Section 5
CULTURAL AND PALEONTOLOGICAL RESOURCES

5.1 Scope

The Huntington Canyon property is bounded on the east by Huntington Creek, on the north by Crandall Canyon and on the south by Mill Fork Canyon. Topography in the area is extremely rugged. Elevations vary from 7200 feet in the canyon bottom to over 9800 feet on the ridges. Approximately 80% of the area is dominated by slopes usually in excess of 60% and, in many places, are regularly broken up by 100% slopes. The remaining 20% of the property is at elevations ranging between 9400 - 9800 feet.

The area receives in the neighborhood of 16 inches of rain per year. Vegetation includes Subalpine and Montane communities. The major game species in the area are deer and elk, with smaller species abundant.

Studies have been completed to ensure that paleontological, historical and cultural resources that might exist on the permit area would not be irretrievably affected by the proposed operations. Literature and field surveys were conducted to determine the presence and/or significance of sites which could warrant inclusion in the National Register of Historic Places.

5.2 Methodology

Archaeological investigations of Beaver Creek Coal Company's Huntington No. 4 Mine were completed by archaeological teams employed by Utah Archaeological Research Corporation (UTARC) in Provo, Utah and consisted of two phases. The first phase was to conduct a literature search in order to compile all previously known and recorded cultural information for the project area.

5.2 Methodology (continued)

Phase II consisted of intensive archaeological field surveys of the entire project area. Reconnaissance of Beaver Creek Coal Company's Huntington Canyon No. 4 Mine was conducted during 1980 to assess the extent and nature of cultural resources. Additional reconnaissance surveys were conducted on the proposed emergency lease area in 1981 and 1982. Refer to Figure 5.1. This report includes the results of both phases of the archaeological investigations, plus conclusions regarding them.

5.3 Historical Resources

5.3.1 Historical Literature Review and Summary

The first documented exploration of the Castle Valley area began with the Dominguez-Escalante expedition of 1776. The purpose of the expedition was to explore a possible route from the Spanish settlements in New Mexico to Monterey on the California coast (Miller 1968). The expedition actually passed to the north of the Castle Valley area, but it served to open up the area to further Spanish exploration.

Subsequent Spanish expeditions into the area, and American fur trapping activities both served to eventually open up a main route between New Mexico and California. This route, known as the Old Spanish Trail, came through the San Juan Country, crossed the Colorado River at Moab, continued to the Green River crossing at the present town of Green River, extended through the San Rafael Desert into the Castle Valley, then crossed the Wasatch Plateau through Salina Canyon and continued through southern Utah, Nevada and into California. The main traffic on this route included numerous trading, trapping, Indian slave and horse trading expeditions (Miller 1968). The trail was in use almost yearly until

5.3.1 Historical Literature Review and Summary (continued)

after the Mexican War. After that, the trail received use from travelers, immigrants, mail carriers and army troops (Stokes and Cohenour 1956).

In 1853, Captain J. W. Gunnison of the Corps of Topographical Engineers traversed the length of Castle Valley. On October 11, Lieutenant E. C. Beckwith reported that coal had been found and brought to camp. At that time, the party was camped some three miles east of the present town of Emery. Several days after leaving Castle Valley, Captain Gunnison and several members of his party were killed by Indians (Stokes and Cohenour 1956).

In 1869 and again in 1871, Major John W. Powell led exploring expeditions down the Green and Colorado Rivers and in so doing opened up an area which until then had been virtually unknown to whites.

In 1873, Lieutenant R. L. Hoxie of the Corps of Engineers and his party mapped the topography and geology of eastern Utah including the Castle Valley area.

The first attempts to establish permanent settlements in the area were undertaken by the Mormon Church. In 1854, a party lead by William Huntington traveled through Castle Valley on their way to the San Juan River and Navajo country. On the basis of this report, the Elk Mountain Mountain Mission was sent out by Brigham Young in 1855 to establish a mission near the present town of Moab. Indian hostilities plus hardships forced the mission to be abandoned that same year (McElprang, 1959). During this period, there was some sheep and cattle grazing in the more favorable ridges and valleys of the Wasatch Plateau (Dilly, 1900).

5.3.1 Historical Literature Review and Summary (continued)

The first successful attempt at a permanent settlement in the area was by James McHadden and Leander Lemmon in 1875. They diverted water from Huntington Creek onto some land near the mouth of Huntington Canyon (Stoke and Cohenour, 1956). By 1877, word had reached the Mormon settlements to the west of good water and arable land along some of the creeks in Castle Valley. In September of that year, a priesthood meeting was held in Mount Pleasant in which 75 men from the Sanpete Stake were called to settle in Castle Valley. However, only a few men responded to the call. Another call was given in the fall of 1878 with a more favorable response. Orange Seeley was called to superintend the founding of the settlements. By the fall of 1878, the crops were sufficient for the families of the settlers to come into the valley. During this time, Ferron, Castle Dale, Huntington, Wilsonville, Lawrence, Molen and Orangeville were settled.

In 1880, the Utah Legislative Assembly created Emery County which included the present counties of Carbon, Grand and Emery. Price wasn't officially established until 1882 when a group of Mormon settlers on the Price River were organized into a ward. In 1883, the Rio Grande Railroad was built through Price and from that time on the settlement became the hub of the area. In 1894, the northern part of Emery County was made into Carbon County and Price was named the county seat (McElprang, 1949).

Even though coal had been reported by Gunnison in 1853, the coal industry in the area really didn't get going until 1875. In that year, the Fairview Coal Mining and Coke Company opened its operations at Connelsville in the upper part of Huntington Canyon. The coke was made there and shipped by wagon to Springville. However, the operation soon became unprofitable and, after three years, it was abandoned (Powell 1976).

5.3.1 Historical Literature Review and Summary (continued)

With the large Mormon settlements to the west growing, the need for coal naturally increased. In 1875, the Pleasant Valley Coal Company built a wagon road from Springville up Spanish Fork Canyon to the coal fields in the Pleasant Valley area. By 1877, a mine had been opened in Winter Quarters Canyon and the area began a rich coal production which continues today. To alleviate problems of transporting the coal over the sometimes impassable wagon road, the Pleasant Valley Railroad Company built a narrow gauge through Spanish Fork Canyon in 1879.

This new coal prosperity lured the Denver and Rio Grande Railroad into routing its new line through Price and Spanish Fork Canyon rather than following the originally proposed line through Castle Valley and Salina Canyon to the south (McElprang 1949).

In 1882, the D&RGW purchased the Pleasant Valley Railroad Company and the Pleasant Valley Coal Company. Threatened by the possibility of losings its hold on the Utah coal industry, the Union Pacific Railroad Company moved into Pleasant Valley in 1882 and formed the Utah Central Coal Company. Later, it opened the Union Pacific Mine near Scofield in 1884. During this period, the railroad companies almost totally dominated the Utah coal industry (Powell 1976).

In the late 1880's and 1890's coal mines began to open up in other parts of the area. In 1888, a mine was opened at Castle Gate near the mouth of Price Canyon. It was followed by the opening of two mines in 1899 at Sunnyside located 24 miles east of Price.

On May 1, 1900, tragedy struck the Utah coal industry. An explosion occurred in the Pleasant Valley Coal Company mine at Winter Quarters, killing some 300 men. The disaster left 800

5.3.1 Historical Literature Review and Summary (continued)

women and children in Scofield without support. Following the disaster, stricter mining regulations were enacted to avoid any such similar occurrence in Utah (Dilley 1900).

In 1906, the Independent Coal and Coke Company, the first non-railroad controlled mine in the area, was opened at Kenilworth, 3 miles east of Helper. Following this development, other private operators began to open mines. F. A. Sweet opened a mine on Miller Creek in 1908 and established the settlement of Hiawatha. A few miles south of this operation, Castle Valley Fuel Company opened a mine and founded the town of Wattis, located several miles north of Hiawatha.

The decade from 1910-1920 saw the development of many other coal production areas. One of the most significant took place in 1913 when Jesse Knight opened a mine and founded Storrs, thus opening the Spring Canyon District. Other mines and camps to open in the canyon were Standardville, Latuda, Peerless, Rains and Mutual. The Spring Canyon District became one of the major coal producing areas of Utah.

The other significant coal producing area to be opened during this time was in the vicinity of Gordon Creek. There had been some prospecting in 1908 but actual production did not begin until the early 1920's.

Companies active in the area were Consumers Mutual Coal Company, National Coal Company and Sweet Coal Company. Camps were built at all three locations and Coal City (Dempseyville) was laid out in 1921 to serve as a business and residential neighborhood for the mines located 2 miles away at National and

5.3.1 Historical Literature Review and Summary (continued)

Consumers (Carr 1972). Coal City lasted for only a few years and National and Consumers died out by the 1940's and 1950's. Coal mining operations continue in the area today.

Most of the coal mines were productive through the first three decades of the 20th Century but, with the coming of the depression and the increasing use of other fuels, coal production gradually decreased and many of the camps had to close down.

The downward trend of coal production continued through the 1940's and 1950's with a brief up-swing during World War II. During the 1950's, many operations had to shut down. With the increased demand for energy in the 1970's, there has been a stepped up pace in coal mining operations, a trend which appears to be promising for the 1980's.

5.3.2 Historical Field Survey

Field surveys of Beaver Creek Coal Company's Huntington Canyon property were carried out during 1980 and November 1981 by UTARC. Personnel involved in the 1980 surveys were Wayne Howell, Clayton Cook, Joel Despain, and Diana Christensen. Clayton Cook surveyed the 1981 area; that area was rewalked in Spring 1982.

Because of the extremely rugged terrain, it was not possible to systematically examine the area using evenly spaced parallel transects nor could straight lines be strictly maintained.

