BRAZTAH CORPORATION
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LOS ANGELES, CALIFORNIA [illegible]

July 25, 1979

Board of Oil, Gas and Mining
Department of Natural Resources
State of Utah
1588 West North Temple
Salt Lake City, Utah 84116

RECEIVED
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STATE OF UTAH
Division of Oil, Gas & Mining

Gentlemen:

Re: In the Matter of the Modification of Braztah Corporation Mine Plan For Braztah Mine No. 5, Carbon County, Utah

Cause No. ACT/007/004

As part of Braztah Corporation's ("Braztah") continuing effort to comply with applicable laws, rules and regulations in the conduct of its underground coal mining and reclamation operations in Carbon County, Utah, Braztah, within the next two weeks, will file its Underground Mining and Reclamation Permit Application ("Permit Application") with the Utah Division of Oil, Gas and Mining. Said Permit Application will be filed pursuant to the Cooperative Agreement by and between the State of Utah and the United States Department of Interior and the permanent regulatory program under the Utah Statute Regulating Coal Mining and Reclamation Operations (UCA (1957) §40-10-1 et seq.), the Surface Mining Control and Reclamation Act of 1977 and the regulations promulgated thereunder.

The underground mining and reclamation operations contemplated under the Permit Application are currently being conducted by Braztah, as operator, pursuant to its Mine Plan U-058184 et al, approved by the United States Geological Survey ("USGS") in April 1977.

As a part of the approved Mine Plan, Braztah contemplated, among other things, to construct an intake air shaft in Sowbelly Canyon to ventilate the existing Mine No. 5. Although the details and specific location of the air shaft were not known at the time of the original Mine Plan approval, the shaft concept was included in the Mine Plan and related drawings.

The design details and specific locations of said intake air shaft has been determined and Braztah therefore respectfully requests that the Board of Oil, Gas and Mining ("the Board") grant permission to construct the subject intake air shaft.

To assist the Board in its consideration of Braztah's request, transmitted herewith are nine (9) copies of a report outlining the proposed modifications at the Mine No. 5 Area. The report has in large part been abstracted from Braztah's aforementioned Permit Application. In addition, Braztah personnel and consultants will present testimony and respond to questions of the Board and/or staff at the hearing of the Board on Friday, July 27, 1979, at 9:00 a.m..

It is submitted that the intake air shaft in Sowbelly Canyon was contemplated when approval of the Mine Plan was granted by the USGS in April 1977. As a result, the action of the Board requested hereby is at most the approval of a minor modification to that approved Mine Plan now that design details and specific location have been determined.

The ventilation requirements of the No. 5 Mine dictate prompt construction of the intake air shaft thereby insuring the health and safety of the mine and the Braztah work force located thereat. As a result, we respectfully request your prompt consideration of our proposed shaft construction permitting the orderly and timely development of the mine while making the "coal resource" derived therefrom available to help meet our nation's "energy crisis".

Thank you for your consideration,

Respectfully submitted,

BRAZTAH CORPORATION

Howard J. Bressler

HJB/rsh

Howard J. Bressler
Vice President and
Assistant General Counsel

ACT / 007 / 004

WEIRCO

PAUL WEIR COMPANY —— MINING ENGINEERS —— CHICAGO

REQUEST FOR MODIFICATION
TO THE PRESENT MINING PLAN
FOR NO. 3 MINE
PRICE RIVER COAL COMPANY
CARBON COUNTY, UTAH

ACT/007/004

RECEIVED
SEP 17 1980
GAS & MINING

Paul Weir Company
Chicago, Illinois

Job No. 2654-C
August 29, 1980

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REQUEST FOR MODIFICATION TO THE PRESENT MINING PLAN FOR NO. 3 MINE PRICE RIVER COAL COMPANY CARBON COUNTY, UTAH

I. INTRODUCTION

Price River Coal Company (PRCC) proposes, as part of their overall mine plan (submitted to and approved by the U.S. Geological Survey in 1976), to construct two mine shafts in Crandall Canyon, together with certain buildings and facilities, all of which are described herein. In the original mine plan, the shaft location was generally stated. This document is a formal request to modify the mining plan by including a site-specific location and a precise and complete description of the facilities to be constructed, including construction procedures to be followed.

The mine shafts and associated facilities are required to permit the diligent development of the No. 3 Mine and the attainment of optimum levels of production from this mine. Primarily, the shafts are required to provide a much needed improvement in mine ventilation and to reduce the underground transportation time for men and materials.

The shafts are centrally located in the remaining minable reserves assigned to the No. 3 Mine. The proposed new mine ventilation fan system to be installed at the No. 1 Shaft will enable operation of twice the present complement of mine equipment in the mine, and the proposed hoisting system will reduce underground haulage distances for men and materials by up to 3 miles. The complete surface facilities are designed, as far as possible, to be accommodated within the canyon floor area and will require a minimum relocation of the existing stream channel now running through the area. The affected surface area will be approximately 12 acres. Following completion of the Crandall Canyon facility, operations in Hardscrabble Canyon (Mines No. 3 and No. 4) and Sowbelly Gulch (Mine No. 5) will be phased out, and the affected surface areas reclaimed. This process will require approximately 3 years following completion of the Crandall Canyon facility to accomplish, and will ultimately result in a net reduction of surface acreage actively affected of some 30 acres.

Exhibits I through VI illustrate the facilities to be installed in Crandall Canyon and are supported by the following explanatory text on the proposed construction program, including a description of the procedures that will be followed to minimize the impact of the construction program and of the completed facility on the present local environment.

The following facilities will be constructed in Crandall Canyon:

1. Two mine shafts.
2. Access road from Highway 6 (approximately 1.5 miles).
3. Water line and gas line (1.5 miles).
4. Mine ventilation fans and associated air heaters.
5. Men and materials hoisting system.
6. Bathhouse and office building (to accommodate a total work force of approximately 630 employees).
7. Car parking facilities adjoining the bathhouse.
8. Mechanical sewage treatment plant.
9. A workshop-warehouse building for the mine.
10. Adjoining materials storage yard.
11. Stream retaining wall, etc.
12. Electric power substation and power line.

Sed ponds

II. SITE PREPARATION

The following steps will be taken prior to shaft or other construction in Crandall Canyon:

The entire construction area, as shown on Exhibit III-A, will be cleared and grubbed; that is, all vegetative matter will be removed from the construction area, transported to and disposed of in a designated and permitted landfill. No organic materials removed during site preparation will be buried on the site.

Clearing and grubbing of the area extending from the proposed sewage treatment plant westward (and upstream) through to the workshop-warehouse area will begin as early as possible. Clearing and grubbing to accommodate access road construction will proceed in stages and in advance of the road work.

Removal of all vegetative matter allows for quick erosion of soils. Immediately upon completion of grubbing and clearing, removal of the topsoil to a storage area will commence.

The topsoils in the construction area are very thin; therefore, a 6" layer that includes the "A" horizon and the unconsolidated materials immediately below it shall be removed and stored on a how much stable segregated area above the warehouse-shop area.

The topsoil storage pile shall be protected by seeding or planting during the first normal period after removal of nonnoxious quick-growing annual and perennial plants.

Immediately after topsoil removal, erosion controls will be implemented on the disturbed surfaces by constructing a diversion ditch about the extremities of the disturbed area. These diversion ditches will be constructed in such a manner as to have berms facing the nondisturbed areas and collecting ditches allowing only drainage from the disturbed areas to be collected.

The diversion ditches will follow the general downhill gradient to a point where they will discharge into sediment retention water erosion control ponds. (See Exhibit III-A-Site Preparation.)

The diversions and the sedimentation-retention ponds will be designed as required to handle the flows created by the runoff to insure compliance with the performance standards and to retain as required the materials carried by the runoff.

To accommodate the shaft construction and buildings to be installed in the narrow canyon floor area, it is necessary through the area between shafts to relocate the stream channel to the north, against the rock face of the nearly vertical canyon wall, and west of the intake shaft to relocate the stream channel to the south against the toe of the south canyon wall.

Stream channel relocation work will be carried out during the dry season. The gradient of the floor of the stream channel will be maintained as at present. The cross section of the stream channel through the entire length of the construction area will be capable of accommodating the peak runoff from a "one-hundred-year storm." (See Appendix 4 for calculations.)

Stream channel relocation will begin as part of site preparation. Permanent structures to contain the relocated stream channel will be constructed as soon as practicable thereafter.

At the upstream end of the flood channel, the stream will be widened to accept or funnel the flow from the upper slopes of the canyon. The slopes of the new channel will be riprapped as required, or in specific sections, the channel will be contained between the natural canyon wall stone facade and a concrete retaining wall.

Exhibit III-A-Preliminary Site Preparation Plot Plan denotes four major areas with cut or excavation requirements, namely, Areas A, B and C. Areas A and B will be cut to final grade and compacted. Area C, the intake shaft and bathhouse office area, will be cut to final grade and the cut material used to raise the immediately adjacent "fill area" to final grade.

III. ACCESS ROAD INCLUDING HIGHWAY INTERSECTION

An access road to Crandall Canyon exists in the form of a jeep trail. This must and will be improved to a Class II road per existing regulations.[1/] The new access road will function as a right-of-way from the Utah State Route 6 to the shaft site permitting vehicular access for personnel and materials. The road is not intended to be a coal-haul road. To facilitate safe access between the proposed Crandall Canyon road and Utah State Route 6 at the mouth of Crandall Canyon, a new intersection will be constructed to Utah Department of Transportation specifications.

The proposed new (or improved) access road to be constructed through the canyon will follow the general routing of the present trail. While adhering to the specifications for a Class II road, the road design will attempt to ensure the minimum amount of cut-and-fill and/or stream channel modification.

In general, the hard-surface roadway will be 24' wide with 8' berms on each side. At the edge of the berms on the hillside, drainage ditches with crossroad culvert pipes will be constructed. A buried utility corridor will exist within one or both berms.

1/ The Federal regulations addressing roads (S817.150 - 817.176, inclusive) have been recinded pursuant to court order. For the purposes of this project, however, the design criteria specified in said regulations have been met.

All cuts, fills, channel relocations and culvert-receiving and outfall areas will be seeded, riprapped or otherwise treated as required to prevent environmental contamination from erosion.

The completed new access road will cross the stream channel in three locations. In these locations, sufficient bridging will be placed to permit the flow of the peak runoff from a "one-hundred-year storm." (See Appendix 4 for calculations.)

The bridges as well as the access road will be designed to carry required H20-S16 loading.

IV. WATER LINE AND GAS LINE

Culinary water for bathing, etc. will be obtained from the Price River Water Board at the mouth of Crandall Canyon and will be piped to a holding tank located in the bathhouse office building area. The pipeline will be adequately sized, located and buried in the berm alongside the access road at sufficient depth to avoid freezing.

A natural gas pipeline (3" diameter) will be installed by the gas company (Mountain States Fuel Co.) through Crandall Canyon to a metering point adjacent to the bathhouse office building. The natural gas distribution system and all devices and equipment consuming natural gas will be equipped with all necessary safety and monitoring devices and audible and visual alarm signals required to ensure their safe operation and compliance with State and Federal regulations regarding their use.

V. SHAFT EXCAVATION AND THE DISPOSAL OF EXCAVATED MATERIALS

Two shafts are to be constructed in Crandall Canyon:

1. A 26' finished-diameter, concrete-lined intake air and materials hoisting shaft, approximately 1,450' deep;

2. A 20' finished-diameter, concrete-lined return airshaft, approximately 1,400' feep.

In each shaft, shaft stations will be constructed at the shaft intersection with each of three minable coal seams, the D, A and Sub 3.

