layers that do not allow water to communicate between the sands. A cross-section (Fig. 2) through the

proposed permit area was developed to show these perched zones and the relation of the local recharge to the springs in the area. This cross-section extends from the highlands in the northwest, through LMC-1, a spring and saturated area, LMC-3 and LMC-4 (Map 10).

Geophysical logs, interpreted by Century Geophysical Corp., provided lithologic control for the drill holes and construction of the cross-section. Coal seams and major sand and clay units correlate very well between drill holes and with BLM coal data base logs.

The cross-section (Fig. 2) is representative of typical surface and subsurface geological conditions in the permit area, and illustrates the perched water zones characteristic of the Blackhawk Formation. The water source for these perched zones is most likely from a limited, nearby, seasonal recharge source. The spring and saturated area, shown on Figure 2, are most likely caused by recharge in nearby uplands. The Blackhawk Formation (and its associated sand and shale units) is known to pinch out to the west in a sequence of interfingering sand and shale units (Doelling 1972). Therefore, water infiltrating from the highlands would be distributed in the sandy units and perched between shale layers down gradient. Where the overlying shales are eroded away the water is allowed to flow to the surface and produce springs and saturated zones.

The Markis Spring (Map 10) is another good example of a spring from a small perched water table. Flow rates measured from the spring indicate a significant seasonal variation in discharge. These seasonal fluctuations in discharge is evidence that the spring is part of a limited local seasonal recharge source. Springs that discharge from a larger, more regional flow system would most likely have less seasonal variation.

The Castlegate "A" seam has been mined below the Beaver Creek in the northwestern section of the permit area with minor water inflows. This mining was done

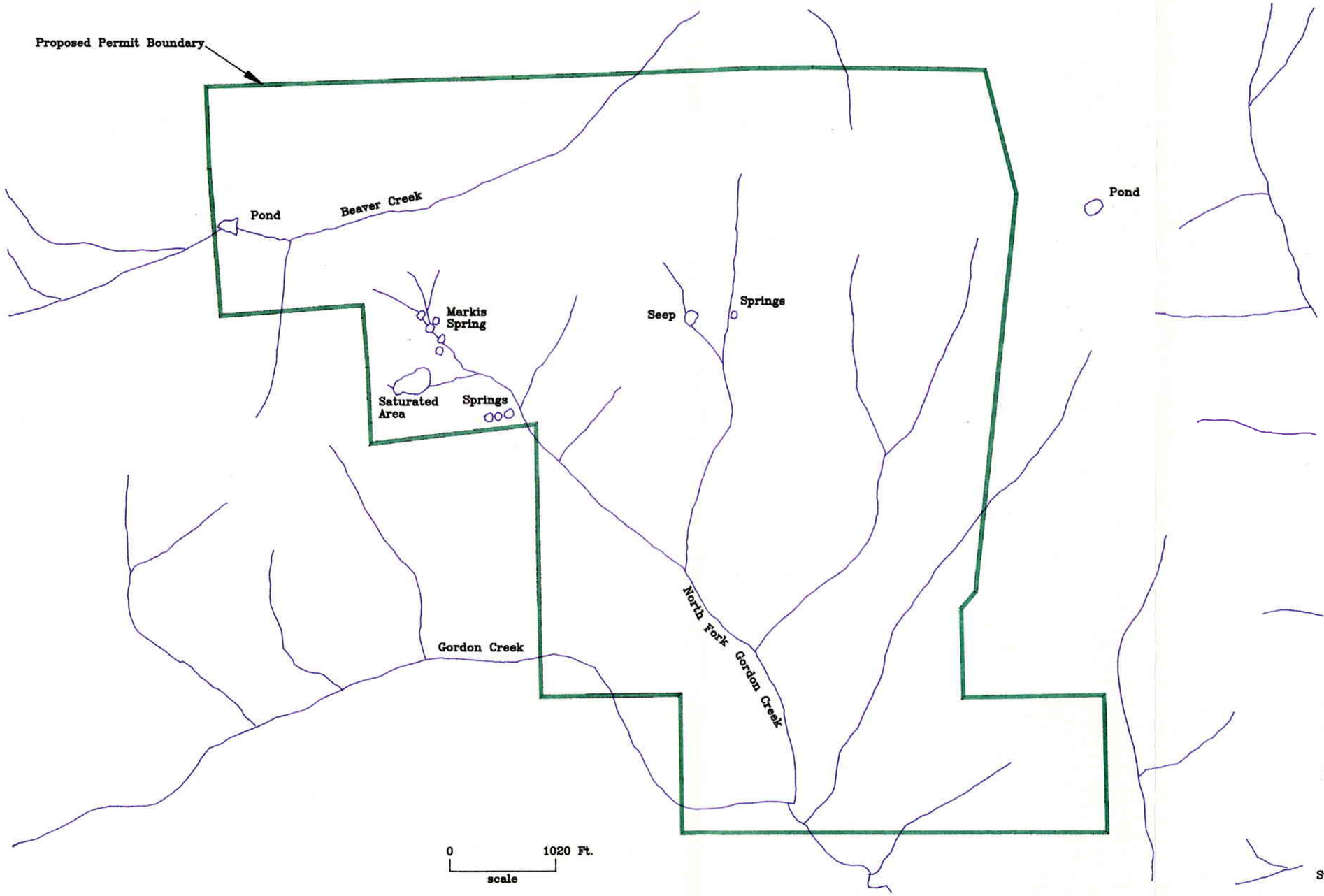
in the Blue Blaze No. 3 Mine and Gordon Creek No. 2 Mine which was mined and pillared and did not cause any documented adverse impacts to the hydrologic balance. Proposed mining in the Castlegate 'A' coal seam appears similar to other previously mined areas with respect to structural and hydrogeologic features.