As a result, different methods were used depending upon the terrain being examined. The canyon bottoms in Mill Fork were carefully examined by spacing two surveyors 15-20 meters apart

5.3.2 Historical Field Survey (continued)

and sweeping up and down the canyon up to the base of the ledge. The relatively flat ridge tops were also examined by walking evenly spaced transects over the entire area. The steep slopes presented a special problem. Evenly spaced transects or even transects following the natural contours were entirely out of the question. Fortunately, several roads had been cut into the slopes in several different locations and levels within the property. Passes were made along these roads and, with binoculars, the areas above and below each road were examined for rockshelters or other visible archaeological sites. Areas where there were no roads were examined by hiking up and down prominent ridges and looking off to both sides with binoculars. In this way, work hazards were kept down and the entire area received what we feel to be adequate sampling.

Survey Results

Historic activity is based on different factors than that of archaeological activity. While pre-historic peoples were interested in hunting and gathering in the area, the thrust of historic interest was in another resource - coal. Different conditions are therefore placed upon historic exploitation in the area.

As stated earlier, coal mining operations began in the Wasatch coal fields in the 1870's and has continued until the present. Those areas with the best coal and easiest access were naturally opened first. Areas of more marginal productivity were developed as need and economics fluctuated. Mining operations in Mill Fork Canyon did not get going until 1943 when the Leamaster Mine was opened (Doelling 1972:193). This mine has been the main producer in the Huntington Canyon area over the years (Doelling, 1972:194). Re-

5.3.2 Historical Field Survey (continued)

Survey Results (continued)

mains of the early workings are still visible in places but these are not of sufficient age to constitute archaeological sites.

The field survey of the Huntington Canyon property recorded no historic archaeological sites. A search of the site files at the Utah Division of State History turned up no previously recorded sites in the project area. A check of the National Federal Register by the consultants showed no historical archaeological sites.

5.3.3 Effects of Mining on Historical Resources

Based on the field survey and Federal Register check Beaver Creek Coal Company's mining operations will not impact historical resources. In the event that cultural resources are discovered or are encountered during permitted operations, the consultants' recommendation concerning proper notification will be followed by Beaver Creek Coal Company.

5.4 Archaeological Resources

5.4.1 Archaeological Literature Review and Summary

Prehistoric human activity in the Castle Valley area can be divided into four phases: Paleo Indian, Archaic, Fremont and Numic.

Paleo Indian

The Paleo Indian phase is represented by a lifestyle geared toward the hunting of the now extinct Pleistocene mammals such as

5.4.1 Archaeological Literature Review and Summary (continued)

Paleo Indian (continued)

mammoth and giant bison (Bison antiquus). It dates from approximately 12,000 B.P. until 7000 B.P. and can be divided into three subphases: Llano, Folsom and Plano (Jennings, 1977).

The Llano culture dates from approximately 12,000 - 10,000 years ago and is characterized by the hunting of mammoths. Evidence for this culture is generally found in sites where these animals were killed and butchered, and bones along with hunting and butchering tools were left behind. Evidences for this subphase of the Paleo Indian culture in the Castle Valley area are scanty. One site, the Tripp site, yielded one Clovis point (Tripp, 1966). Other Clovis points have been reported from other parts of Utah (Lindsay, 1976, BLM files).

During the Folsom period (11,000 B.P. to 9000 B.P.), emphasis turned from the hunting of the rapidly diminishing mammoth to the Bison antiquus. A smaller and thinner point, known as the Folsom Point, came into use at this time. As in the case of the Llano culture, evidence for the Folsom culture comes from kill and butchering sites. These sites are found predominantly on the high plains east of the Rocky Mountains, although many sites are found outside that area.

In the Castle Valley area, only one site has been found which might date to this period. Site 42Em8, also known as the Silverhorn Site, was excavated by Gunnerson in the 1950's (Gunnerson, 1956). One point which is very similar to the Folsom point was found by a local collector in an arroyo cut. Other materials from the site are very similar to materials taken from other Folsom sites.

5.4.1 Archaeological Literature Review and Summary (continued)

Paleo Indian (continued)

Evidence for the Plano subphase (9000 B.P. to 7000 B.P.) is minimal in Utah. During this time, a great diversity of projectile points were manufactured and activity became restricted pretty much to an area east of the Rocky Mountains.

In summary, although there is very little evidence for Paleo Indian activity in the Castle Valley area, what evidence there is does show that this area was used by these early big game hunting peoples.

Archaic

Beginning about 8000 - 9000 years ago, the lifestyle of the aboriginal populations shifted from the hunting of big game animals to a dependence on smaller game animals and the gathering of wild plant foods. This period is known as the Archaic Phase and in the Castle Valley area can be divided into four subphases based on changes in both projectile point types and population densities (Schroedl, 1976).

The Black Knoll subphase lasted from approximately 8300 B.P. to 6200 B.P. and is characterized by two types of dart points, the Pinto and the Northern Side Notch (Schroedl, 1976). During this period, hunting was done with the atlatl (spear thrower) and the primary species utilized were deer and mountain sheep with some dependence on antelope and bison. A variety of wild plants and insects were also utilized. Caves and rockshelters were the main areas of occupation. Near the end of this phase, projectile points of the Elko series were introduced. Around 7200 B.P., there was an increase in population.

5.4.1 Archaeological Literature Review and Summary (continued)

Archaic (continued)

The Castle Valley subphase lasted from 6200 B.P. to 4500 B.P. Subsistence strategies and the use of caves and rockshelters were essentially the same as in the Black Knoll subphase. The main difference between the two subphases is a change in projectile point types. During the Castle Valley subphase, points such as the Rocker Base, Sudden Side Notch and Hawken Side Notch appeared. Toward the end of the Castle Valley subphase, the Humboldt point become the dominant point style.

The Green River subphase began about 4500 B.P. and lasted until about 3300 B.P. Subsistence strategies appear to have continued basically unchanged from the previous subphase. The Humboldt point continued in use through this period but other points, such as the Gypsum and San Rafael Side Notch, became popular. During this time, the northeastern part of the Colorado Plateau received influence from the Plains.

The last subphase of the Archaic, the Dirty Devil, lasted from approximately 3300 B.P. to 1500 B.P. Subsistence activities during the early part of this period were essentially unchanged from the previous periods but, between 1600 B.P. and 2000 B.P., evidences of corn horticulture began to apear (Winter, 1973; Hurst, 1948; Jennings, in press). The Gypsum point continued to be the dominant projectile point in use during this period but, toward the end of the Dirty Devil (1600 B.P. to 1500 B.P.), the bow and arrow came into use. The end of the Dirty Devil subphase marked the transition from an Archaic hunting and gathering lifeway to the beginnings of sedentary village life.

5.4.1 Archaeological Literature Review and Summary (continued)

Archaic (continued)

Archaeological evidence for the presence of Archaic peoples in the Castle Valley area is relatively abundant. For example, in Emery County, a total of 16 Archaic sites are known; one on the Wasatch Plateau, four from the San Rafael Area and the remaining eleven are from Castle Valley (Sargent, 1977). A total of four Archaic rockshelters have been excavated in and near the Castle Valley (Wylie, 1971; Lindsay and Lund, 1976; DeBloois, in preparation; Jenning, Schroedl and Homer, in preparation). From the information gathered at these sites, it appears there was a preference for upland hunting - lowland gathering during Archaic times, possibly reflecting a seasonal round (Jennings, 1975; Schroedl, 1976; Lindsay and Lund, 1976). Toward the end of this period, there was a gradual shift from seasonal hunting and gathering to the beginnings of corn horticulture and a more sedentary way of life.

Fremont

The Fremont culture dates from approximately 1800 B.P. to 650 B.P. and, in general, is characterized by the use of permanent habitations, ceramics and some dependence upon corn horticulture. The Fremont culture inhabited most of Utah north of the Colorado River and part of eastern Colorado. Traditionally, the Fremont have been divided into five regional variants: Parowan, Sevier, Great Salt Lake, Uintah, and San Rafael. Recently Madison and Lindsay (1977) have re-evaluated the information and proposed a three-fold division: the Sevier culture, located west of the Wasatch Plateau and dependent primarily upon marsh land environments for subsistence; the Fremont culture, located east of the Wasatch Plateau and north of the Colorado River, dependent upon corn horticulture and living in small permanent villages adjacent to

5.4.1 Archaeological Literature Review and Summary (continued)

Fremont (continued)

permanent streams; and the unnamed plains-derived culture located in northeastern Utah, dependent upon bison hunting and collecting of wild plants for subsistence and living in shallow pit-like structures.

The Castle Valley area lies entirely within the Fremont culture area. Fremont sites in the area are characterized by the presence of Emery Gray pottery, with some Uintah Gray in the north and Sevier Gray and Ivie Creek Black-on-white in the west. Snake Valley Gray and Anasazi trade wares are also present in the area.

Diagnostic projectile points include Rose Spring, Desert Side Notch and Bull Creek types with a continuation of the use of Elko series and Gypsum type dart points.

Villages tended to be small. Semi-subterranean and surface dwellings were built and both stones and adobe were utilized in their construction. These small villages were usually located on ridges or knolls near permanent streams where both water and rich soils were present. Caves and rockshelters were often utilized for storage and habitation.

Although no Fremont sites have been excavated in the immediate vicinity of the Huntington #4 Mine, there has been considerable work done on Fremont sites in other parts of the Castle Valley area. The main body of work has been done by the University of Utah with excavations at 42Em47 (Gunnerson, 1956), Windy Ridge Village, Crescent Ridge and Power Pole Knoll (Madsen, 1975), Innocents Ridge (Schroedl and Hogan, 1975), levels of Clyde's

5.4.1 Archaeological Literature Review and Summary (continued)

Fremont (continued)

Cavern (Wylie, 1971) and Pint-Size Shelter (Lindsay and Lund, 1976). The U.S. Forest Service also found Fremont remains in Joe's Valley Alcove (DeBloois, in preparation).