Any aquifers intersected by the shafts will be either grouted off or contained and collected in shaft water rings for later use in the mine. Hydrologic studies lead us to believe that water inflow in the shafts will be minimal and is not expected to alter the ecological balance. The excavated materials removed from the shafts will be three types: (1) nontoxic alluvial deposits encountered in the first 50' or so; (2) nontoxic consolidated sandstones and shales; and (3) coal-bearing materials. All coal-bearing materials will be separated from the main portion of the excavated materials and then transported to the existing preparation plant where they will be processed.

The noncoal-bearing materials will be spread in even layers and compacted as fill beneath the bathhouse-office building, the parking lot, the access road at the intake shaft area, and exhaust shaft-sewage plant site.

During the entire period of shaft construction and disposal of the excavated material from the shafts, the diversion ditches and the sedimentation ponds will be maintained as required to prevent erosion loss to the Crandall Canyon stream channel.

Upon completion of the shaft construction and the fill process, the final grade, minus hard-surfacing and required dressing, will have been reached. (See Exhibit IV-A-Final Surface Plot Plan.)

VI. SURFACE FACILITIES

(a) Workshop-Warehouse Building and Storage Area

A workshop-warehouse building will be constructed at the upper end of the site. The building will contain office, storage, sanitary and maintenance facilities required to support the personnel working within.

An external unloading ramp permitting tailgate unloading of large tractor-trailer combination will be built to the rear of the building.

Oils and other petrochemicals will be used and stored on the site in a designated area. No petrochemical or related products will be disposed of on-site.

All sanitary effluents will be piped directly to the sewage treatment facility located at the lower end of the main construction area.

The parking lot-storage area about the workshop-warehouse building will be covered with crushed stone and hard-surfaced as required to support the loads handled. All surface runoff from the hard-surfaced area will be channeled through a sediment trap before being discharged to the stream channel.

Cuts and fills made in construction of the site that have not been hard-surfaced or built upon will be seeded or riprapped as required to avoid the erosion processes.

(b) Access Road to the Workshop-Warehouse

The access road to the workshop-warehouse area will be designed, as will the bridge it crosses, to H20-S16 loading. The utility corridor containing natural gas, potable water and sewage lines will be located in the berms of the access road.

The runoff from the access road will be channeled through a sediment trap before being discharged to the stream.

(c) Incoming Electrical Power Line and Substation

Electrical power required by the facilities will be obtained by constructing an overhead power line from Hardscrabble Canyon over the ridge on the south side of the intake shaft to a substation located approximately 200' from the shaft. The path of the power line will be cleared only of tall trees and only as required. There will be minimal disturbance to soil and low growing vegetation as a result of this construction.

The substation will be of the oil-cooled type and will be erected on a crushed stone raised bench surronded by protective fencing.

Immediately to the south behind the substation, a culvert with wing-walls and trash rock will receive the runoff from the undisturbed area further to the south. The culvert will carry runoff northward underground through the center of the main site and will discharge into the improved stream channel. The inlet and outlet of the culvert will be riprapped as required to prevent erosion.

Clean-outs and manholes are stationed periodically along the pipe's length. None of these will permit runoff from the disturbed area to enter the water flow.

(d) Men and Materials Hoisting System

As shown in Exhibit I, a mine hoisting system will be installed at and over the main intake airshaft. The hoist will be a fully automated ground-mounted (multirope) friction-type hoist with a large cage and counterweight in balance. The hoist system will be used to raise and lower men, materials and mine equipment to any of the three mine levels.

Because of the proposed "blowing" system of mine ventilation to be employed, access to and from the cage at the shaft collar (surface) elevation will be through the airlock enclosing the headframe as shown in Exhibit I.

(e) Mine Ventilation System

A complete mine ventilation fan and air heating system, that will supply the No. 3 Mine with the required total ventilating air requirements, will be installed at the intake airshaft. Exhibit I shows the general arrangement of these facilities.

The mine fans, operating as a blowing system, will be mounted in parallel and will be capable of providing the mine with up to 1,200,000 cubic feet per minute of air at up to 12" water gauge pressure.

Mine air heating is required to prevent shaft icing. Air entering the shaft will be maintained above 32°F at all times by an indirect, natural gas-fired heating system located on the intake side of the mine fans. Exhaust gases from the natural gas heaters will be exhausted through ducting which prohibits their entering the mine.

One supply fan will have an emergency diesel-drive system that actuates upon power loss to the fan electrical system. This emergency system will be completely automatic, starting and stopping upon loss or reestablishment of electric power from the main power source. The diesel system will be capable of providing 600,000 cubic feet of air per minute to the mine.

All automated systems dealing with the hoist, fans and heaters will have audible and visual warning devices indicating failures or disruptions of service.

(f) Bathhouse-Office Building

The bathhouse-office building, that will serve the entire mine work force, will be constructed immediately adjoining and east of the intake airshaft. Exhibit VI illustrates the conceptual configuration of this building and the facilities to be provided therein.

(g) Finished Surfaces in Shaft Area

The areas around the intake shaft and associated buildings will be hard-surfaced to facilitate movement of materials and equipment into and from the shaft through the airlock door systems on north and/or south sides of the shaft, and also to maintain ready access to either the hoist or mine ventilation systems.

Surfaces in the disturbed areas, which are not hard-surfaced, will be riprapped or seeded with required ground cover to prevent erosion. Runoff from all of the disturbed areas will be collected and channeled through a sediment trap before entering the stream.

(h) Parking Lot

To the east of the bathhouse-office building, a parking area will be constructed. The compacted and graded fill from the shafts will be topped with crushed stone and later with hard-surfacing. Surfaces of the parking area not hard-surfaced will be riprapped or seeded with required ground covers to prevent erosion. All runoff from the parking area will be channeled through sediment traps before entering the stream.

(i) Exhaust Shaft

The exhaust shaft will be located on a lower bench east of the parking lot. An access ramp will connect the exhaust shaft surface area with the parking lot.

The concrete collar of the exhaust shaft will protrude 3' above the finished surface elevation surrounding the shaft. A safety fence will surround the shaft.

(j) Sewage Facility

An extended aeration sewage treatment plant, sized on the basis of applicable State of Utah Department of Health Standards, will be installed to treat the sanitary wastes generated at the bathhouse-

office and workshop-warehouse buildings. The plant will be installed immediately east of the exhaust shaft. The treated plant effluent (secondary treatment equivalent) will be discharged to the ground through an approved leachbed. The effluent will pass through a fine mesh screen prior to entering the leachbed to preclude the possibility of solids carryover from plugging the leachbed. A chlorine disinfection system will be installed if required by the Department of Health. The plant and related system will be installed and operated in full compliance with requirements of the Utah Department of Health and, as applicable, the U.S. Environmental Protection Agency.

VII. ENVIRONMENTAL STUDIES

During the process of gathering the required data for the Underground Mining and Reclamation Plan, several volumes of data were compiled. Volume II deals entirely with environmental resource data gathered for the overall mine plan area and several site-specific locations. One of these locations was Crandall Canyon.

The following list is of the material addressed in Volume II dealing with Crandall Canyon and the General Mine Plan Area:

1. General Environmental Resources - addressing:

   Cultural and historical resources.

   Site-specific archaeology surveys.

2. Geology

   a. General geology within the mine plan area.

   b. Cross sections and related drill logs.

   c. Coal formations.

   d. Chemical and mechanical tests on floor and roof rock and refuse.

   e. Properties of overburden.

3. Ground Water Hydrology

   a. Potential of formation ground water.

   b. Site-specific monitoring stations, chemical analysis and flows.

   c. Specific aquifers.

4. Surface Water Hydrology

   a. Site-specific monitoring stations.

   b. Monitoring program, data collection, chemical analysis and flow.

5. Alternative Water Supply Information

   a. Price River direct flow rights.

   b. Scofield Reservoir rights.

   c. Mining, springs and other sources.

   d. Price River Water Improvement District.

6. Climatological Data

   a. Precipitation.

   b. Temperature.

   c. Air patterns.

   d. Sedimentation, diversion, drainage, other hydraulic structures.

   e. Peak flows.

   f. Channel designs.

   g. Storm runoff.

   h. Culvert design.

7. Vegetation Data

   a. Plant associations.

   b. Wildlife support.

   c. Revegetation, seeding mixtures.

8. Fish and Wildlife Resource Information

   a. Site-specific baseline inventory.

   b. Wildlife management plan.

9. Soil Resources

   a. Crandall Canyon soil survey study.

   b. Willow Creek Canyon soil survey study.

   c. Castle Gate Preparation Plant area soil survey study.

   d. Sowbelly Canyon soil survey study.

   e. Hardscrabble Canyon soil survey study.

   f. Potential and present production.

10. Land Use Information

   a. Existing land use.

   b. Land capability and productivity.

   c. Site-specific land use and capabilities.

11. Prime Farmland Investigation

   Conclusion and determination.

In the time since Volume II has been published, further Crandall Canyon site-specific environmental studies have been performed. These are:

1. Soil Survey

   a. Toxicity and types of soils.

   b. Strata and formation.

2. Archaeological Study

   a. Complete canyon.

   b. Power line construction path.

3. Raptor Study

   Canyon and power line path.

4. Peak Flow Study

   a. 100-year MPP storm runoff.

   b. Channel flows and designs.

   c. Culvert placement and designs.

   d. Diversion and sedimentation ponds.

Respectfully submitted,

PAUL WEIR COMPANY

By: _____
for William A. Smith

By: _____
John C. Weir

DATED: August 29, 1980.

APPENDIXES

APPENDIX 1

Crandall Canyon Soil Survey Study
by Horrocks & Carollo Engineers
dated July, 1979
Excerpts from "Soil Survey Study
for Helper, Utah Coal Property"

SOIL SURVEY STUDY

FOR

HELPER, UTAH COAL PROPERTY

INTRODUCTION

This Soil Survey Study has been made as required by the Surface Coal Mining and Reclamation Operations Program, March 1979. The new regulations require that a soil survey of permit areas be made.

Thirteen backhoe pits were dug in five designated areas. The location of the pits is shown on Figure 1. The soils in Crandall Canyon and on the mountainsides surrounding the study areas were in their normal conditions--hence could be described as soils. The other areas consisting of mostly fill material are classified as a miscellaneous land type or made land.

CRANDALL CANYON

Pits 1, 2, and 3 were taken in Crandall Canyon. A proposed mine shaft is to be located in this area. The soils are a mixture of two kinds. Pits 1 and 3 are Kornman (like) being in a coarse-loamy, mixed, mesic family of Ustic Torrefluvents. The other soil is similar except that it has about 35 percent coarse fragments (by volume), mainly boulders, throughout the profile. This soil is in a loamy-skeletal, mixed, calcareous, mesic family of Ustic Torrefluvents.

These soils are only moderately errosive and are designated as K1. Soils in this area should be compatible with locating a mine shaft.

Descriptions of the soils in the three (3) pits follows:

Pit 1. Lower part of the shaft site in Crandall Canyon area (Figure 2). Vegetation is grasses with some big sagebrush. The soil is formed in alluvium derived from mixed sedimentary rocks, mainly sandstone, shale and limestone. The soil is well drained, has no appreciable amount of soluble salt but has occasional boulders on the surface.

Soil Profile:

A1 horizon, 0 to 4 inches - light brownish gray (10 YR 6/2) loam having about 20 percent clay, dark grayish brown (10 YR 4/2) when moist; moderate medium platy structure; soft, friable, slightly sticky, slightly plastic; moderate effervescence with acid, mildly alkaline (pH 7.5); abrupt smooth lower boundary. No coarse fragments other than occasional boulders.

