O. Transportation

1. Coastal States Proposal and Alternate Ownership

No mitigating measures have been developed.

P. Research, Administration, and Special Uses

1. Coastal States Proposal and Alternate Ownership

No mitigating measures have been developed.

Q. Wilderness and Roadless Areas

1. Coastal States Proposal and Alternate Ownership

No surface activities would be allowed which would reduce or eliminate potential wilderness values in the RARE II area on the Manti-LaSal National Forest or the uninventoried roadless area on BLM administered lands until after proper inventories have been completed and a determination on wilderness character made.

CHAPTER V

ADVERSE IMPACTS WHICH CANNOT BE AVOIDED SHOULD THE PROPOSAL BE IMPLEMENTED OR AN ALTERNATE OWNERSHIP OCCUR

A. Geology and Topography

1. Coastal States Proposal

Subsidence would occur on approximately 922 acres (35 percent of the proposed lease area). Subsidence (up to 9 feet) has occurred over Coastal States' existing mine workings. However, the only obvious surface manifestations are surface fractures in the vicinity of East Spring Canyon. Individual displacements along these fractures are usually less than 1 foot vertically and in width.

Surface deformation on the proposed lease area would probably be expressed as broad depressions with associated fractures above the areas of subsidence activities. Maximum depths of these depressions would be 8 to 10 feet. Formation of tension cracks would appear a few months after mining. Compression bulges and anticlines would appear about 1½ to 2 years after completion of mining. Additional formation of tension cracks as the surface subsides to a final profile would occur several years after completion of mining.

2. Alternate Ownership

The environmental impacts of alternate ownership would be similar to those described above. Effects on topography would be dependent upon location of facilities and mining methods used. Subsidence would occur on various portions of the proposed lease area in relation to mining methods used and the amount of coal removed.

B. Mineral Resources

1. Coastal States Proposal

a. Coal - Approximately 14 million tons could be mined during the life of the lease at 66 percent recovery rate. The remaining coal would be permanently lost.

b. Oil and Gas - The sedimentary units that have produced oil and gas in the Wasatch Plateau lie more than 3,000 feet below the coal of the Upper Hiawatha bed. Although there would be no conflict between the two resources, future wildcat wells that may be drilled on the lease area may require special methods of drilling and coordination with Coastal States to avoid mining operations.

c. Other Mineral Resources - No adverse impacts are anticipated.

2. Alternate Ownership

a. Coal - Recovery rate of coal reserves on the proposed lease tract would be dependent upon the mining plan and mining techniques. Coal not mined would be lost. Normal underground recovery rates range from 45 to 60 percent of inplace reserves. This lower recovery rate would result from the necessity to leave barrier pillars between Coastal States' operation and the new mine.

b. Oil and Gas Environmental impacts associated with alternate ownership would be similar to those analyzed for the Coastal States proposal.

c. Other Mineral Resources No adverse impacts are anticipated.

C. Hydrology

1. Coastal States Proposal

Subsidence after mining could break a 20-foot thick bentonitic shale aquiclude above the coal seam providing additional avenues for hydraulic connection of water bearing zones. Water zones in the area are fresh; however, the creation of additional avenues for water movement increases the potential for raising the dissolved solids concentrations in the water, reducing water quality.

The flow of two local upland springs may be lost or reduced. This would result in loss of water sources to livestock and wildlife in the area. Vegetation types surrounding these springs and seeps would also change. If water flow is reduced or halted, it is doubtful that former levels of flow would ever be attained.

2. Alternate Ownership

Environmental effects on surface and subsurface hydrology would be similar to those associated with the Coastal States proposal. The additional surface disturbance associated with developing new mine facilties, haulage roads, etc. (approximately 75 - 100 acres) would increase potential for runoff. Intensity and significance would depend on the location of the disturbances.

D. Soils

1. Coastal States Proposal

As a result of Coastal States' exploration programs which would be conducted during the first field season after the lease is issued,

3 to 5 acres of soil would be disturbed. The effects of a maximum of 12 drill pads and 1 mile of new low grade road would be short-lived. Similar drill sites on the plateau have revegetated 2 to 3 years after rehabilitation. No prime or unique farmlands, flood plains, or alluvial valley floors would be affected by the proposal.

2. Alternate Ownership

Between 75-100 acres of surface disturbance is anticipated should alternate ownership and development of the lease occur. Part of this disturbance would be shortlived as described above, and the remainder would extend for the duration of the mining activities and beyond. These areas include permanent haulage roads, mine site, etc. Increased erosion at construction sites could not be avoided during the period of soil exposure, particularly during intense rainstorms. Studies in the area indicate that approximately 1.5 to 4.0 cubic yards of soil per acre per year could be eroded during the period of soil exposure. This is an increase of 1.0 to 3.0 cubic yards above the natural rate of erosion (Pacific Southwest Interagency Committee System, 1968). After rehabilitation is completed, erosion rates would decline to near normal levels. Normal productivity of disturbed and occupied soils would be lost for the duration of the disturbance.

E. Climate, Air Quality, and Noise

1. Coastal States Proposal

Some temporary reduction in local air quality (particulate matter) could be anticipated during exploratory activities. Trucks would continue to produce exhaust emissions at slightly increased rates as coal truck traffic would increase from an average of 9.6 to 11.1 trucks per hour. Trucks would also run an additional 1½ years. Localized sources of noise would occur during the 4-month exploratory program.