Numic

The Numic speaking peoples, commonly known as the Ute, Paiute, Southern Paiute, Shoshoni and Bannock, were the last aboriginal peoples to inhabit Utah prior to European contact. Although there is considerable debate as to their origins (Lamb, 1958; Taylor, 1959; Gunnerson, 1962; Madsen, 1975), the Numic speakers were definitely in the southwestern Great Basin by 650 B.P. (Madsen, 1975). Some sites indicate that the Numic and Fremont were inhabiting some areas contemporaneously (Madsen, 1975). They rapidly spread throughout the Great Basin and Colorado Plateau and, by the arrival of the Europeans in the 1700 - 1800's, they appear to have been occupying virtually all of Utah and Nevada and portions of surrounding states (Warner, 1976; Powell, 1875).

Archaeologically, we know very little about the Numic. All that remains of their occupation of the area are bits of pottery, arrowheads and, in unusual circumstances, fragments of basketry, clothing and other perishable materials. Their pottery is easily distinguished from other types in that it is crudely made using a paddle-and-anvil technique, is typically thick walled, has large temper particles, is poorly smoothed, is fired in an oxidizing atmosphere and occasionally has fingernail incised decoration (Eueler, 1964). The distinctive projectile point is the Desert Side Notch point.

5.4.1 Archaeological Literature Review and Summary (continued)

Numic (continued)

The Numic practiced an Archaic-type subsistence, depending upon the hunting and gathering of wild plants, animals and insects for survival. Groups tended to be loosely formed and usually consisted of no more than an extended family.

Large areas were needed for subsistence activities but these were very ill defined and different bands utilized portions of the same areas.

With the arrival of the Europeans, the Numic lifeway rapidly began to change. Traditional hunting and gathering grounds were cut off by white expansion. The various Numic bands were severely restricted in their movements and were eventually forced to change their lifeway. Today, the Numic speaking peoples are restricted to several reservations scattered throughout Utah, Nevada, Colorado, Idaho, and Arizona.

Unfortunately, not much evidence of Numic occupation of the Castle Valley area has been found. Sargent (1977) lists only two Numic sites which postdated 650 B.P. (Adovasio, 1971). Historical accounts say very little about Indians being present in the area at the time of white arrival (McElprang, 1949).

History of Archaeological Work

The first account of an archaeological site being reported in the Castle Valley area comes from the 1869 journal of Major John Wesley Powell. On his journey down the Green River, Powell noted the presence of some ruins, possibly in the vicinity of Chandler Creek (Dellenbaugh, 1926).

5.4.1 Archaeological Literature Review and Summary (continued)

History of Archaeological Work (continued)

The first expedition into the area for the purpose of doing archaeological work was in 1929 - 1930 by the Claflin-Emerson expedition and mention was made of several sites (Morss, 1931; Gunnerson, 1969).

In 1935, A. B. Reagan did a survey in the area and noted a pictograph panel (Reagan, 1935).

Range Creek to the north of Castle Valley was investigated by Leh in 1936 and several granaries were noted (Leh, 1936).

Work continued to be sporadic through the 1930's and 1940's. During the 1950's, however, interest was turned again to eastern Utah. In 1954, Morss made mention of the site from which the Piling Cave figurines came (Morss, 1954). In the 1950's, the University of Utah passed through the Castle Valley area as a part of the statewide archaeological survey. They surveyed on Range, Last Change, Ivie, Quitchupah, Muddy and Ferron Creeks and recorded 49 sites (Gunnerson, 1957). Since that time, the University of Utah has been extensively involved in the archaeology of the area.

Their work includes several surveys (see bibliography) and a number of excavations which constitute the main body of archaeological knowledge for the Archaic and Fremont of eastern Utah. The excavations include: the Silverhorn site, a possible Paleo-Indian site (Gunnerson, 1956); 42Em5, a Fremont structure (Gunnerson, 1957); Clyde's Cavern, a rockshelter in Emery County with nine strata ranging from Archaic through Numic (Wylie, 1971); three

5.4.1 Archaeological Literature Review and Summary (continued)

History of Archaeological Work (continued)

small Fremont villages - Windy Ridge, Crescent Ridge, and Power Pole Knoll (Madsen, 1975); Innocents Ridge, a Fremont village with five structures (Schroedl and Hogan, 1975); the Poplar Know site (Taylor, 1957); Snake Rock Village (Gunnerson, 1957; Aikens, 1967); the Old Woman site (Taylor, 1957); the Round Spring site (Gunnerson, 1957); the Fallen Woman, Old Road and Ivie Ridge sites (Wilson and Smith, 1976); and Sudden Shelter, an Archaic rockshelter (Jennings, Schroedl and Holmer, in preparation). The University of Utah also conducted excavations north of the project area in Nine Mile Canyon in 1936 (Gillin, 1955).

Other excavations in the area include Pint Size Shelter, an Archaic-Fremont site dug by the Utah State Division of History (Lindsay and Lund, 1976) and Joe's Valley Alcove, another Archaic-Fremont site dug by the U.S. Forest Service in 1974 (DeBloois, unpublished manuscript).

The decade of the 70's has brought about a marked increase in surveys as a result of cultural resource management. Institutions involved in the bulk of the work have been Brigham Young University (see bibliography), the Museum of Northern Arizona (Keller, 1975 a,b,c,d; 1976), Southern Utah State College (Dykman and Thompson, 1976) and agencies such as the Bureau of Land Management, the U.S. Forest Service and the Antiquities Section of the Division of State History. Since the expansion of cultural resource management, most of the work done in the last few years has been survey, with very little excavation taking place.

5.4.2 Archaeological Field Survey

Field surveys of Beaver Creek Coal Company's Huntington Canyon property were carried out during 1980 by UTARC. Personnel involved in the surveys were Wayne Howell, Clayton Cook, Joel Despain, and Diana Christensen. Additional survey work was completed in November, 1981 by Clayton Cook and that same area rewalked Spring 1982. In 1975, David Gilio of the U.S. Forest Service conducted a survey of Crandall Canyon for a proposed haul road.

Because of the extremely rugged terrain, it was not possible to systematically examine the area using evenly spaced parallel transects nor could straight lines be strictly maintained. As a result, different methods were used depending upon the terrain being examined. The canyon bottoms in Mill Fork were carefully examined by spacing two surveyors 15-20 meters apart and sweeping up and down the canyon up to the base of the ledge. The relatively flat ridge tops were also examined by walking evenly spaced transects over the entire area. The steep slopes presented a special problem. Evenly spaced transects or even transects following the natural contours were entirely out of the question. Fortunately, several roads had been cut into the slopes in several different locations and levels within the property. Passes were made along these roads and, with binoculars, the areas above and below each road were examined for rockshelters or other visible archaeological sites. Areas where there were no roads were examined by hiking up and down prominent ridges and looking off to both sides with binoculars. In this way, work hazards were kept down and the entire area received what we feel to be adequate sampling.

5.4.2 Archaeological Field Survey (continued)

The archaeological surveys of the Huntington Canyon property recorded no prehistoric archaeological sites. A search of the site files at the Utah Division of State History turned up no previously recorded sites in the project area.

The 1975 Gilio survey located one site, 42Em722. The site is situated on the northside of Crandall Canyon. In a report dated September 5, 1975, David Gilio recommended clearance but considered 42Em722 to be a significant site and recommended that it be fenced. The same recommendations were made by Wayne Howell, UTARC Archaeologist, from his survey of Crandall Canyon on June 26, 1980. Subsequently, the site has been fenced.

The lack of any prehistoric remains in the area can be explained by several factors. Although favorable conditions such as abundant water and game are definitely present on the Wasatch Plateau, human activity would have been kept to a minimum because of the extremely rugged terrain. Hauck (1979) in his Central Coal Project sampling study on the Wasatch Plateau stated, "Most sites recorded in the Wasatch Plateau region are found on either fairly level plateau surfaces or at the base of escarpments in moderately level canyons and valleys" (Hauck 1979: 255). The near total lack of any such topographical features in the project area would not favor the presence of any archaeological sites.

Another factor which does not favor prehistoric activity in the area is elevation. The only level area of any size in the area is located between 9400 - 9800 feet. Hauck states that the majority (60%) of sites in the Wasatch Plateau lie between 8000 - 9000 feet, while less than 10% lie between 9000 - 10,000 feet (Hauck, 1979:237).

5.4.2 Archaeological Field Survey (continued)

There are no actual or potential National Register properties located in the Huntington Canyon #4 Mine permit area. Therefore, no archaeological values will be disturbed in any way by Beaver Creek Coal Company's operations (see Figures 5.2 and 5.3.) letters of archaeological clearance from UTARC).

5.4.3 Effects of Mining on Archaeological Resources

A check of the National Federal Register by the consultants showed no prehistoric archaeological sites within the permit area. Therefore, Beaver Creek Coal Company's mining operations will not impact any archaeological resources.

In the event that cultural resources are discovered or are encountered during permitted operations, the consultants' recommendations concerning proper notifications will be followed by Beaver Creek Coal Company.

5.5 Paleontological Resources

During the 1980 field season, geologic investigations were performed by a Beaver Creek Coal Company geologist at the Huntington Canyon No. 4 Mine. At that time, the Blackhawk formation (coal bearing unit) was examined and no paleontologic materials were found. The Blackhawk formation is a non-marine formation, thus, unlikely to contain fossil remains.

Various literature references indicate that fossils of animal origin are likely to occur on the lease area in nearly all of the geologic units. However, with the exception of the dinosaur footprints found in the coal seams of the Blackhawk, no significant paleontologic specimens are known to be present.