C1 horizon, 4 to 9 inches - light brownish gray (10 YR 6/2) gravelly fine sand, having about 5 percent clay, dark grayish brown (10 YR 4/2) when moist; single grain, loose, nonsticky, nonplastic; moderate effervescence with acid; mildly alkaline (pH 7.5); abrupt smooth lower boundary. Soil has about 20 percent gravel.

C2 horizon, 9 to 27 inches - light brownish gray (10 YR 6/2) sandy loam having about 110 percent clay, dark grayish brown (10 YR 4/2) when moist; massive; soft, very friable, slightly sticky, nonplastic; strong effervescence with acid; mildly alkaline (pH 7.5); abrupt smooth lower boundary. Soil has no coarse fragments.

C3 horizon, 27 to 35 inches - light brownish gray (10 YR 6/2) clay loam having about 29 percent clay, dark grayish brown (10 YR 4/2) when

moist; massive; hard, firm, sticky and plastic; strong effervescence; mildly alkaline (pH 7.5); clear smooth lower boundary. No coarse fragments.

C4 horizon, 35 to 37 inches - light brownish gray (10 YR 6/2) sandy loam having about 9 percent clay, dark grayish brown (10 YR 4/2) when moist; massive; soft, very friable, slightly sticky, nonplastic; strong effervescence; mildly alkaline (pH 7.5); abrupt smooth lower boundary. No coarse fragments.

C5 horizon, 37 to 40 inches - light brownish gray (10 YR 6/2) gravelly loamy sand having about 5 percent clay, dark grayish brown (10 YR 4/2) when moist; single grain; loose, nonsticky, nonplastic; strong effervescence; abrupt smooth lower boundary. Soil has about 20 percent coarse fragments.

C6 horizon, 40 to 50 inches - light brownish gray (10 YR 6/2) loamy sand having about 5 percent clay, dark grayish brown (10 YR 4/2) when moist; massive, loose, nonsticky, nonplastic; strong effervescence; abrupt smooth lower boundary. No coarse fragments.

A1b horizon, 50 to 53 inches - very dark gray (2.5 Y 3/1) loam, having about 25 percent clay, black (2.5 Y 2/1) when moist; massive; slightly hard, friable, slightly sticky, slightly plastic; strong effervescence; abrupt smooth lower boundary. No coarse fragments.

C7b horizon, 53 to 58 inches - light brownish gray (10 YR 6/2) sand having about 5 percent clay, dark grayish brown (10 YR 4/2) when moist; single grain; loose, nonsticky, nonplastic; violent effercescence; abrupt smooth lower boundary. No coarse fragments.

IIA1b horizon, 58 to 67 inches - very dark gray (2.5 Y 3/1) loam having about 25 percent clay, black (2.5 Y 2/1) when moist; massive, soft, friable, slightly sticky, slightly plastic, moderate effervescence.

Pit 2. Upper end of the propsed shaft site in Crandall Canyon (Figure 2). Native vegetation is big sagebrush, cottonwood, yellowbrush and grasses. Climate is semidesert, soil forming in alluvium derived from mixed sedimentary rocks (sandstone, shale and limestone) in a stream bottom. It is well drained on east facing 3 percent slope. Roots penetrate to 5 feet. Erosion is slight and permeability moderate.

Soil Profile:

A1 horizon, 0 to 5 inches - light brownish gray (10 YR 6/2) sandy loam having about 15 percent clay, dark grayish brown (10 YR 4/2) when moist; moderate medium platy structure; soft, very friable, slightly sticky, nonplastic; strong effervescense with acid; mildly alkaline (pH 7.5); abrupt smooth lower boundary. About 15 percent coarse fragments, mostly boulders.

C1 horizon, 5 to 17 inches - light brownish gray (10 YR 6/2) loam having about 22 percent clay, dark grayish brown (10 YR 4/2) when moist; massive; hard, friable, slightly sticky, slightly plastic, violent effervescence; abrupt smooth lower boundary. About 15 percent boulders.

C2 horizon, 17 to 26 inches - light brownish gray (10 YR 6/2) very gravelly sandy loam with about 17 percent clay, dark grayish brown (10 YR 4/2) when moist; massive; hard, very friable, nonsticky, nonplastic; violent effervescence; clear wavy lower boundary. Soil contains about 60% coarse fragments of which about 15 percent is boulders.

C3 horizon, 26 to 32 inches - light brownish gray (10 YR 6/2) light sandy loam with about 12 percent clay, dark grayish brown (10 YR 4/2) when moist; massive; soft, very friable, nonsticky, nonplastic; violent effervescence; abrupt smooth. lower boundary. Soil contains about 15 percent boulders.

A1b horizon, 32 to 46 inches - dark gray (2.5 Y 4/1) sandy loam with about 10 percent clay, very dark gray (2.5 Y 3/1) when moist; massive, slightly hard, friable, slightly sticky, slightly plastic; strong effervescence; gradual wavy lower boundary. Horizon has about 30 percent stones and boulders.

C4b horizon, 46 to 89+ inches - light brownish gray (10 YR 6/2) very stony sandy loam with about 15 percent clay, dark grayish brown (10 YR 4/2) when moist; massive; hard, friable, slightly sticky, nonplastic coarse fragments make up 80 percent of horizon and consist of stones and boulders.

Pit 3. 200 feet west of Pit 2, on an alluvial fan in Crandall Canyon, (Figure 2). Vegetation consists of big sagebrush, stipa, houndstongue, and snowberry. Climate is semi-desert. Slope is about 6 percent. Roots penetrate to 6 feet.

01 horizon, 0 to 3 inches - litter.

A1 horizon, 0 to 7 inches - light brownish gray (10 YR 6/2) loam, with about 22 percent clay, dark grayish brown (10 YR 4/2) when moist; moderate, medium platy structure; slightly hard, friable, slightly sticky, slightly plastic; strong effervescence with acid; mildly alkaline (pH 7.5); clear wavy lower boundary. Horizon has 5 percent coarse fragments.

C1 horizon, 7 to 13 inches - light brownish gray (10 YR 6/2) sandy loam, having about 15 percent clay, dark grayish brown (10 YR 4/2) when moist; weak platy structure; soft friable, slightly sticky, nonplastic; strong effervescence; mildly alkaline (pH 7.5); gradual wavy lower boundary.

C2 horizon, 13 to 80+ inches - this consists of stratified layers of sandy loam and light loam textures each ranging from 2 to 4 inches thick. Colors are the same as the C1 horizon. The sandy loam layers are massive; loose, very friable, nonsticky, nonplastic; violent effervescence. They have about 10 percent stones. The light loam layers are massive; slightly hard, very friable, slightly sticky, slightly plastic; moderate effervescence. They have about 15 percent stones. There is evidence of a buired A1 horizon at 72 inches.

PRESENT AND POTENTIAL PRODUCTION

C - Castle Valley soil produces 327 pounds air dry herbage per acre, 29 percent from bullgrass, 55 percent from pinyon-juniper, 16 percent from dryland sedge, bluebunch wheatgrass, penstemon, mat buckwheat, hairy golden aster, rock goldenrod, woody phlox and shadescale. The potential plant cover is about 57 percent pinyon-juniper, and 40 percent Indian ricegrass, bluegrama, galletagrass, perennial mustard, senecio, milkweed, birchleaf mahogany, prickly pear, Mormon-tea and winterfat with total potential production of 450 pounds of forage in favorable years and 100 pounds in less favorable years per acre. This soil is in a semi-desert stony hills range site.

K-1 - Kornman like soil. This soil has a total potential production of 950 pounds per acre of air dry forage in favorable years and of 550 pounds per acre in unfavorable years. Vegetation consists of

needle-and-thread, squirreltail, winterfat, bud sagebrush, and big sagebrush. In its present condition it produces about 60 percent of its potential. This soil is in a semi-desert loam, bench range site.

K-2 - Kennilworth - Castle Valley soils. The Castle Valley soils produce essentially the same as that described above. The Kennilworth soils in potential condition have an overstory of pinyon and juniper. The understory consists of 85 percent Indian ricegrass. The remainder is squirreltail, needle-and-thread, bullgrass, and sand dropseed 5 percent; birchleaf mahogany, bitterbrush, cliffrose, Morman-tea and mockarange 5 percent; phlox, scarlet globemallow, pinstemon, locoweed, and aster 5 percent.

It produces 1,250 pounds of forage per acre in good years and 900 pounds in less favorable years. The potential production would be about 50 percent higher.

M1, M2 and M3. This made land will produce about the same amount of forage as the Kornman soil if a cover can get established. Getting a cover established would probably consist of seeding to crested wheatgrass and may require some irrigation.

M4. This made land will produce about 60 percent as much forage as the other made land. These yields are estimated from those of similar soils in Carbon County, Utah.

Legend

C = Castle Valley extremely rocky very fine sandy loam.

K1 = Kornman like loam and Kornman like sandy loam with bouldary profile - Pits 1, 2, and 3.

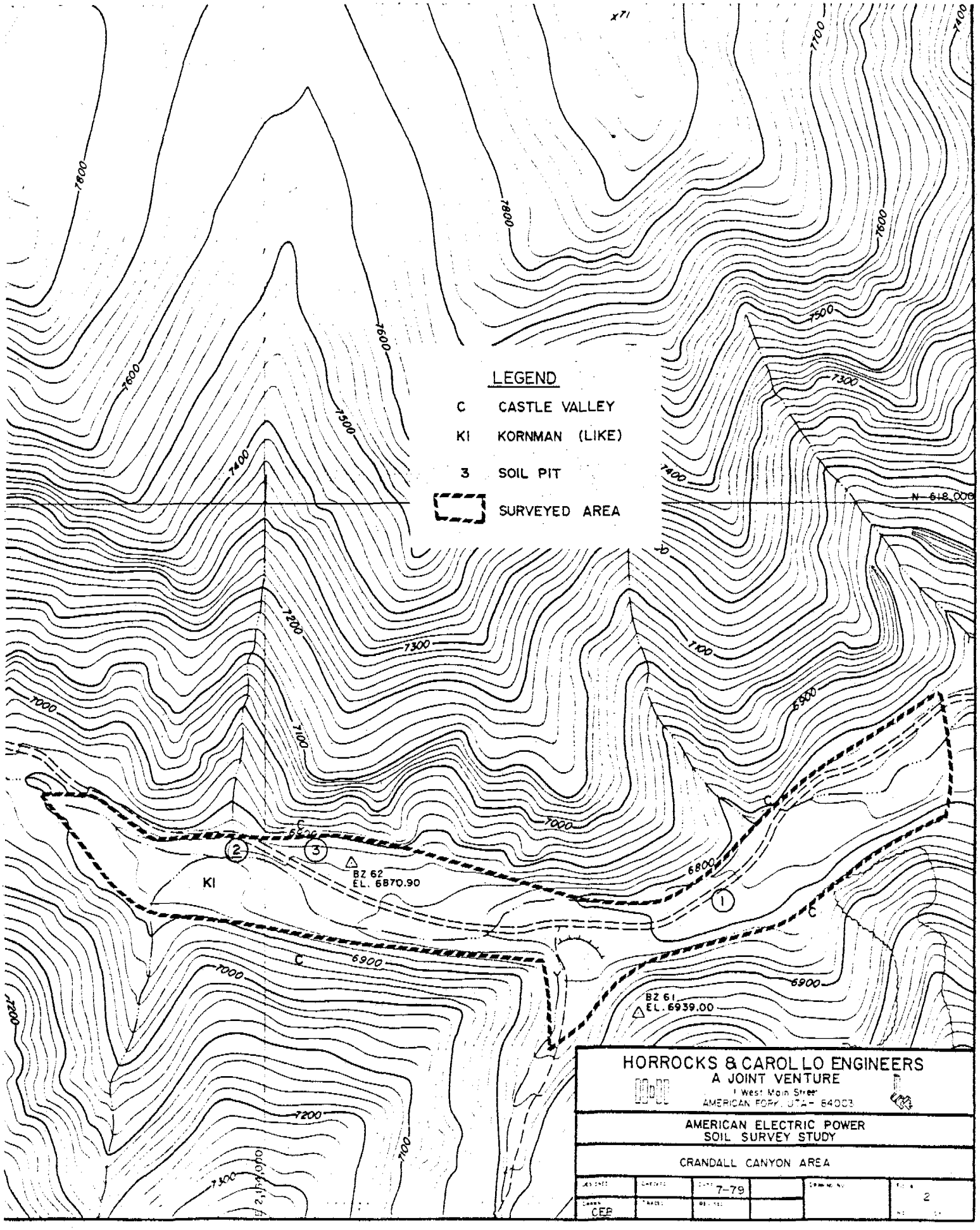
K2 = Kennilworth - Castle Valley soils.