If this area was mined with only minor inflows, it can be assumed that the Castlegate "A" seam is above the regional water table. Mine workings approximately 650 feet lower then the elevations of the previously mentioned springs is further evidence that the perched zones are above the regional water table. There is a possibility that during mining of the Castlegate "A" seam, perched zones may be intersected. These types of inflow have been observed in previous mining operations and are easily controlled and should be limited. The presence of perched conditions should provide hydraulic separation from the surface and deeper proposed mining activity.

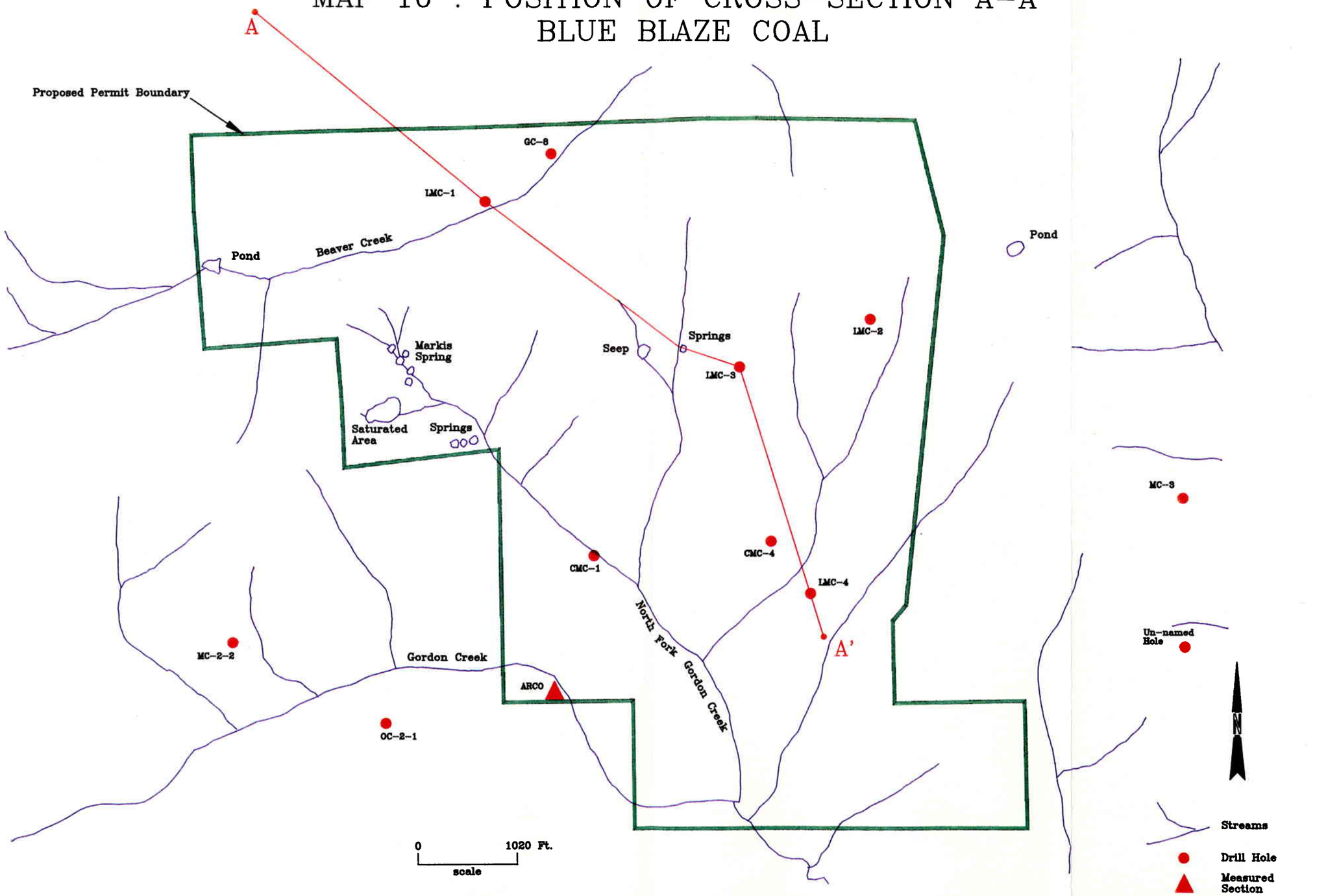
Water levels have been measured in two open drill holes (LMC-1 and LMC-3) in December 1991, within the proposed permit area by Blue Blaze Coal. LMC-1 is reported to be open to 600 feet and does not contain any measurable water. Similarly, LMC-3 is reported to be a dry hole and open to 650 feet. Both of these holes are shown on cross-section A-A' (Figure 2). Inspection of section A-A' shows that LMC-3 is open below the Castlegate 'A' coal seam and intersects several possible saturated perched zones. Since the hole is dry, it can be assumed that it does not intersect a confined aquifer which is under pressure. LMC-1 is not open to the Castlegate 'A' coal seam but is dry to 600 feet .