FIGURE 5-1

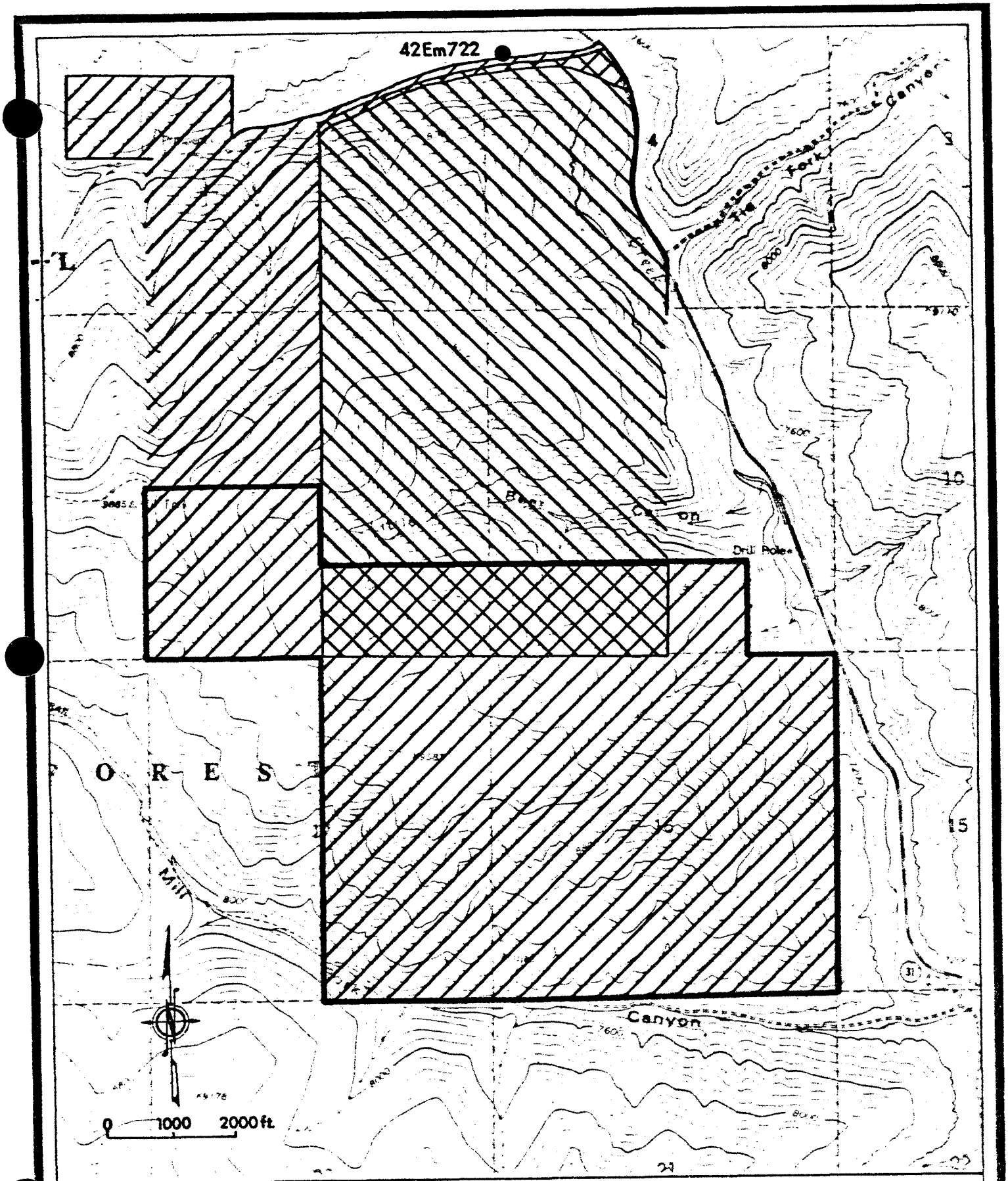


FIGURE Archeological Field surveys of the Huntington Canyon No. 4 Mine permit area.

Figure 5-2

UTAH ARCHAEOLOGICAL RESEARCH CORPORATION • 125 E. 300 S., SUITE 105 • PROVO, UTAH 84601 • (801) 375-7589

July 30, 1980

Mr. David R. Chenoweth
Associate Environmental Coordinator
ARCO Coal Company
555 Seventeenth Street
Denver, Colorado 80202

Dear Mr. Chenoweth:

Enclosed you will find the final report of the archaeological survey of the Huntington Canyon #4 mine property. Work was carried out under a contract between ARCO Coal Company and this firm. Field work was done between June 10 and July 1, 1980, and the final report was finished July 30, 1980.

As the final chapter of the report reveals, no historic or prehistoric archaeological sites are located within or near the project area.

Since no actual or potential National Register properties are located in or near the project area, and no archaeological values will be desturbed in anyway by ARCO Coal developments or activities in the area, I recommend complete archaeological clearance provided ARCO Coal Company agrees to;

1) Notify a qualified archaeologist should project boundaries be enlarged or should development activities extend outside the current project boundaries, and

2) Notify a qualified archaeologist should subsurface archaeological materials be uncovered during the course of the project.

Sincerely,

Wayne Howell

Wayne Howell, Archaeologist

Figure 5-3

UTAH ARCHAEOLOGICAL RESEARCH CORPORATION • 87 E. CENTER, SUITE 103 • SPANISH FORK, UTAH 84660 • (801) 798-7061
FIELD OFFICE: P.O. BOX 1147 • MONTICELLO, UTAH 84535

May 20, 1982

Mr. David Chenoweth
Aniconda Minerals
1860 Lincoln Street
P.O. Box 5300
Denver, Colorado 80217

Dear Mr. Chenoweth;

Utah Archaeological Research Corporation has conducted a Class I File Search and a Class II Pedestrian Survey of the Beaver Creek Coal Company Huntington Canyon No. 4 Mine Emergency Lease Tract located between Crandall Canyon and Little Bear Canyon in Township 16 South, Range 7 East, Section 9 W½, Section 8 E½, Section 5 SE¼, and Section 4 SW¼. The survey was conducted by Clayton W. Cook, UTARC Principal Investigator on November 19, 1981 with a subsequent visit on May 15, 1982. The study consisted of a stratified sampling of the area due to the steep terrain of the canyons. Areas of high potential such as along creeks, at the base of cliffs, and atop ridges, were checked intensively while steep mountain sides were randomly sampled. The work was conducted under Federal Antiquities Permit #81-Ut-181, Utah State Antiquities Permit #689, and Manti LaSal National Forest Special Use Permit dated March 1982.

Results of the survey showed that no cultural resources or National Register real or potential properties lie within the boundaries of the project. As a result clearance has been recommended to the Forest Service with no further work being required.

Sincerely,

Clayton W. Cook

Clayton W. Cook
Principal Investigator

CC/sc

5.6 Bibliography

Aikens, C. Melvin
1967 Excavations at Snake Rock Village and the Bear River No. 2 Site. University of Utah Anthropological Papers, No. 87, Salt Lake City.

Alexander, Thomas G.
1963 From Dearth to Deluge: Utah's Coal Industry; in Utah Historical Quarterly vo. 31 no. 3, pp. 235-248.

Aovasio, James M.
1971 Basketry from Clyde's Cavern. In Report of Excavation at Clyde's Cavern (42Em177), Emery County, Utah, Henry G. Wylie. Ms. on file, Department of Anthropology, University of Utah, Salt Lake City.

Beckwith, Lieut. E. G.
1855 Report of Explorations for a Route for the Pacific Railroad, by Captain J. S. Gunnison, Topographical Engineer, near the 38th and 29th Parallels of North Latitude. Reports of Explorations and Surveys, Vol. II. Washington.

*Berge, Dale L.
1973 An Archaeological Survey in the Castle Valley Area, Central Utah. Museum of Archaeology & Ethnology, Brigham Young University Press, Provo.
1974 An Archaeological Survey in the Castle Valley Area, Central Utah. Publications in Archaeology, Department of Anthropology and Archaeology, New Series No. 1, Brigham Young University Press, Provo.
1976a Cultural Resource Evaluation of the Cleark Creek Substation-Helper - Blackhawk 46 K.V. Transmission Line, Swisher Mine. Department of Archaeology and Anthropology, Brigham Young University, Provo. (Manuscript submitted to the Utah Power and Light Company).
1976b Archaeological Investigations Near Hanksville, Utah. Department of Archaeology and Anthropology, Brigham Young University, Provo. (Manuscript submitted to Central Explorations Company, Inc., Oklahoma City).
1977a Cultural Resource Evaluation of the Trail Mountain Coal Company Transmission Line; Department of Anthropology, Brigham Young University, Provo.
1977b Pictograph Site Evaluation Near Wellington, Carbon County, Utah; Department of Anthropology, Brigham Young University, Provo.
1977 Cultural Resource Evaluation of the Emery Substation-Dog Valley Mine Distribution Line; Department of Anthropoogy, Brigham Young University, Provo.

5.6 Bibliography (continued)

Berge, Dale L. and Michael Benson
1977 A Cultural Resource Evaluation of the Emery Plant to Emery City to Emery City Transmission Line; Department of Anthropology, Brigham Young University, Provo.

Berry, Michael S.
1975 Archaeological, Historical and Paleontological Survey for Consolidation Coal Company and Kemmerer Coal Company in Emery County, Utah; A Special Report, Division of State History, Salt Lake City.

Carr, Stephen L.
1972 The Historical Guide to Utah Ghost Towns; Western Epics, Salt Lake City.

DeBloois, Evan
n.d. Joe's Valley Alcove; (unpublished manuscript).