M1 = Made land #1 at proposed mine #6 in Willow Creek, Pits 4 and 5.

M2 = Made land #2 in Castle Gate preparation plant area, Pits 6 to 10.

M3 = Made land #3 Sowbelly, Pits 11 and 12.

M4 = Made land #4 in Hardscrabber, Pit 13.


LEGEND
C CASTLE VALLEY
KI KORNMAN (LIKE)
3 SOIL PIT
SURVEYED AREA
N 618,000
BZ 62
EL. 6870.90
BZ 61
EL. 6939.00
KI
HORROCKS & CAROLLO ENGINEERS
A JOINT VENTURE
1 West Main Street
AMERICAN FORK, UTAH 84003
AMERICAN ELECTRIC POWER
SOIL SURVEY STUDY
CRANDALL CANYON AREA
7-79
CEP
2

APPENDIX 2

Crandall Canyon Archaeological Study
by Kay Sargent
dated July 3, 1980
titled "Crandall Canyon Survey,
Price River Coal Co."

M E M O R A N D U M

TO: LaMar Lindsay
Assistant State Archeologist

DATE: July 3, 1980

FROM: Kay Sargent
Staff Archeologist

RE: Crandall Canyon Survey, Price River Coal Co.

I spent Monday, June 30, and Tuesday, July 1, surveying the bottom of Crandall Canyon and a transect from the upper part of that canyon into upper Hardscrabble Canyon, per the request of Don Stephens, geologist for the Price River Coal Co. (see attached maps). The survey in Crandall Canyon was for the access road and mining facilities; the transect into Hardscrabble Canyon was for a power line, to affect a ca. 50-60 foot corridor. As part of the power line crosses federal lands, I checked with Craig Benson (BLM-Price Office) prior to the survey. It turns out that only a small part of the access road is on federal land (SE 1/4, NW /1/4, NW 1/4, Sec. 27, T12S, R9E) and less than a mile of the power line will cross federal land (Craig Benson personal communication).

There is presently an access road into Crandall Canyon. I first examined the southeast side of the drainage and then the northwest. I proceeded on a zig-zagging and weaving course to cover the area. Special care was taken to examine any rockshelters or knolls in or very near the survey area. Flagged and staked points were followed in surveying the power line route, starting from the north. The terrain was extremely rugged and steep. Much of the power line route was under heavy forest cover (pinyon-juniper, longer needled pine, wild flowers such as columbine, lupine, Indian paint brush, etc., and sagebrush). Approximately half a mile of the northern end (dashed on map) was not thoroughly checked due to the ruggedness of the terrain. Most of this is on the side of a very steep, rocky ridge and is private land. The rest of the route was very difficult, but more than an adequate width was examined as I often had to go out of the way to find access along the route.

A literature search had been conducted and the State and National Register of Historics consulted (Division of State History files) prior to the survey. There are no known archeological sites immediately near the survey area. There are several petroglyph sites (C6149-160) in Gordon Canyon to the south, in Township 14 South, Range 9 East. A recent survey of a couple of ranges to the east by our office (Hawkins & Seward, 1980) located several historic sites but no prehistoric ones.

No archeological sites per se were present in the area surveyed. One rockshelter near the mouth of Crandall contains much bone. Some of it appeared recent, some weathered and old. There was also some charred and fragmented bone. No artifacts were found in association. No prehistoric remains were found elsewhere on the survey in contrast to abundant historic remains. No Smithsonian site number was assigned. It is on the opposite side of the drainage from the access road and should not be affected.

Several historic structures were located in the canyon. These were for the most part "crude" - most of the stones were unshaped, loosely laid without mortar (the exception is the one lowest in the canyon). All were unusual in incorporating large boulders. According to Gene Haub and Frank Pero, these were all built by an old sheepherder who had lived in Crandall Canyon. The northernmost structures were a cluster of contiguous "rooms" built against the northern cliff wall. Several courses of stones were loosely stacked. This appears to have been a "junk" area as there was quite a bit of debris such as corrugated metal sheets, metal barrels, etc. There is the remnant of a fence to the west. One strange construction was the partial body of an old car upon, and around which, stones were piled. Supposedly a fire was built in this by the old sheepherder to provide heating in the winter for young lambs. The dimensions of this area is approximately 200 meters east-west by 75 meters north-south.

A couple of hundred meters down the canyon, across the stream bed, there is another, better constructed building. This is built onto the canyon wall on the south and onto a large boulder on the east. Two sawed logs form the lintel for each of the two windows and the doorway in the west wall.

Half-way down the canyon, and adjacent to the road on the northwest side, is a better constructed building. The southeast wall is a large boulder. The other stones appear shaped and are mortared. Nailed wood planks form the frames for the windows and door. A long, low retaining wall is formed by several courses of rock.

None of the structures identified have roofs. No early glass (purple) or soldered cans were found, so the time of occupation is unknown. The two building sites further up the canyon are within the area where the mining facilities are to be built.

Since the time of construction is unknown, it is unclear whether these structures qualify for the 50 years age minimum for historic sites. Upon discussion with Phil Notarianni (Historian, Utah State Historical Society) who has done much research in Carbon County, these may be significant in documenting sheep herding in the area which was not common. He had scheduled to go to Price next week (July 9th) and is willing to stop in Crandall Canyon to examine them. If they are of interest, they can be studied and photographed, yet need not interrupt construction plans. No Smithsonian site numbers were assigned to the buildings.

I recommend clearance for the project, with the allowance that the historic buildings can be studied if it is warranted in Phil Notarianni's opinion, after his visit on July 9.

Approximately two field days, including travel time, and one office day were spent on this project. Price River Coal Company should be billed accordingly.

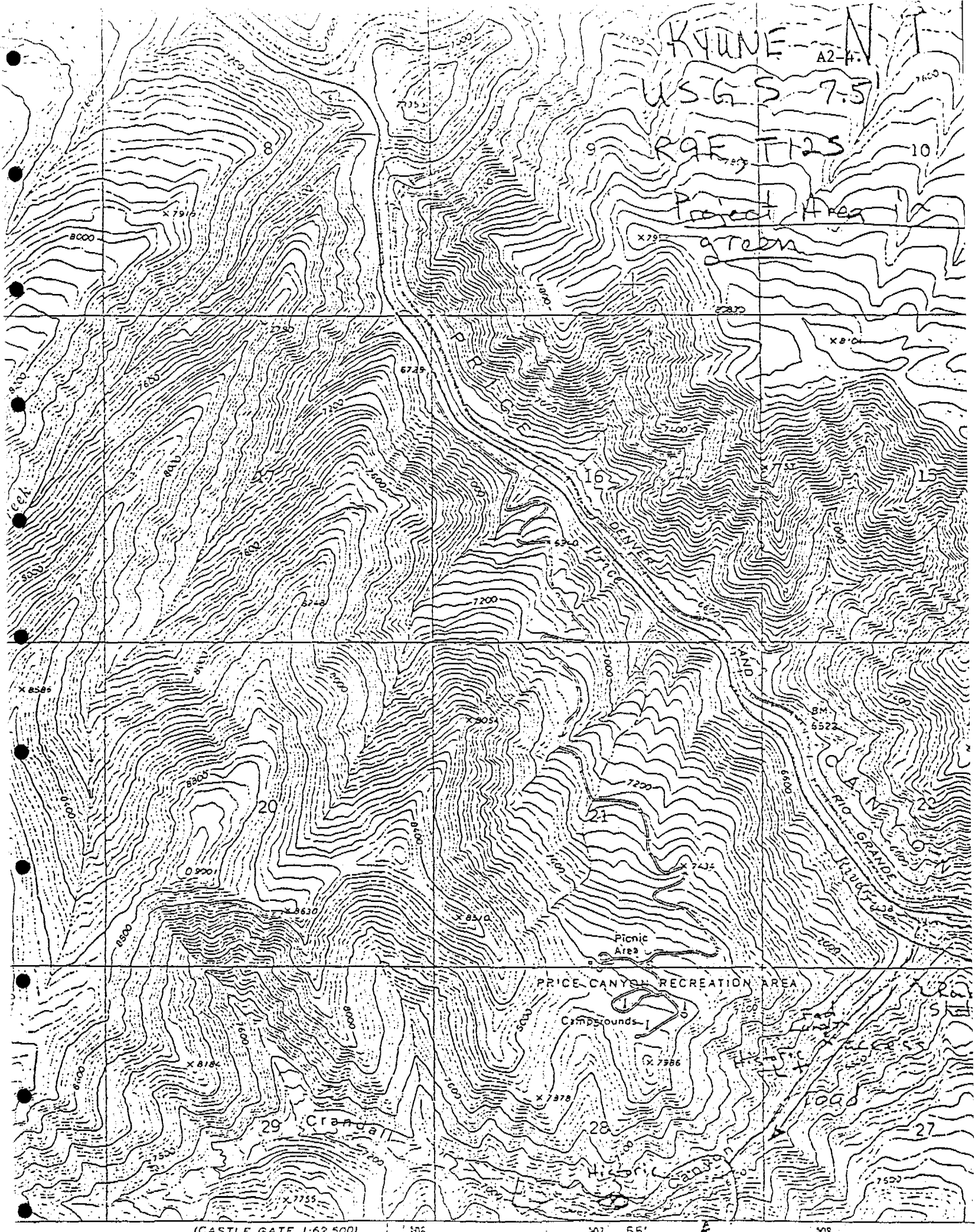
Sincerely,

Kay Sargent

Kay Sargent
Archeologist

KS:dh

cc: Craig Benson,
BLM Archeologist, Price Office
Phil Notariani,
Historian, Utah State Historical Society
Bruce Hawkins,
Historic Archeologist, State Antiquities Section