Furthermore, drill holes LMC-1, LMC-3 and LMC-4 produced very little water when drilled, LMC-2 was dry (Harvey, 1991). Joseph A. Harvey, a mining consultant, supervised the construction of these drill holes and tested them during drilling by blowing at various intervals and measuring water production.

MAP 9 : SURFACE WATER AND SPRINGS
BLUE BLAZE COAL



MAP 10 : POSITION OF CROSS-SECTION A-A'
BLUE BLAZE COAL



4.0 PROBABLE HYDROLOGIC CONSEQUENCES

The hydrologic consequences are presented below with supporting data and conditions potentially affecting the hydrologic balance in and adjacent to the permit area. Due to their individual distinct characteristics, of the proposed No. 1 and No. 2 Mines, the possible impacts on the hydrologic balance are presented separately.

4.1 Blue Blaze No. 2 Mine (Castlegate 'A' Coal Seam)

Existing baseline data indicates that coal mining in the proposed Castlegate 'A' seam should have no impact on the hydrologic balance. The Castlegate "A" seam appears to be above the regional water table. This assumption is based on the following information; (1) four drill holes in the permit area produced very little water when drilled. Two of these drill holes do not currently contain any measurable or reported water, (2) previous mining in the Castlegate "A" seam, in and adjacent to the proposed permit area, has not produced significant groundwater flows, (3) the presence of perched water zones in the area, and (4) the occurrence of springs at higher elevations then previous dry mine workings.

If upper perched zones are distinct zones, and not hydraulically connected, mining below them should not be effected. Similarly, the perched zones should not be effected by mining below the confining layers. Lithologic drill logs show that the Blackhawk Formation consists of interfingering sands, silts and shales which produce perched water zones that are not areally consistent. Water in these perched zones would result from an upland source outside the proposed permit area (Fig. 2)

Adverse effects on the hydrologic balance due to mining in the Castlegate "A" seam contains much less uncertainty than that related to the Hiawatha coal seam.

4.2 Blue Blaze No. 1 Mine (Hiawatha Coal Seam)

At the present time there are a number of possible effects to the hydrologic balance due to mining of the Hiawatha coal seam in the proposed permit area.

If the Hiawatha coals lie above the regional aquifer then mining in the No. 1 mine may not adversely effect the regional hydrology. This scenario implies that the Starpoint sandstone is not a regional aquifer. Doelling (1972), states that the Starpoint Sandstone in this area is generally a poor aquifer. The Lower Emery and Ferron sandstones are believed to be the major regional aquifers in this area (Doelling, 1972, Price and Arnow, 1974).

Historically mining of the Hiawatha coal has not produced significant amounts of water except near the previously discussed fault. Hydrologic impacts due to mining of the Hiawatha coal in the No. 1 Mine would be source driven.

4.3 References

Doelling, H.H., 1972, Central Utah Coal Fields: Utah Geological and Mineral Survey Monograph Series no. 3, 571pp.

Harvey, J.A., 1991, personal communication

Kohler, M.A., Nordenson, T.J., and Baker D.R., 1959, Evaporation Maps for the United States: Department of Commerce, Hydrologic Services Division, Technical Paper no. 37.

Price, D., and Arnow, T., 1974, Summary appraisals of the Nations Groundwater Resources--Upper Colorado Region: U.S. Geological Survey Professional Paper 813-C, 40p.