Dellenbaugh, Frederick S.
1926 A Canyon Voyage: The Narrative of the Second Powell Expedition Down the Green and Colorado Rivers from Wyoming and the Explorations on Land in the Years 1871 and 1872; New Haven.

Dilley, J. W.
n.d. History of the Scofield Mine Disaster; The Skelton Publishing Company, Provo.

Doelling, H. H.
1972 Central Utah Coal Fields: Sevier-Sanpete, Wasatch Plateau, Book Cliffs and Emery; Utah Geological and Mineralogical Survey, Monograph Series No. 3; Salt Lake City.

Durant, Stephen D.
1952 Mammals of Utah; University of Kansas Publications, Museum of Natural History, No. 6; Lawrence.

Dykman, James L. and Richard A. Thompson
1976 The Dog Valley Strip Mine Survey; A Special Report; Southern Utah State College; Cedar City.

Euler, Robert C.
1964 Southern Paiute Archaeology; American Antiquity, Vol. 29, No. 3, pp. 379-381; Salt Lake City.

5.6 Bibliography (continued)

Gillin, John
1955 Archaeological Investigations in Nine Mile Canyon, Utah; A Republication, University of Utah Press, Salt Lake City.

Gillio, David A.
1975a Archaeological Survey of Crandall Canyon Mine Road; Ms. on file, Antiquities Section, Utah State Historical Society, Salt Lake City.
1975b Archaeological Survey of North Dragon Limestone Mine; Ms. on file, Antiquities Section, Utah State Historical Society, Salt Lake City.
1975c Archaeological Survey of Lowry Water Bridge Site; Ms. on file, Antiquities Section, Utah State Historical Society, Salt Lake City.
1975d Archaeological Survey of Trail Mountain Timber Sale; Ms. on file, Antiquities Section, Utah State Historical Society, Salt Lake City.

Gunnerson, James W.
1956 A Fluted Point Site in Utah; American Antiquity, vol. 21, No. 4, Salt Lake City.
1957 An Archaeological Survey of the Fremont Area; University of Utah Anthropological Papers, No. 28, Salt Lake City.
1962 Unusual Artifacts from Castle Valley, Central Utah; Miscellaneous Collected Papers, University of Utah Anthropological Papers, No. 60, Salt Lake City.
1969 The Fremont Culture: A Study in Culture Dynamics on the Northern Anasazi Frontier; Papers of the Peabody Museum of Archaeology and Ethnology, Vol. 59, No. 2, Cambridge.

*Hauck, F. R.
n.d. Archaeological Reconnaissance in the Paradise Lake Locality of Sevier County, Utah; Papers of AERC, No. 7, Salt Lake City.
1975 An Archaeological Report on the Lost Creek Chaining Project; Papers of AERC, No. 1, Salt Lake City.
1976a Archaeological Reconnaissance in the Dog Valley Locality, Emery County, Utah; Papers of AERC, No. 3, Salt Lake City.
1976b An Archaeological Survey of the Banning Railroad Siding Locality in Carbon County, Utah; Ms. on file at AERC, Salt Lake City.
1977a Archaeological Reconnaissance in the Nine Mile Canyon Locality of Carbon County, Utah; Papers of AERC, No. 6, Salt Lake City.
1977b Archaeological Clearance of Support Facilities and Right-of-Way at the Wilberg Mine on Grimes Creek in Emery County, Utah; Ms. on file at AERC, Salt Lake City.

5.6 Bibliography (continued)

1977c An Archaeological Survey of Access Roads and a Mine Service Area in the Ferron Creek Locality of Emery County, Utah; Ms. on file at AERC, Salt Lake City.

1979 Cultural Resource Evaluation in Central Utah 1977; Bureau of Land Management, Cultural Resource Series No. 3, Salt Lake City.

Helm, Claudia

1973 Preliminary Report of an Archaeological Survey in Eastern Utah; Department of Anthropology, University of Utah, Salt Lake City, Utah.

1974 Preliminary Report of an Archaeological Survey in Sevier, Emery and Garfield Counties; Department of Anthropology, University of Utah, Salt Lake City.

Jennings, J. D.

1975 Prehistory of North America; Second Edition, McGraw-Hill, Inc.,New York.

Jennings, Jesse D., Alan R. Schroedl and Richard N. Holmer

n.d. Sudden Shelter; University of Utah Anthropological Papers, Salt Lake City (in preparation).

Keller, Donald R.

1975 Final Report for Tennessee Valley Authority Drill Hole Survey, April 30, 1975: A Special Report, Museum of Northern Arizona, Flagstaff (various addendums).

Lamb, Sydney M.

1958 Linguistic Prehistory in the Great Basin: Intermountain Journal of American Linguistics, Vol. 24.

Leh, L. L.

1936 Prehistoric Pueblo Ruins in Range Creek Canyon, Utah. University of Colorado Studies, Vol. 23, No. 2.

Lindsay, LaMar W. and Christime K. Lund

1976 Pint Size Shelter, Antiquities Section Selected Papers, Vol. III, No. 19, Division of State History, Salt Lake City.

Louthan, Druce D. and Dale L. Berge

1975 "Archaeological Survey of the Huntingston-Sigurd Transmission Line on Bureau of Land Management Lands." Department of Archeology and Anthropology, Brigham Young University. (Manuscript submitted to the Utah Power and Light Company).

5.6 Bibliography (continued)

Lupton, C. T.
1916 Geology and Coal Resources of Castle Valley, U.S.Geological Survey Bulletin 628, Washington.

Madsen, David B.
1975a Dating Paiute - Shoshoni Expansion in the Great Basin. American Antiquity, Vol. 40, No. 1, Washington, D.C.

Powell, Allan Kent
1973 "Tragedy at Scofield"; In Utah Historical Quarterly, Vol. 41, No. 2, Utah State Historical Society, Salt Lake City.

1976 A History of Labor Union Activity in the Eastern Utah Coal Fields; 1900 - 1934. University of Utah, Salt Lake City.

Powell, John Wesley
1875 Explorations of the Colorado River of the West and its Tributaries. Explored in 1869, 1870, 1871 and 1872, Under the Direction of the Secretary of the Smithsonian Institution. Government Printing Office. Washington.

Reagan, Albert B.
1935 An Archaeological Trip to Buck Horn Draw - Indians Worshipping the Sun. Utah Academy of Sciences, Arts and Letters, Vol. VII, Salt Lake City.

Reynolds, Thursey, J. et al
1948 Centennial Echoes From Carbon County. Daughters of the Utah Pioneers of Carbon County, Salt Lake City.

Sargent, Kay
1977 Emery County: An Archaeological Summary." Division of State History, Salt Lake City.

Schneider, Hyrum
1935 "Geologic Processes and their Relation to Human Activities in Utah;" in Proceedings of the Utah Academy of Sciences, Arts and Letters, Vol. XII, Provo.

Schroedl, Alan R.
1976 "The Archaic of the Northern Colorado Plateau." Unpublished Dissertation, Department of Anthropology, University of Utah, Salt Lake City.
1975 Innocents Ridge and the San Rafael Fremont. Antiquities Section Selected Papers, Vol. I, No. 2. Salt Lake City.

5.6 Bibliography (continued)

Spieker, Edmund M.
1949 The Transition Between the Colorado Plateaus and the Great Basin in Central Utah. Guidehood to the Geology of Utah, No. 4. Salt Lake City.

Stokes, William L. and Robert E. Cohenour
1956 Geologic Atlas of Utah (Emery County). Utah Geological and Mineralogical Survey Bulletin, No. 52, Salt Lake City.

Taylor, Dee Calderwook
1957 Two Fremont Sites and Their Position in Southwestern Prehistory. University of Utah Anthropolical Papers, No. 29, Salt Lake City.

Tripp, George
1966 A Clovis Point from Central Utah. American Antiquity, Vol. 27, No. 3.

Walker, J. Terry
1977 "Archaeological Investigations on Trough Springs Ridge and Near the Huntington Canyon - Electric Lake Dam." Department of Anthropology and Archaeology, Brigham Young University, Provo. (Manuscript on file).

Warner, Ted S.
1976 The Dominguez - Escalante Journal: Their Expedition through Colorado, Utah, Arizona and New Mexico in 1776; Brigham Young University Press, Provo.

Wilson, Curtis J. and Howard L. Smith
1976 Interstate Highway I-70 Salvage Archaeology, Antiquities Section Selected Papers, Vol. II, No. 7, Division of State History, Salt Lake City.

Wylie, Henry G.
1971 Report of excavations at Clyde's Cavern (42Em177), Emery County, Utah. A Special Report, Department of Anthropology, University of Utah, Salt Lake City.

*These authors and/or institutions have too many small cultural resource reports to include them in the bibliography. All are on file at the Antiquities Section, Division of State History, Salt Lake City, Utah.

Section 6

GEOLOGY

6.1 Scope

Geologic information for the Huntington Canyon No. 4 Mine area has been assembled to address requirements set forth in UMC 783.13 and 783.14.