KYUNE - N T
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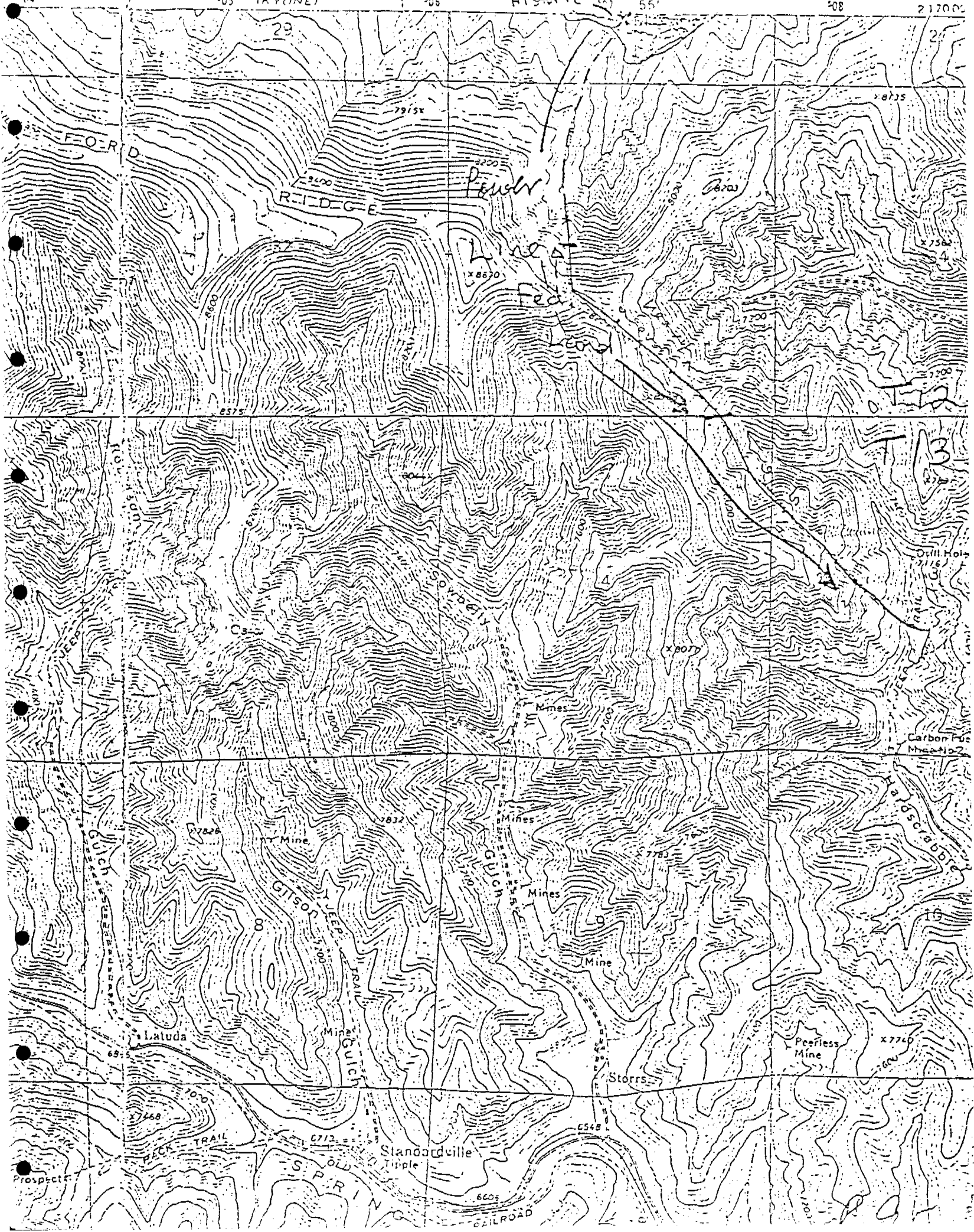
USGS 7.5
R9E T12S
Project Area
green
8
9
10
16
15
17
20
21
22
27
28
29
Picnic Area
PRICE CANYON RECREATION AREA
Campgrounds
Crandall
Canyon
DENVER
RIO GRANDE
Mining
(CASTLE GATE 1:62 500)
3963 III
SCALE 1:24 000

7.5' USGS

A2-5.

N


Historic
Fed. Land
Fed. Land
FEORD
RIDGE
Soverly
Gulch
Gilson
Gulch
Mines
Mine
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Latuda
Peerless Mine
Storrs
Standardville
Tipple
Drill Hole
Carbon Fus
Halascabore
JEEP TRAIL
PACK TRAIL
OLD
SPRING
RAILROAD
Prospect

U.S.
Department of the Interior
Bureau of Land Management
Utah State Office

Summary Report of
Inspection for Cultural Resources

For BLM Use Only A2-6.

BLM Report ID No. | | | | - | | | | | | (1–10)

Report Acceptable Yes __ No __

Mitigation Acceptable Yes __ No __

Comments: _____

1. Cultural Report or Project CRANDALL CANYON (11–40)

2. Development Company Price River Coal Company

3. BLM Mini Permit No. | | | | | (41–45)

4. BLM Antiquities Permit No. pending formal notice | | | - | | | | | (46–55)

5. Report Date 7 3 1980 (56–62) (Month Day Year)

6. Field Work Dates 6/31/80 - 7/1/80

7. Responsible Institution STATE HISTORY (63–77)

Fill in spaces at 85, 93, 97 only if: V = Vernal Meridian, H = Half Township

8. Fieldwork Location: TWN T12S (78–81) Range R09E (82–85) Section(s) 22 (86 87), 27 (88 89), 28, 33
TWN T13S (90–93) Range R09E (94–97) Section(s) 03 (98 99), 04 (100 101)

9. Resource Area PR (102–105) Other: Carbon County

BO = Bonneville, WA = Wasatch, HR = House Range, WS = Warm Springs,
SE = Sevier River, HM = Henry Mtns., BR = Beaver River, DX = Dixie,
KA = Kanab, ES = Escalante, SJ = San Juan, GR = Grand, PR = Price River,
SR = San Rafael, DM = Diamond Mountain, BC = Book Cliffs.

10. Description of Examination Procedures: Single person zig-zagging to cover area. For power line, 50 - 60 ft. corridor; canyon bottom on both sides of access; for larger areas, zig-zagged until all covered.

11. Linear Miles Surveyed 3 (104–112)
and/or
Definable Acres Surveyed | | | | | | | | (113–121)
and/or
*Legally Undefinable Acres Surveyed ca 160 (122–130)
(*A parcel hard to cadastrally locate i.e., center of section)

12. Inventory Type I (131)
R = Reconnaisance
I = Intensive
S = Statistical Sample

13. Description of Findings (attach appendices, if appropriate)
No prehistoric sites found. One shelter with bone, some burned, but no artifacts. Several historic buildings, all of unknown age. No Smithsonian numbers assigned.

14. Number Sites Found: 0 (132–137)
No sites = 0

15. Collection: N (138) Y = Yes, N = No

16. Actual/Potential National Register Properties Affected:
None.

17. Conclusion/Recommendations:
Recommend clearance.

18. Signature of person in direct charge of field work: [signature]

19. Signature and Title of Institutional Officer Responsible [signature]

APPENDIX 3

Crandall Canyon Raptor Study
by Dr. Janet Lee Young
dated June 9-11, 1980
titled "Report on Raptor Study,
Conducted for Price River Coal Company"

Report on Raptor Survey Conducted 9-11 June 1980

for Price River Coal Company

Four raptor species and 23 additional avian species were observed within a one kilometer radius of the proposed shaft site and along the proposed power line during the twenty hours I spent on the area over the three day period (see the attached list). The weather was excellent for observing raptors as all three days were clear and sunny.

No raptor nests were found on the study area and there was no evidence of nesting by any of the raptorial species observed.

At one time as many as seven Turkey Vultures were observed circling above the ridge behind the proposed shafts (TV on the map). These avian scavengers should have young on the nest at this time. If they were nesting within the study area they would have been observed going to their nests. Since they are quite wide-ranging in search of food, their nests could be a considerable distance away.

The one Goshawk sighting was of a bird soaring above the proposed power line (GH on the map). Goshawks should be incubating or have young hatching in early June. The adults are extremely vociferous and defensive of their nest site. The behavior of this bird indicated it was probably at the edge of its hunting range rather than near its nest. The average territory or range for the Goshawk is 1-4 square miles with a diameter of 1-3 miles.

Red-tailed Hawks also should have young on the nest or fledglings at this time. Both sightings (two RT's on the map) were of individual birds which appeared to be hunting. There was no indication that there was a nest nearby. Red-tailed Hawks are very active in the defense of their young with both adults participating, no such behavior was observed.

I followed the proposed power line outside of the kilometer circle (see map) from pole #10 to pole #3. From marker #3 I observed the remaining area to the connecting power line. There was no indication of any nesting activity along the proposed power line.

Janet Lee Young

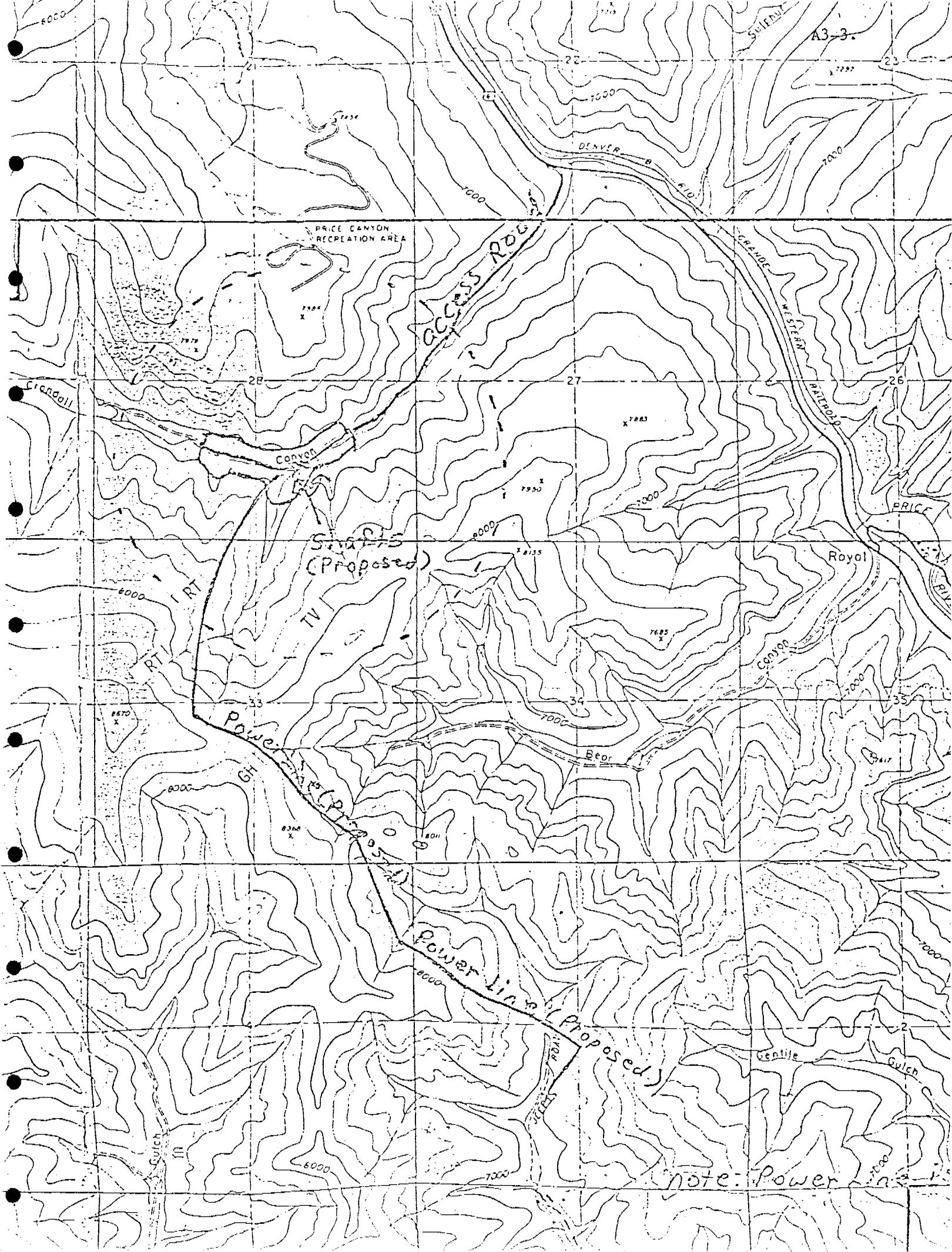
Janet Lee Young, PhD.
1592 North 1640 East
Logan, Utah 84321

Bird Species Observed

White-throated Swift *(Aeronautes saxatalis)*
Broad-tailed Hummingbird *(Selasphorus platycercus)*
Empidonax Flycatcher *(Empidonax sp.)*
Western Wood Pewee *(Contopus sordidulus)*
Violet-green Swallow *(Tachycineta thalassina)*
Steller's Jay *(Cyanocitta stelleri)*
Mountain Chickadee *(Parus gambeli)*
White-breasted Nuthatch *(Sitta carolinensis)*
Rock Wren *(Salpinctes obsoletus)*
Swainson's Thrush *(Catharus ustulatus)*
Golden-crowned Kinglet *(Regulus satrapa)*
Ruby-crowned Kinglet *(Regulus calendula)*
Warbling Vireo *(Vireo gilvus)*
Orange-crowned Warbler *(Vermivora celata)*
Yellow Warbler *(Dendroica petechia)*
Yellow-rumped (Audubon's) Warbler *(Dendroica coronata)*
Western Tanager *(Piranga ludoviciana)*
Black-headed Grosbeak *(Pheucticus melanocephalus)*
Pine Siskin *(Spinus pinus)*
Green-tailed Towhee *(Chlorura chlorura)*
Rufous-sided Towhee *(Pipilo erythrophthalmus)*
Gray-headed Junco *(Junco caniceps)*
Chipping Sparrow *(Spizella passerina)*

Number of sightings (one sighting = observation of one bird until it disappeared from view) of raptorial birds during 20 hours spent on the study area 9-11 June 1980, and the estimated number of individuals using the area.