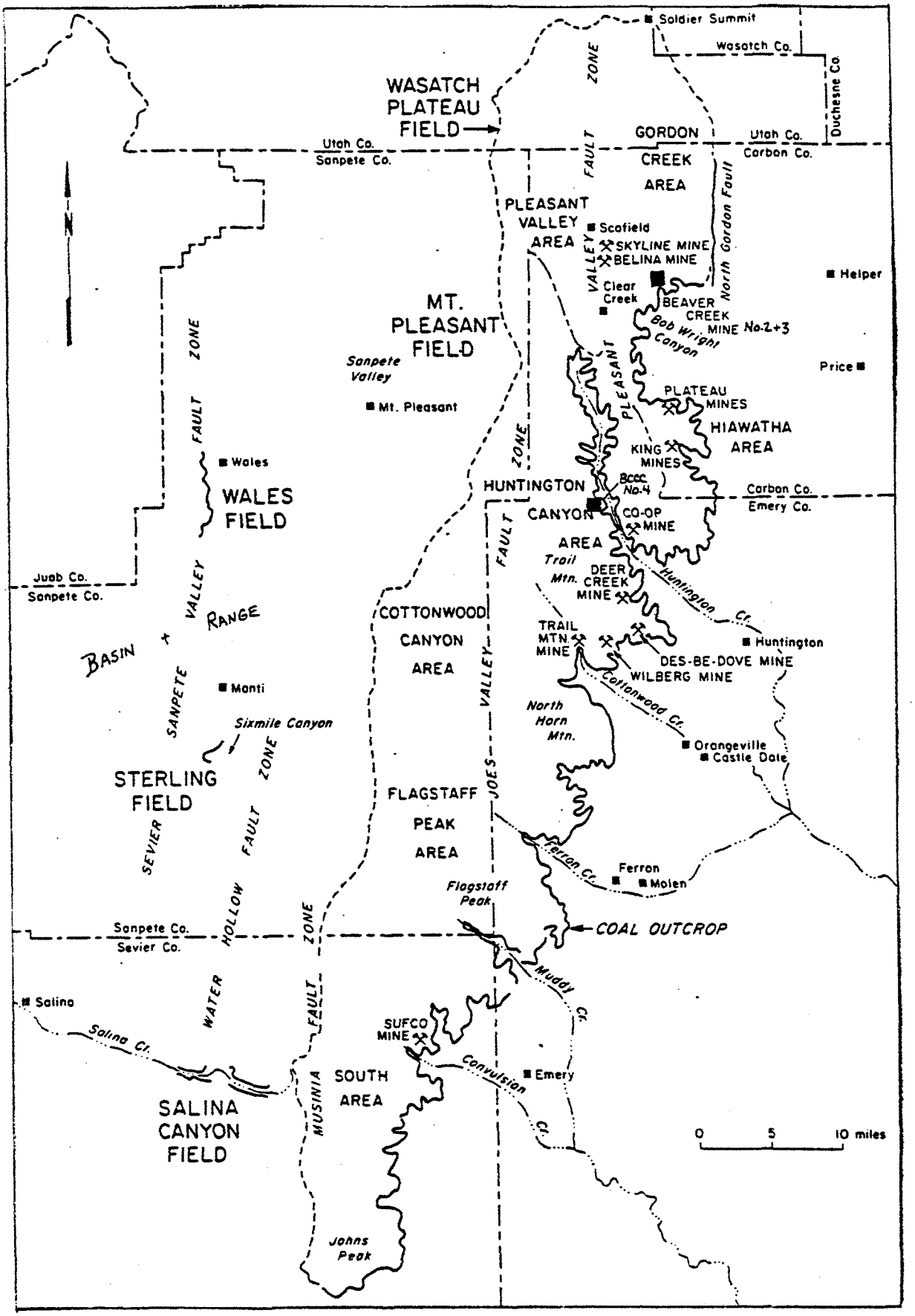
6.2 Methodology

This study includes information from the 1981 Mining and Reclamation Permit for the Huntington Canyon No. 4 Mine, a hydrogeologic report by Hydroscience, Inc. and in-house and published data. Additional information has been generated as a result of 1981 exploration and development drilling, aerial photography reconnaissance, in-mine mapping, and surface seismic activity.

6.3 Regional Geologic Framework

The Huntington Canyon No. 4 Mine is located along the eastern edge of the Wasatch Plateau, which is the transition zone between the complex Basin and Range Province to the west and the geologically simpler Colorado Plateau to the east (Figure 6-1). The eastern boundary of the Plateau is defined by conspicious, generally east-facing sandstone cliffs of the Mesaverde Group (Hayes and others, 1977). The area is dissected by steep, relatively narrow canyons, such as Crandall Canyon north of the mine, and Mill Fork Canyon along the south boundary of the lease area.

FIGURE 6-1



Location of Huntington Canyon No. 4 Mine

6.4 Geology of Project Vicinity

6.4.1 Stratigraphy

The rocks of the Wasatch Plateau are comprised of Tertiary and Cretaceous aged sedimentary units. These rocks are of both continental and marine origin and are comprised principally of shale and sandstone. Siltstone, mudstone and limestone also occur but in lesser amounts. The Cretaceous aged sediments contain most of the economically significant coal beds in the Wasatch Plateau.

The Huntington Canyon No. 4 Mine is located in the Wasatch Plateau Coal Field. The stratigraphy is composed of the Cretaceous aged Mancos Shale and Mesaverde groups and the Tertiary aged Wasatch group. Table 6-1 is a generalized stratigraphic section for the Central and Southern part of the Wasatch Plateau.

In the vicinity of the No. 4 Mine, the oldest rock exposed is the Masuk Shale member of the Mancos Shale and the youngest rock present is the North Horn Formation of the Wasatch group. The geology of the No. 4 Mine area is shown in map form on Plate 6-1 and in a geologic cross section on Plate 6-2.

A. Cretaceous Aged Rocks

1. Mancos Shale

Masuk Shale

The Masuk Shale, which is the uppermost unit of the Mancos Shale is a light gray to blue gray, sandy marine shale. It ranges from 300 to 1300 feet in thickness. In

TABLE 6-1

GENERALIZED STRATIGRAPHIC SECTION
FOR THE
CENTRAL AND SOUTHERN PART
OF THE
WASATCH PLATEAU

(AFTER DOELLING, 1972 MONOGRAPH SERIES)

System	Stratigraphic Unit		Thickness (feet)	Description
Tertiary	WASATCH GROUP	North Horn Formation	500 - 2,500	Variegated shales with subordinate sandstone, conglomerate and fresh-water limestone, slope former; sandstone and limestone units may supply limited quantities of ground water.
Cretaceous	MESA VERDE GROUP	Price River Formation	600 - 1,000	Gray to white gritty sandstone interbedded with subordinate shale and conglomerate, ledge and slope former, little potential for ground water.
		Castlegate Sandstone (Unconformity)	150 - 500	White to gray, coarse-grained often conglomeratic sandstone, cliff former, weathers to shades of brown, good aquifer material, ground water not present if outcrops occur nearby.
		Blackhawk Formation MAJOR COAL SEAMS	700 - 1,000	Yellow to gray, fine-to-medium-grained sandstone, interbedded with subordinate gray and carbonaceous shale, several thick coal seams; perched ground water may occur in sandstone units, springs and seeps common.
		Star Point Sandstone	90 - 1,000	Yellow-gray massive cliff-forming sandstone, often in several tongues separated by Masuk Shale; ground water present, but generally a poor aquifer.
	MANCOS SHALE	Masuk Shale	300 - 1,300	Yellow to blue-gray sandy shale, slope former.
		Emery Sandstone COAL	50 - 800	Yellow-gray friable sandstone tongue, cliff former. Coal present in subsurface; major regional aquifer.
		Blue Gate Member	1,500- 2,400	Pale blue-gray, nodular and irregularly bedded marine mudstone and siltstone with several arenaceous beds, weathers into low rolling hills and badlands.
		Ferron Sandstone Member MAJOR COAL SEAMS	50 - 950	Alternating yellow-gray sandstone, sandy shale and gray shale with important coal beds of Emergy coal field, resistant cliff former; major regional aquifer.
		Tununk Shale Member	400 - 650	Blue-gray to black sandy marine shale slope forming mudstor

6.4.1 Stratigraphy (continued)

Masuk Shale (continued)

outcrop, the shale forms generally steep slopes almost devoid of vegetation.

In the vicinity of the lease area, the Masuk Shale is exposed in the bottoms of Mill Fork and Crandall Canyons, and along Huntington Creek.

2. Mesaverde Group

Star Point Sandstone

The Star Point Sandstone, which conformably overlies the Masuk Shale, is the basal formation of the Mesaverde Group. This unit consists of several tan to light gray, massive sandstone units separated by shale tongues (Davis and Doelling, 1977). It ranges from about 200 to 1,000 feet in thickness. It is the lowest cliff forming unit on the east side of the Wasatch Plateau.

In the vicinity of the No. 4 Mine, the Star Point Sandstone is between 250 and 400 feet thick and consists of three major sandstone units separated by interbedded shale, siltstone, and sandstone sequences. In outcrop, this unit is easily recognizable by its pronounced massive bedding and whitish appearance.

6.4.1 Stratigraphy (continued)

Blackhawk Formation

The Blackhawk Formation is the principal coal-bearing unit of the Mesaverde Group. It conformably overlies the Star Point Sandstone. The boundary between these two units is sharp, marked by the massive sandstone below and a more easily erodable thin-bedded shaley sandstone above. The formation is divided into three units:

A lower sandstone unit composed of friable quartzitic sandstone that is massive to thin-bedded with pronounced large thin cross bedding;

A middle unit comprised of massive cliff-forming sandstone, coal beds, medium gray, calcareous and carbonaceous shale; and

An upper gray shale unit.

In the vicinity of the No. 4 Mine, the Blackhawk Formation is approximately 800 feet thick. The principal coal seams, the Hiawatha and the Blind Canyon seams, occur near the base of the formation.

Castlegate Sandstone

The Castlegate Sandstone overlies the Blackhawk Formation. It forms the uppermost cliffs over much of the eastern side of the Wasatch Plateau. The unit consists of fluvial sandstones, conglomerates and a few thin beds of gray sandy shale (Davis and Doelling, 1977).

6.4.1 Stratigraphy (continued)

Castlegate Sandstone (continued)

The sandstone is chiefly medium to coarse grained and massive. It ranges in color from white to tan to yellow-brown. In outcrop the cliffs take on a light gray hue. The sandstone is generally coarser-grained than either those of the sandstones of overlying or underlying formations.