Species	No. of sightings	Estimated no. of individuals
Turkey Vulture *(Cathartes aura)*	14	7 adults
Goshawk *(Accipiter gentilis)*	1	1 adult
Red-tailed Hawk *(Buteo jamaicensis)*	2	1 adult
Commom Raven *(Corvus corax)*	1	1
TOTALS for four species	18	10


PRICE CANYON RECREATION AREA
DENVER & RIO GRANDE WESTERN RAILROAD
Access Road
Crandall
Canyon
Shafts (Proposed)
TV
RT
GH
Power line (Proposed)
Royal
Canyon
Bear
PRICE
Gentile
Gulch
Gulch
note: Power

JANET LEE YOUNG

1592 North 1640 East, Logan, Utah 84321 · 801/753-3278

OBJECTIVE

Field Ornithology-- preferably bird surveys, breeding bird censuses, and avian-habitat interaction studies.

EDUCATION

Doctor of Philosophy from Utah State University, 1977. Dissertation: Density and Diversity Responses of Summer Bird Populations to the Structure of Aspen and Spruce-Fir Communities on the Wasatch Plateau, Utah. Master of Science in Zoology from Utah State University, 1973, and Bachelor of Arts, Hiram College, with a Major in Biology, 1969. Additional field ornithology classes taken at the University of Michigan Biological Station and Arizona State University.

PAPERS PRESENTED

"Breeding Bird Populations and Habitat Utilization in Aspen Stands," Cooper Ornithological Society Meeting, San Francisco, 1973; "Aspen and Spruce-Fir Forest Heterogeneity and Bird Species Diversity," Cooper Ornithological Society Meeting, Pocatello, Idaho, 1977.

EXPERIENCE

Teaching field ornithology for Logan City Community Education Program, Spring 1980. Teaching assistantships including Ornithology, Hiram College and Utah State University, 1969 - 1974. Bird censuses for the Forest Service, Summers 1973-1977.

PROFESSIONAL AFFILIATIONS

The American Ornithologists' Union, Cooper Ornithological Society, Wilson Ornithological Society, Sigma Xi.

OTHER FACTS

Born March, 1948...Enjoy cross-country skiing, back-packing and fishing...Active member and officer in the Bridgerland Audobon Society, group leader for the Christmas Bird Counts and field trip leader for the Regional Conference, May 1980.

APPENDIX 4

Crandall Canyon Flow Studies
by Allen & Garcia Company

Price River Coal Co. - A. E. P.

Crandall Canyon Shaft Facility

Peak Flow Study

The peak flow in Crandall Canyon was estimated using the Rational Method. The criteria for this method is that for storms of uniform intensity, evenly distributed over the entire watershed, the peak or maximum runoff rate occurs when the entire watershed is contributing to the point of concentration at the outlet, and that this flow is proportional to the rainfall intensity. The duration of that rainfall intensity is equal to the time of concentration; the time which a unit of water from the most distant point takes to travel to the point of concentration.

Duration = time of concentration = $tc = 0.0078\ L^{0.77}\ S^{-0.385}$

Where: L = maximum length of travel = 12,400 by topo map.

S = slope = H/L = 2,710'/12,400' = 22%

$\therefore$ tc = 20 min.

No gauging or rainfall intensities were found available for the specific area of Crandall Canyon. Utah State Climatologist, Mr. Richardson, provided us with a printout of the Scofield Dam, Utah area precipatation and the original Environmental Resource Data study for the total mine provided similar data for the Price, Utah area.

Using the Scofield information, a frequency analysis graph was plotted with Duration against Rainfall Intensity. At the tc value of 20 minutes the intensity (i) was found to be 2.3 inches per hour for the 100 year storm return period.

Following this same logic for the Price data, the intensity (i) was found to be 2.0 inches per hour for the 100 year storm.

The Peak Flow formula for the Rational Method is:

$Q = c\,i\,A$

Where: A = area of watershed in acres from the topograph maps supplied = 2400 acres

i = rainfall intensity = 2.3 inches per hour (Scofield)
2.0 inches per hour (Price)

c = runoff coefficient = rocks, gravel, sandy soil with light vegetation = 0.15 to 0.50, we will use 0.50

Q = 2,760 c.f.s. = Peak flow for the Scofield data.

Q = 2,400 c.f.s. = Peak flow for the Price data.

The diversion channel formula per Chezy-Manning is:

$$Q = \frac{1.49}{n} A R_h^{.667} S^{.5}$$

Where: Q = 2,760 c.f.s.

A = cross sectional area in ft^2

n = Manning roughness coefficient

R_h = hydraulic radius = A/p in ft.

P = wetted perimeter

S = Slope = H/L = 60'/1200' = 5%

A, R_h and P are all factors of the width and height of the channel. For ease of calculation, we will assume the width of the channel to be twice that of the height.

$\therefore$ Height = h Width = b = 2h

$A = h^2 \qquad P = 4h \qquad R_h = \frac{2h^2}{4h}$

n = for jagged rock sides = 0.05 for concrete gutter = 0.016

We will use 0.035 since the channel will be partially concrete and partially rock.

$$Q = \frac{1.49}{n} A R_h^{.667} S^{.5}$$

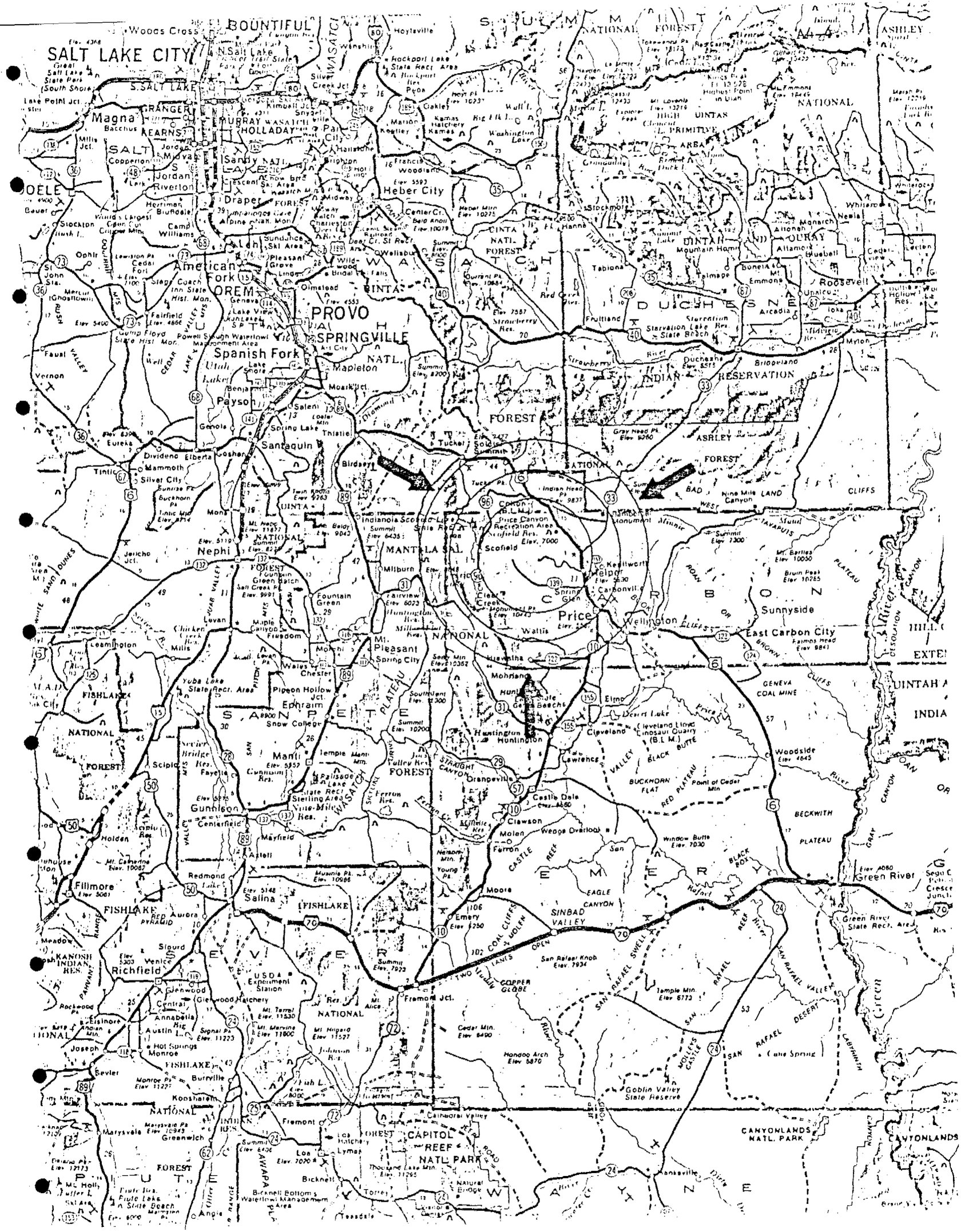
$$Q = \left(\frac{1.49}{n}\right) (2h^2)\left(\frac{2h^2}{4h}\right)^{.667} (.05)^{.5}$$