In the lease area of the No. 4 Mine, the Castlegate is approximately 240 feet thick. It forms a prominent, conspicious cliff throughout the area near the tops of most slopes.

Price River Formation

The Price River Formation is the uppermost unit of the Mesaverde group. Lithologically, it is mostly sandstone with a few interbedded pebble conglomerates and gray shales. In outcrop it forms steep, receding slopes.

In the vicinity of the No. 4 Mine, the Price River may exceed 500 feet in thickness. It is the surface bedrock over most of the lease area. It is easily recognized in the outcrop by its stratigraphic position and the abrupt change in slope above the Castlegate Sandstone.

6.4.1 Stratigraphy (continued)

B. Tertiary Aged Rocks

1. Wasatch Group

North Horn Formation

The North Horn Formation of Tertiary Age, is comprised of interbedded limestone, siltstone, sandstone and shale (Spieker, 1931). It conformably overlies the Price River Formation. The limestone is hard, dense and generally sandy or silty and is either gray or tan. The sandstone is generally fine grained, crossbedded, dense and is grayish in color (Cordova, 1964). The North Horn Formation forms steep to gentle slopes and produces a hummocky surface (Davis and Doelling, 1977). It has a reported thickness that can exceed 1,000 feet. Its top and bottom boundaries, however, are arbitrary because its contacts are gradational with the underlying Price River and overlying Flagstaff Formations.

The North Horn occurs within the No. 4 lease area as a relatively thin cap at the top of the ridge between Mill Fork and Little Bear Canyons. It generally is less than 40 feet thick, and on the basis of aerial photograph interpretation, is predominantly a shaley unit. In outcrop, when viewed at a distance, it exhibits a pink to salmon color.

6.4.1 Stratigraphy (continued)

C. Unconsolidated Deposits

Unconsolidated deposits of silt and fine-grained sand, alluvial sediments and talus debris occur along valley bottoms and sides and at the base of steep slopes (Davis and Doelling, 1977). The thickness of these sediments is variable. In general, the larger or wider the valley, the thicker the alluvial deposits.

In the lease area, these Quaternary deposits are principally restricted to the major drainages, such as Mill Fork, Little Bear and Crandall Canyons and along Huntington Creek. The thickness of these deposits is variable but it it unlikely that they exceed 20 feet.

6.4.2 Structure

The strata of the Wasatch Plateau generally dip gently in a westerly direction. Superimposed over the region are numerous synclines, anticlines and fault zones (Figure 6-2). The anticline and syncline axes have a predominant east-west orientation (Davis and Doelling, 1977) and the fault zones have a predominant north-south orientation.

The Huntington No. 4 Mine is located between the east-west trending axes of the Flat Canyon Anticline and the Crandall Canyon Syncline. Other minor flexures do occur between these axes. The Huntington No. 4 Mine is located within a horst between the Joes Valley Fault Zone to the west and the Pleasant Valley Fault Zone to the east. A synclinal axis parallels the drainage at Little Bear Canyon. The predominant dip is less than 5 degrees to the east.

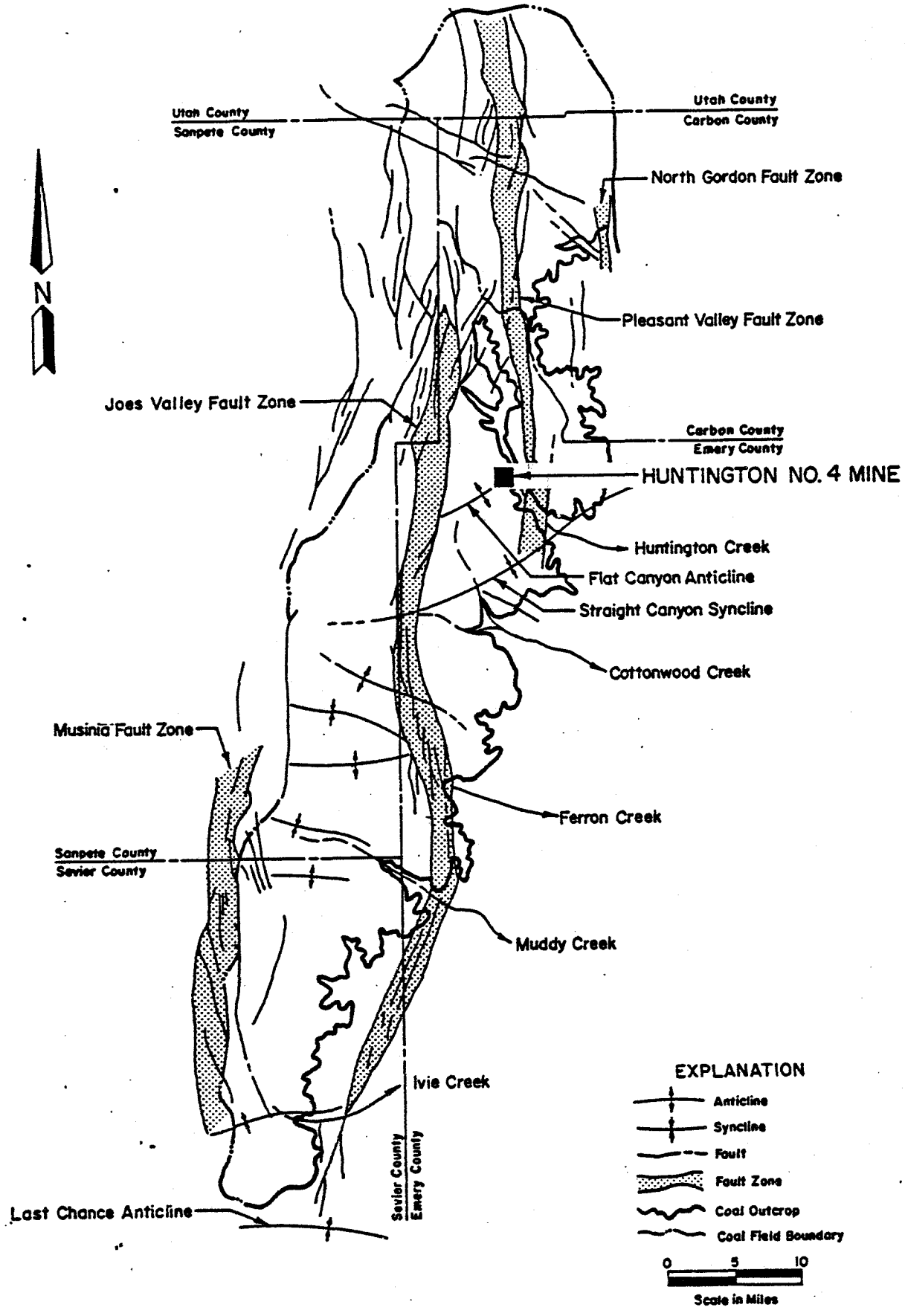


Figure 6-2. Principal structural features in the Wasatch Plateau.

6.4.2 Structure (continued)

Faults

Beaver Creek Coal Company has encountered two northeast trending faults with displacement of less than 30 feet. Three other faults of similar magnitude and trend have been interpreted ahead of present mining. Plate 6-1 shows the location of the faults. The most earterly fault has been encountered in the mine and the locations of this known fault as well as the probable and inferred faults have been verified using aerial photographs, field reconnaissance, drill data and/or seismic data.

Joints

There is an array of jointing patterns existent on the lease tract. The most dominant is parallel to the trend of the faulting (N40-48E). A second jointing pattern is dominant in the massive sand units of the Star Point Sandstone and within the roof of the mine workings (NS-N4E). These two dominant trends could be related to the occurrence of springs in the area. Other less common trends that occur on the lease include: EW, N58-77E and N38-40W. Joints are well developed in the massive sand units of the Star Point Sandstone but they become obscured within intervening shale units and within the overlying Blackhawk Formation. Oxidation of the coal seams often occur along the N4E joint trend in the mine workings.

6.5 Geology of the Coal Beds and Adjacent Units

6.5.1 Exploration and Drilling

Plate 6-1 shows the locations of all surface drill holes on the No. 4 Mine property.

6.5.1.1 Casing and Sealing

Table 6-2 is a list of all in-mine and surface drill holes on the Huntington No. 4 Mine lease. In addition, type, location, total depth, casing and completion records are tabulated. A map showing surface drill hole locations is found in Plate 6-1.

Permit approvals for additional drilling are being pursued. Since specific approvals will be necessary for this drilling, complete plans for casing, sealing, and otherwise managing these new holes will be presented to the regulatory authority at that time.

6.5.2 Stratigraphy

The commerical coal beds on the tract occur in the Blackhawk Formation.

6.5.2.1 Hiawatha Seam

The lower coal is the Hiawatha seam. It lies directly above the Star Point Sandstone. This contact is the boundary between the Blackhawk Formation and the Star Point Sandstone.

From core hole data it appears that the Hiawatha seam usually is overlain by a sandstone unit, but in places the immediate roof is shale.

Plate 6-3 is an isopach map of the Hiawatha seam, which averages 5.2 feet in thickness.

Rock slopes have been driven down to the Hiawatha seam from existing works. In the past, the seam was prospected in Mill Fork Canyon in conjunction with the Leamaster Mine.

Table 6-2

TYPE, LOCATION, TOTAL DEPTH, CASING AND COMPLETION RECORD
FOR ALL DRILL HOLES ON THE HUNTINGTON NO. 4 MINE LEASE

Hole Designation	Type	Section Location	Total Depth	Casing	Completion
MC-4-1	In-mine	NW16	151	0-120	Cased hole
MC-4-2	In-mine	SE16	105	None	Cement 0-105
MC-4-3	In-mine	SW9	76	None	Cement 0-76
MC-4-4	In-mine	NW16	90	None	Cement 0-90
MC-4-5	In-mine	NW16	105	None	Cement 0-105
MC-4-6	In-mine	NW16	112	None	Cement 0-112
MC-4-7	In-mine	NW16	110	None	Cement 0-110
MC-4-8	In-mine	NW16	95	None	Cement 0-95
HC-4	Surface	NW8	1562	0-1393	Cement 1340-1562, surface plug
HCD-1	Surface	SW8	1730	0-1407	Cement 1407-1730, surface plug
HCD-2	Surface	NE17	1815	0-1575	Cement 1525-1815, surface plug
DH-1	Surface	SE16	417	*	*
DH-2	Surface	NE16	438	*	*
DH-2A (redrill)	Surface	NE16	303	*	*
DH-3	Surface	SE16	319	*	*
DH-4	Surface	NE16	288	*	*
DH-6	Surface	SE16	599	*	*
DH-7	Surface	SE16	713	*	*
DH-8	Surface	SW16	672	*	*
DH-9	Surface	SE17	437	*	*
DH-9A (redrill)	Surface	SE17	650	*	*
DH-10	Surface	SE17	693	0-30'	*
DH-12	Surface	NW16	1623	0-15'	*
DH-2-76A	Surface	SW8	1805	*	*

Table 6-2 (Continued)

*The designated DH series were drilled during 1974-1976 and casing and completion information were not recorded (except where noted). Upon reinspection of the old drill sites in 1981, the holes that were located appeared to have been covered or naturally plugged; no open core holes were noted. Core sizes were of the NX type (approximately 2 inches in diameter), originally leaving a very small surface hole. Water was not recorded as encountered during drilling; therefore, no sealing or other casing measures were employed to prevent water pollution.

Table 6-2 (continued)

*The DH series of drillholes were drilled from 1974-1976, and casing and completion information were not recorded, except where noted. Due to the small size of the holes (NX or 2" diameter cores) and the fact that no groundwater was encountered during drilling, no sealing or casing measures were employed to prevent water pollution.

Upon re-inspection of these old drill sites in 1981, the sites that were located had been covered or naturally plugged. Since these holes can no longer be located, it would be impossible to re-plug them. There appears to be little or no possibility of water pollution or communication of aquifers in the holes due to the absence of groundwater in the area, and little or no possibility of entering the holes from the surface, since they are naturally plugged.

6.5.2.2 Blind Canyon Seam

The upper mineable coal seam is the Blind Canyon seam. Currently it is being mined at the No. 4 Mine and was mined at three other smaller mines. These were the Skeen Mine, the Helco Mine and one of the Leamaster Mines. The present workings are accessed through the old Leamaster Mine.

The Blind Canyon seam lies approximately 40 to 110 feet above the Hiawatha seam. The interburden between these two coals is composed of interbedded sandstones, shales and an occasional thin, lenticular coal. The Blind Canyon usually overlies a thick shale unit and in turn is overlain by a massive sandstone which is composed of a number of stacked sandstone channels. Only locally is the Blind Canyon overlain by anything other than sandstone; in those places the roof tends to be slickenside, carbonaceous shales.

The No. 4 Mine workings have encountered five "coal wants" which were areas where the coal had been partially eroded by a paleo-channel and had been replaced by a sandstone channel fill. Maximum widths of the channels are approximately 600 feet, with less than 5 feet of coal height under the channel. Mining in the Skeen Mine was stopped when the workings encountered another area where the coal seam had been eroded and replaced in the same manner. As mining continues in the No. 4 Mine more of these erosion features probably will be encountered.

The thickness of the Blind Canyon seam ranges from over 13 feet to the southeast to 5.0 - 6.0 feet to the northwest with local occurrences of thinner coal. Plate 6-4 is an isopach of the Blind Canyon seam. In an area in the northwest, the Blind Canyon appears to split into three thin seams. The upper splits could possibly represent the Upper and Lower Bear Canyon seams.

6.5.3 Structure

The regional and site specific structure have been discussed in Section 6.4.2 and the structure of the individual coal seams reflects the same trends. Plate 6-5 and 6-6 are structure maps for the Blind Canyon and Hiawatha Seams, respectively. In general, the Blind Canyon seam dips gently to the southeast at less than 5 degrees and the Hiawatha seam shows a similar orientation.

The interburden of the seam, which averages 90 feet in thickness, thins in the central portion of the Huntington No. 4 Mine at Little Bear Canyon to a minimum of 40 feet.

6.5.4 Detailed Columns of Interest and Cross Sections

Plate 6-7 is a north-south statigraphic cross section through the No. 4 Mine area. Plate 6-8 illustrates the stratigraphy of the Starpoint Sandstone and seams of interest in Mill Fork and Little Bear Canyon. Plate 6-8 also shows the apparent stratigraphic location of Little Bear Spring.

6.5.5 Coal Reserves

6.5.5.1 Reserve Calculations

Table 6-3 is a list of the in-place, mineable in-place, and run-of-mine recoverable coal reserves for the Huntington Canyon No. 4 Mine Lease Block.

6.5.5.2 Coal Quality and Characteristics, Sulfur Forms, Clay and Alkalinity

Table 6-4 lists the run-of-mine quality for the Blind Canyon seam and the predicted run-of-mine quality for the Hiawatha seam.

Table 6-3

COAL RESERVES FOR THE HUNTINGTON CANYON

No. 4 MINE PROPERTY (MMT)

Seam	In-Place	Mineable In-Place	Run-of-Mine Recoverable	
BLIND CANYON				
Fed. Lease U-33454	4.01	0.92	0.41	
Fed. Lease U-064903	1.99	0.46	0.21	(45%)
Other Leases	7.90	1.82	0.82	
TOTAL	13.90	3.20	1.44	
HIAWATHA				
Fed. Lease U-33454	6.29	2.10	1.05	
Fed. Lease U-064903	1.20	0.40	0.20	(50%)
Other Leases	6.91	2.30	1.15	
TOTAL	14.40	4.80	2.40	

Table 6-4

COAL QUALITY FOR THE HUNTINGTON CANYON NO. 4 MINE LEASE BLOCK

Seam	Moisture (%)	Ash (%)	Sulfur (%)	BTU's	Fixed Carbon	Volatiles
Blind Canyon, Run-of-Mine	6.0	10.0	0.8	12,000	46.1	40.3
Hiawatha, Predicted Run-of-Mine	7.0	9.0	0.6	11,800	48.5	40.6

6.5.5.2 Coal Quality and Characteristics, Sulfur Forms, Clay and Alkalinity (continued)

Table 6-5 lists the sulfur forms (as received basis) and alkalies as Na_2O (dry coal basis) for the Blind Canyon and Hiawatha seams.

Presently in the mine workings, there are no significant partings which could attribute a high clay content in the seam.

6.5.6 Adjacent Units

The overburden and underburden for both the Blind Canyon and the Hiawatha seams has been discussed in Section 6.5.2.

6.5.6.1 Rock Characteristics, Acid-Toxic, Pyrite, Clay, and Alkalinity

Table 6-6 shows the analyses of several samples taken from the immediate overburden and underburden of mineable seams. The analyses include acid/base potential, alkalinity ($CaCO_3$ equivalent), pyritic sulfur and total sulfur. The underburden samples were analyzed for their sand, silt, and clay content. Based on these analyses, no inherent toxic material should be generated as a result of mining the seams. Refer to Plates 6-3 (Blind Canyon Seam) and 6-4 (Hiawatha Seam) for sampling locations.

6.6 Geologic Effects of Mining

6.6.1 Mining Hazards

The types of mining hazards which have been encountered at the No. 4 Mine are typical of those found in the other mines of the Wasatch Plateau. There probably have been fewer roof related problems because in most areas in the mine the roof has been a very massive and solid sandstone. Methane has never been

Table 6-5

SULFUR FORMS FOR THE BLIND CANYON SEAM,
HUNTINGTON CANYON NO. 4 MINE LEASE BLOCK

Seam	Pyrite (%)	Sulfate (%)	Organic (%)	Alkalies as Na_2O
Blind Canyon	0.05 - 0.15	0.0	0.45 - 0.74	0.21 - 0.36
Hiawatha	0.02 - 0.08	0.0 - 0.08	0.26 - 0.56	0.12 - 0.58

Table 6-6

OVERBURDEN AND UNDERBURDEN CHEMICAL CHARACTERISTICS

	Blind Canyon					Hiawatha Seam	
	Location 1 Overburden	Location 2 Overburden	Location 3 Overburden	Location 4 Underburden	Location 5 Underburden	Overburden Location 1	Overburden Location 1
Acid/base potential ± tons of $CaCO_3$ equiv./1000 tons of material	509	210	11	4.6	7.8	480	5.5
Alkalinity $CaCO_3$ equiv.	51	21	1.4	1.4	0.9	48	0.8
Pyritic sulfur	0.03	0.01	0.09	0.30	0.04	0.01	0.08
Total sulfur	0.04	0.01	0.21	0.50	0.12	0.01	0.16
Sand	-	-	56	63	70	-	65
Silt	-	-	29	20	18	-	25
Clay	-	-	15	17	12	-	10

6.6.1 Mining Hazards (continued)

detected in the No. 4 Mine. The maximum overburden thickness is about 1,600 feet which is not excessive; therefore, explosive rock bursts and "rib rolls" have not occurred and are not expected to occur.

6.6.2 Surface Hazards

Slumps occur naturally within the Huntington drainage and only one minor zone occurs on the lease tract. This natural occurring slump is located at the head of Little Bear Canyon. In addition, it is located approximately 0.5 miles northwest of the mine workings.

6.6.3 Impacts of Mining

There will be no geologic affects other than the possible disturbance of the groundwater and surface subsidence. These potential problems have been fully discussed in Section 3.4.8 and Section 7.