For the Scofield data - h = 7.7 ft = height
b = 15.4 ft = width

Following the same calculations using the Price information:

h = 7.3 ft = height

b = 14.6 = width


SALT LAKE CITY
BOUNTIFUL
Woods Cross
Magna
Bacchus
GRANGER
HEARNS
MURRAY
HOLLADAY
Sandy
Draper
Riverton
Bluffdale
Herriman
Heber City
Midway
Charleston
Wallsburg
Francis
Kamas
Oakley
Coalville
Hoytsville
Peoa
Park City
Kimball Jct.
Snyder
Hailstone
Brighton
Alpine
Lehi
American Fork
OREM
Provo
SPRINGVILLE
Spanish Fork
Mapleton
Payson
Salem
Santaquin
Genola
Eureka
Dividend
Elberta
Goshen
Mammoth
Silver City
Tintic
Nephi
Levan
Mt. Pleasant
Spring City
Fairview
Fountain Green
Mona
Chester
Ephraim
Manti
Gunnison
Centerfield
Mayfield
Fillmore
Holden
Kanosh
Sevier
Salina
Redmond
Aurora
Richfield
Sigurd
Venice
Glenwood
Central
Annabella
Elsinore
Joseph
Monroe
Hot Springs
Burrville
Koosharem
Fremont
Loa
Bicknell
Torrey
Greenwich
Marysvale
Angle
Fish Lake
Scipio
Fayette
Sterling
Nine-Mile Res.
Moroni
Freedom
Mills
Leamington
Oak City
Birdseye
Thistle
Tucker
Colton
Price Canyon Recreation Area
Scofield
Mill Burn
Helper
Kenilworth
Carbonville
Price
Wellington
Sunnyside
East Carbon City
Hiawatha
Mohrland
Huntington
Cleveland
Elmo
Castle Dale
Clawson
Orangeville
Emery
Green River
Woodside
Ferron
Moore
Fremont Jct.
Cainsville Valley
Los
Lyman
Bicknell
Torrey
Teasdale
Hanksville
Goblin Valley State Reserve
Temple Mtn.
Cedar Mtn.
Handcart Arch
Natural Bridge
Cathedral Valley
Thousand Lake Mtn.
Mt. Holly
Fish Lake
Fish Lake State Beach
Marysvale
Greenwich
Kanosh Indian Res.
Ashley National Forest
Uinta National Forest
Manti-La Sal National Forest
Fishlake National Forest
Dixie National Forest
Capitol Reef Natl. Park
Canyonlands Natl. Park
Uintah Mountain Home
Roosevelt
Duchesne
Tabiona
Altonah
Bluebell
Neola
Myton
Bridgeland
Fruitland
Starvation Lake Res.
Starvation State Beach
Duchesne
Arcadia
Ioka
Indian Reservation
Ashley National Forest
Nine Mile Canyon
Price Canyon Recreation Area
Scofield Res.
Gray Head Pk.
Indian Head Pk.
Tuck Pk.
Mt. Nebo
Mt. Baldy
Indianola
Scofield Lake State Rec. Area
Fairview
Huntington Res.
Millburn
Wattis
Spring Glen
Carbonville
Clear Creek
Mt. Pleasant
Spring City
Sanpete Summit
Southfork
Huntington
Cleveland
Elmo
Desert Lake
Cleveland Lloyd Dinosaur Quarry (B.L.M.)
Lawrence
Woodside
Castle Dale
Clawson
Molen
Ferron
Emery
Moore
Green River
Green River State Rec. Area
Temple Mtn.
Cedar Mtn.
Handcart Arch
Goblin Valley State Reserve
Canyonlands Natl. Park
Cainsville Valley
Thousand Lake Mtn.
Natural Bridge
Hanksville
Bicknell Bottoms Waterfowl Management Area
Fish Lake State Beach
Fish Lake State Park
Yuba Lake State Rec. Area
Pigeon Hollow Jct.
Snow College
Gunnison Res.
Palisade Lake
Sterling Area
Nine-Mile Res.
Ferron Res.
Huntington Res.
Millsite Res.
Joes Valley Res.
Scipio Bridge Res.
Kanosh Indian Res.
Kolob Canyon
Zion National Park
Bryce Canyon
Cedar City
Parowan
Kanab
Page
Moab
Vernal
Roosevelt
Duchesne
Price
Green River
Hanksville
Salt Lake City
Provo
Ogden
Logan
Tooele
Wendover
Delta
Fillmore
Richfield
Manti
Nephi
Vernal
Roosevelt
Duchesne
Price
Green River
Hanksville
Moab
Kanab
Page
Cedar City
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Waterpocket Fold
San Rafael Swell
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Green River
Colorado River
Dirty Devil River
Fremont River
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Virgin River
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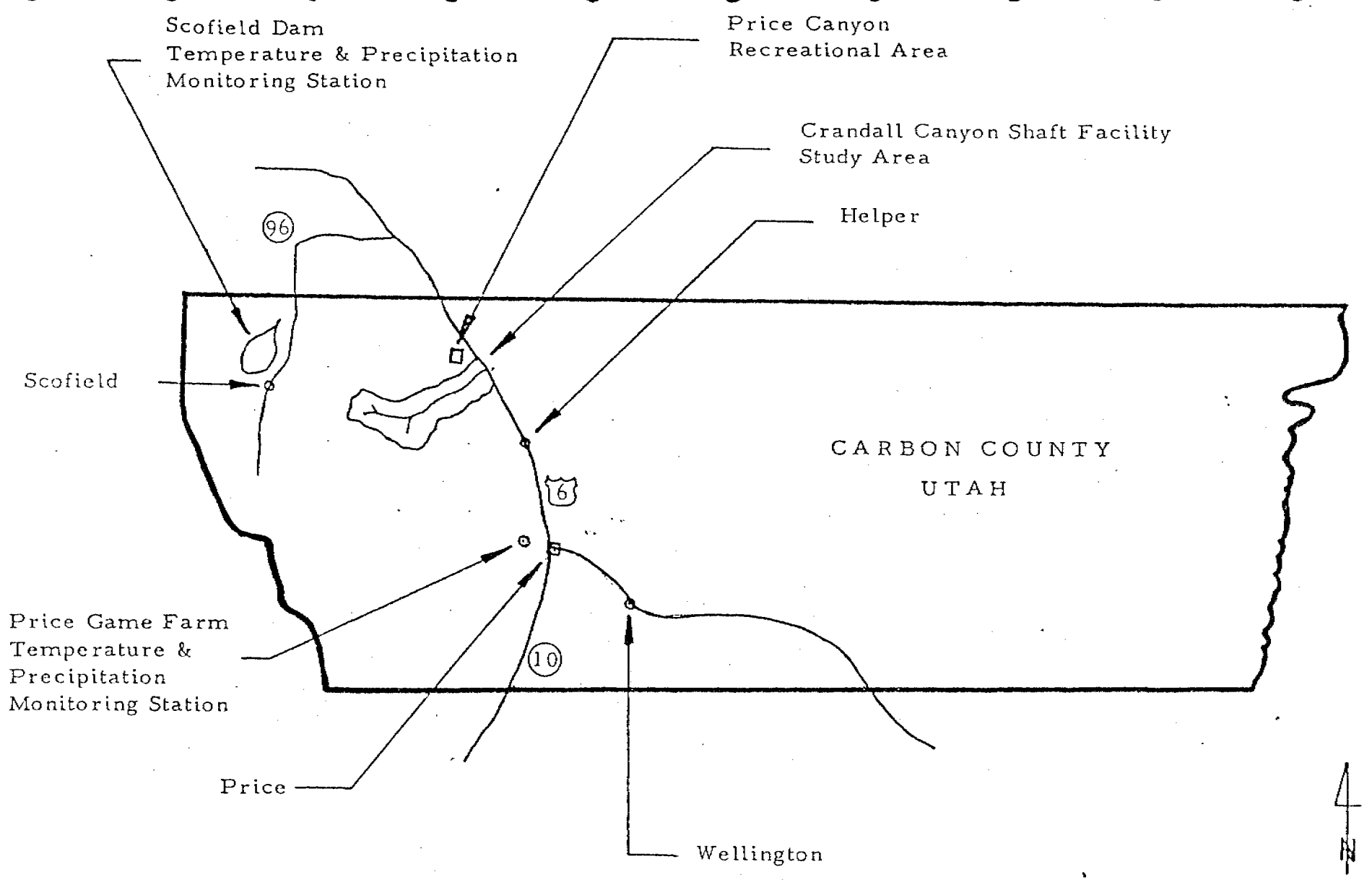
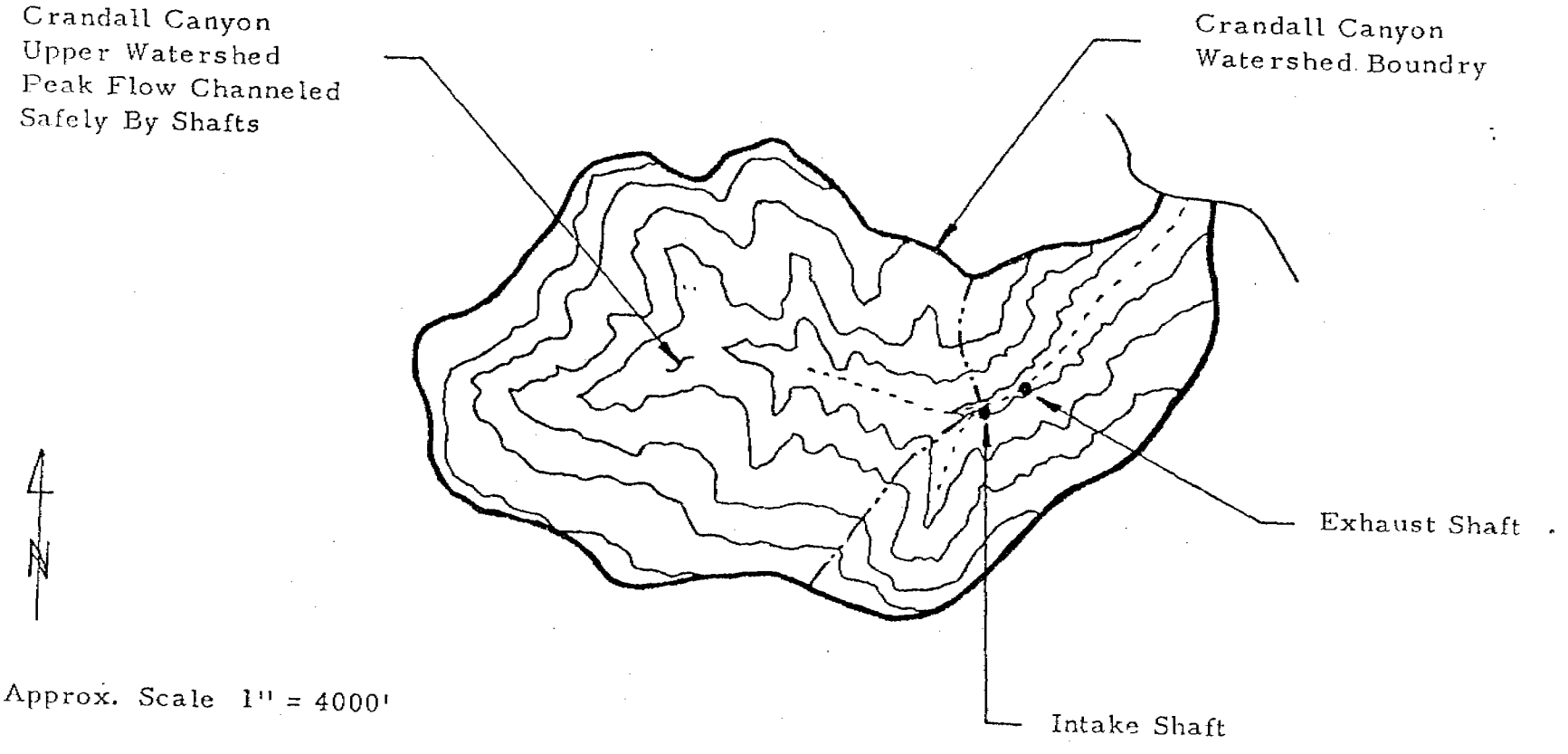


Approximate Locations - Study Area and Precipitation Monitoring Stations.



Crandall Canyon Watershed Diagram

ESTIMATED RETURN PERIODS FOR SHORT DURATION PRECIPITATION (INCHES) - PRICE, UTAH*

Return Period (yrs)	Duration 5 Min	10 Min	15 Min	30 Min	1 Hr	2 Hr	3 Hr	6 Hr	12 Hr	24 Hr
1	0.08	0.13	0.17	0.23	0.29	0.37	0.44	0.62	0.78	0.95
2	0.12	0.18	0.23	0.32	0.40	0.49	0.58	0.80	1.00	1.20
5	0.16	0.25	0.32	0.44	0.56	0.68	0.79	1.07	1.32	1.58
10	0.20	0.31	0.39	0.54	0.68	0.81	0.94	1.25	1.53	1.82
25	0.24	0.37	0.47	0.65	0.82	0.98	1.13	1.50	1.83	2.18
50	0.28	0.43	0.54	0.75	0.95	1.12	1.29	1.71	2.18	2.47
100	0.31	0.49	0.62	0.85	1.08	1.27	1.45	1.91	2.32	2.74

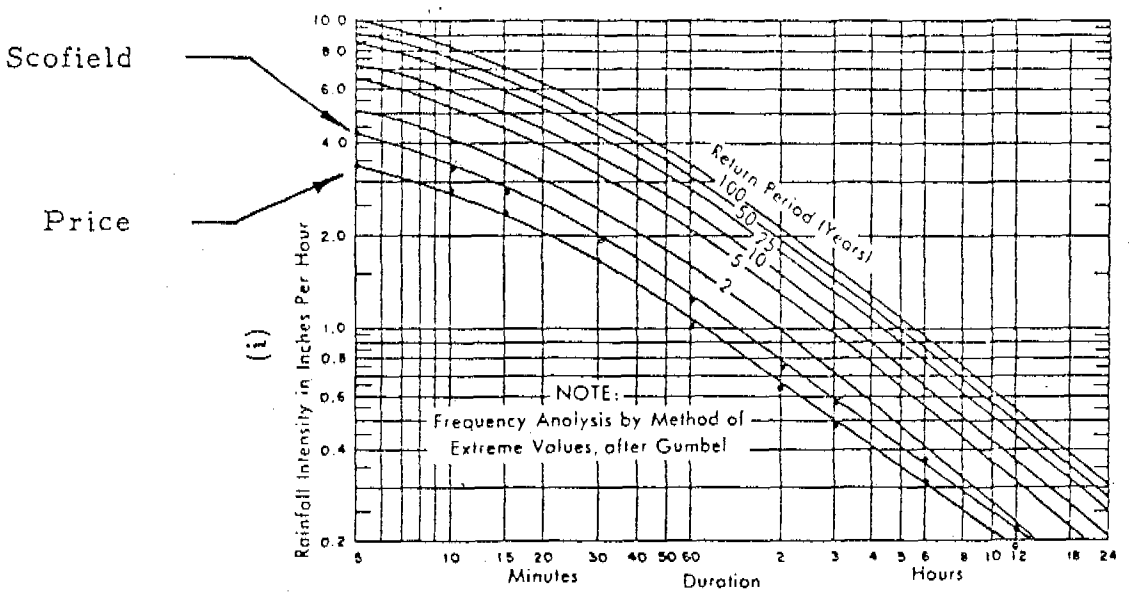
*Ref: Utah State University, 1971, Department of Soils and Biometeorology, Bulletin No. 1.

ESTIMATED RETURN PERIODS FOR SHORT DURATION PRECIPITATION (inches)

Station: Scofield Dam ** Elevation: 7630
Latitude: 39° 47' Longitude: 111° 07'

RETURN PERIOD (years)	DURATION 5 Min	10 Min	15 Min	30 Min	1 Hr	2 Hr	3 Hr	6 Hr	12 Hr	24 Hr
1	.15	.23	.29	.40	.51	.58	.65	.81	.96	1.11
2	.17	.27	.34	.47	.60	.69	.78	1.00	1.20	1.40
5	.22	.34	.43	.60	.76	.88	1.00	1.29	1.55	1.82
10	.25	.39	.49	.68	.86	1.00	1.14	1.49	1.80	2.12
25	.31	.48	.60	.84	1.06	1.23	1.39	1.80	2.16	2.54
50	.33	.51	.64	.89	1.13	1.33	1.52	2.00	2.43	2.87
100	.36	.55	.70	.97	1.23	1.46	1.67	2.21	2.69	3.19

** Ref: Utah State Climatologist, Utah State University, Logan, Utah

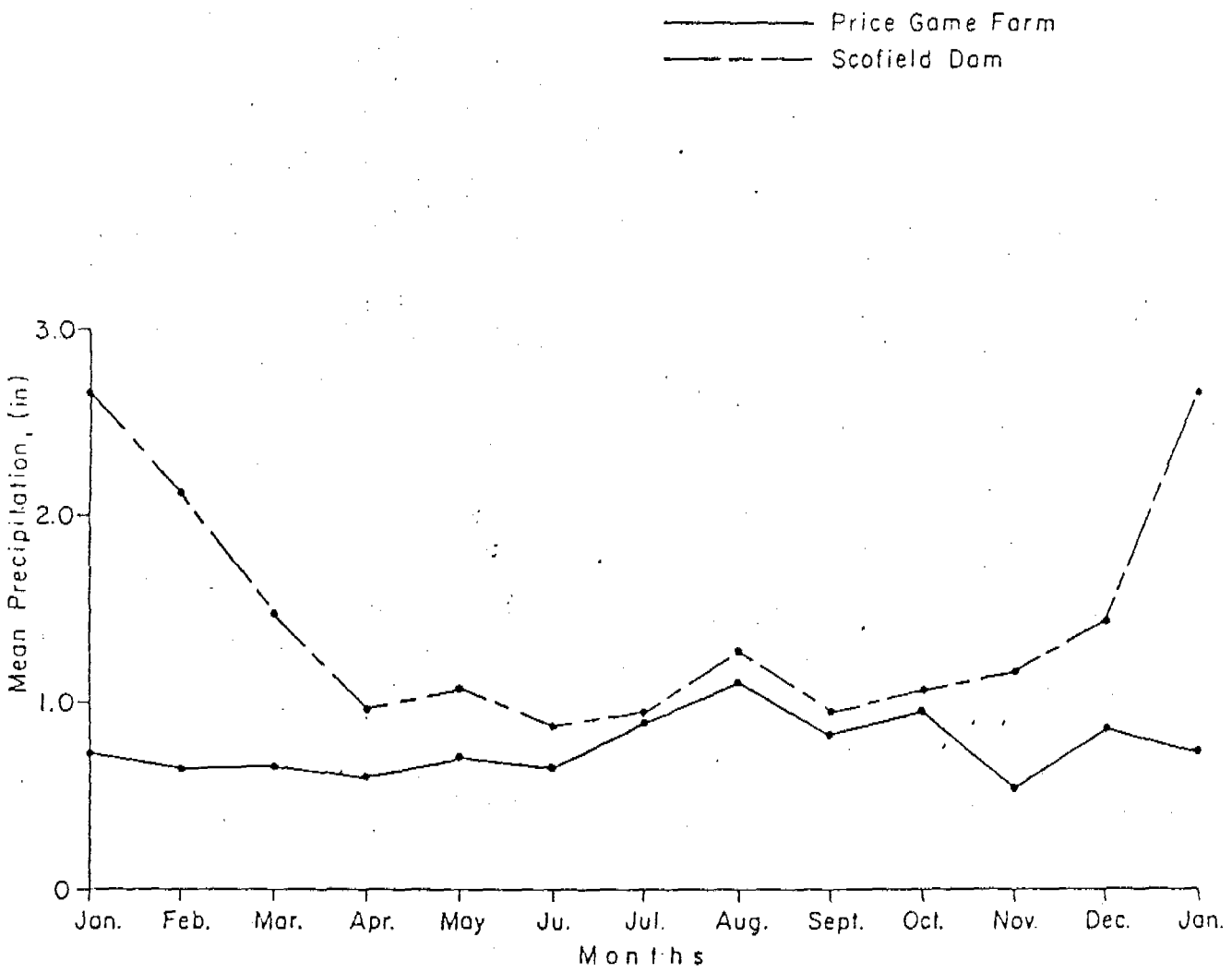


Rainfall intensity for various durations and return periods.

Duration = tc

Frequency Analysis Curves for Scofield & Price, Utah

(from Utah Division of Water Resources, 1975)



Annual Mean Precipitation by Month

CULVERT SIZES FOR CRANDALL CANYON, UTAH

As per 30 CFR 817.163 (a)(1) and 30 CFR 817.163 (c)(1)(i), the culverts in Crandall Canyon were designed to handle a 10-year, 24-hour storm. The various "fingers" in the canyon were identified and the maximum flow rates for a 10-year, 24-hour storm were calculated. The culverts were then sized based on a discharge rate of 10 fps. In some cases, more than one culvert was required due to 30 CFR 817.163 (c)(2)(i)(C), which states that distances between culverts must not exceed 400' when grades are between 6 and 10%. The maximum road grade in Crandall Canyon is 9%. The smallest culvert used was 18". Please refer to the map for the areas labeled A-G.

Area	Culverts
A	18"
B	18"
C	18"
D	18"
E	24" & 18"
F	24"
G	4 - 18"

B. A. Molyet
6/23/80
1999

CULVERT SIZING

Location	Area (acres)	c	i_{max}	Q_{max} [1]	Velocity	Culvert Size [2]	Used
A	7.83	0.5	2.3	9.0	10	12.8"	18"
B	15.48	0.5	2.3	17.8	10	18.1"	18"
C	13.93	0.5	2.3	16.0	10	17.1"	18"
D	12.82	0.5	2.3	14.7	10	16.4"	18"
E	42.09	0.5	2.3	48.4	10	29.8"	24" & 18
F	28.74	0.5	2.3	33.1	10	24.6"	24"
G	40.85	0.5	2.3	47.0	10	29.4"	4 - 18"

1 Q_{max} = Area x c x i_{max}

2 $$\text{Culvert Size} = 24 \left(\frac{Q_{max}}{\text{Velocity} \times \pi} \right)^{1/2}$$

B. A. Molyet
6/24/80
1999

Price River Coal Co. - A. E. P.

Crandall Canyon Shaft Facility

Runoff Control

During the initial construction phases of the project while the shafts are being sunk, considerable shaft muck will be brought to the surface and distributed to the area between the shafts.

To eliminate contamination of streams in Crandall Canyon, it has been proposed that precipitative runoff controls be established in and about the muck transportation and deposition areas. (See attachment.)

The proposal suggests that all precipitative runoff from the contractor's areas at both the intake and the exhaust shafts be diverted along with the runoff from the muck roads and deposition area into catch basins. These basins shall be of size to maintain a 10-year, 24-hour storm.

Diversion trenches about the intake shaft contractor's area, along both sides of the muck road, and about the deposition area will channel the runoff into an upper catch basin. Further diversion trenches about the exhaust shaft contractor's area and along both sides of the muck road will channel the runoff into a lower catch basin.

These diversion channels will have to be maintained and reconstructed as the areas and corresponding grades change during construction.

The attached calculations give the respective volumes required of the catch basin for a 10-year, 24-hour storm. Again, no specific data is available for Crandall Canyon precipitation; therefore, the data from both Price and Scofield monitoring stations was considered.

Price River Coal Co. - A.E.P.

Crandall Canyon Shaft Facility

Muck Area Runoff Control

UPPER CATCH BASIN:

Runoff Area = 94,700 ft.^{2}

Rainfall - 10-year, 24-hour = Scofield 2.12 inches
= Price 1.82 inches

Maximum Water Volume, 10-year, 24-hour storm = 16,730 ft.^{3}

Basin Size = 60' x 40' x 7' average depth

LOWER CATCH BASIN:

Runoff Area = 22,200 ft.^{2}

Rainfall - 10-year, 24-hour = Scofield 2.12 inches
= Price 1.82 inches

Maximum Water Volume, 10-year, 24-hour storm = 3,922 ft.^{3}

Basin Size = 10' x 20' x 2' average depth