2. Alternate Ownership

Undetermined reductions in air quality could be anticipated during all phases of mine development, including road and powerline construction onto the proposed lease area, the construction of surface facilties, and exploratory drilling activities. Haulage of coal from the new mine would produce additional amounts of noise, dust, and engine emissions. All phases of new mine development would increase noise levels in the area an undetermined degree.

F. Fire

1. Coastal States Proposal

The risk of man-caused fires may be higher in the area as a result of increased activities; however, detection of fires also would be faster. Most additional surface activity would be limited to a single 4-month summer field season.

2. Alternate Ownership

The possibility of man-caused fires would increase as a result of men and equipment working in the area. These additional people would be in the proposed lease area for up to 25 years. They would also provide earlier detection of fires started by man or nature.

G. Fish and Wildlife

1. Coastal States Proposal

The 4-month exploratory drilling program would temporarily displace wildlife species on a local basis. Most notable would be mule deer which utilize the area for summer range. Elk are usually found in the area only during winter months and would not be affected.

Road and drill pad construction would cause the loss of 3 to 5 acres of vegetation used by wildlife for food and cover. This loss would continue until revegetation is successful (2-3 years). Loss of this vegetation would reduce the carrying capacity for deer by one deer (or less) annually.

Loss of wildlife habitat due to elimination of surface water sources cannot be avoided.

Wildlife highway mortality could not be avoided and the mortality associated with the proposed action would continue for the extended life of the mine. Deer highway mortality on I-70 in Salina Canyon could increase by 16 percent or 16 deer annually.

The proposed action would not be expected to adversely affect the endangered bald eagle or peregrine falcon which may occur in the area.

2. Alternate Ownership

Vegetation would be disturbed and removed on 75-100 acres. Any of the environmental disturbances described above would increase both in space and duration. Loss of 75-100 acres of deer and elk range could not be avoided. Lost carrying capacity for deer would range from 7 to 25 deer annually. Wildlife populations would be reduced in those areas immediately surrounding areas of heavy and sustained activity.

Increased wildlife highway mortality of up to 16 deer annually could not be avoided and would continue for the life of the mine.

Impacts to threatened or endangered species would not be anticipated.

H. Vegetation

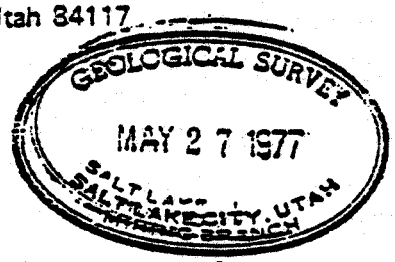
1. Coastal States Proposal

Surface disturbing activities would temporarily disturb 3 to 5 acres of vegetation during the 4-month exploration program. With proper

RESEARCH CORPORATION

P.O. Box 17544 – Salt Lake City, Utah 84117
Tel.: (801) 582-0313

May 23, 1977



Subject: A Cultural Resource Survey of Drill Sites and Access Roads on U.S. Forest Lands in the Convulsion Canyon Area, Sevier County, Utah

Project: Coastal States Energy Company - 1977 Drilling Program in the Southern Utah Fuel Company Mine Area

Dept. of Agriculture Permit: Renewable Blanket Permit Issued by Robert Safran, Director of Recreation, Region 4, U.S. Forest Service

To: Mr. Ralph Blumer, U.S. Geological Survey, 8426 Federal Bldg., 125 So. State, Salt Lake City, Utah

Mr. Dennis Anderson, Coastal States Energy Company, 1354 East 3300 South, Suite 303, Salt Lake City, Utah 84106

Fifteen drill pads and six associated access roads were surveyed for cultural materials on May 16, 17, and 23, by Jim Dykman, working in association with Dennis Anderson of Coastal States Energy. The survey was located in the following area: Township 22 and 21S., Range 5E., Acord Lakes Quad.

All drill sites and access roads are located on U.S. Forest land in the Fishlake National Forest.

Drill Sites: There are a total of 15 drill sites that consist of impact areas of about 30 meters in radius. Nine of the drill sites were located near existing roads with the other six located on proposed access roads. The drill sites were surveyed by the walking of a concentric circle pattern out to 30 meters from the center of the drill pad area.

mesa top in a montane environment of pine with an understory of aspen, sagebrush, mansanita, and oak brush. Six of the drill sites were located in a mansanita zone, seven in a sagebrush understory and two in an oak brush understory.

Access Roads: Six access roads in conjunction with six drill sites were surveyed for cultural resource material. The roads ranged in length from 20 meters to 1.5 kilometers. A 15 meter wide corridor was cleared for each of the proposed roads. Methodology used included utilization of parallel sweeps on the access route and the use of a zig zag pattern when return on the road is impractical.

Cultural Resource Material: No cultural material was located during the survey of the proposed drill holes and associated access roads. The State Archeologist's files were also checked to locate known sites that may be in close proximity to the project area; no sites were located.

CONCLUSIONS AND RECOMMENDATIONS:
Drilling and equipment operations over the area noted above will have no adverse impact upon cultural resources of the Acord Lakes area if Coastal States Energy Company personnel and its representatives in the field comply with the following recommendations:

1) All vehicle traffic and drilling operations be confined to existing roads, cleared drill platforms and cleared access roads;

2) personnel and staff refrain from pilfering individual artifacts or disturbing any archeological sites within the locality; and

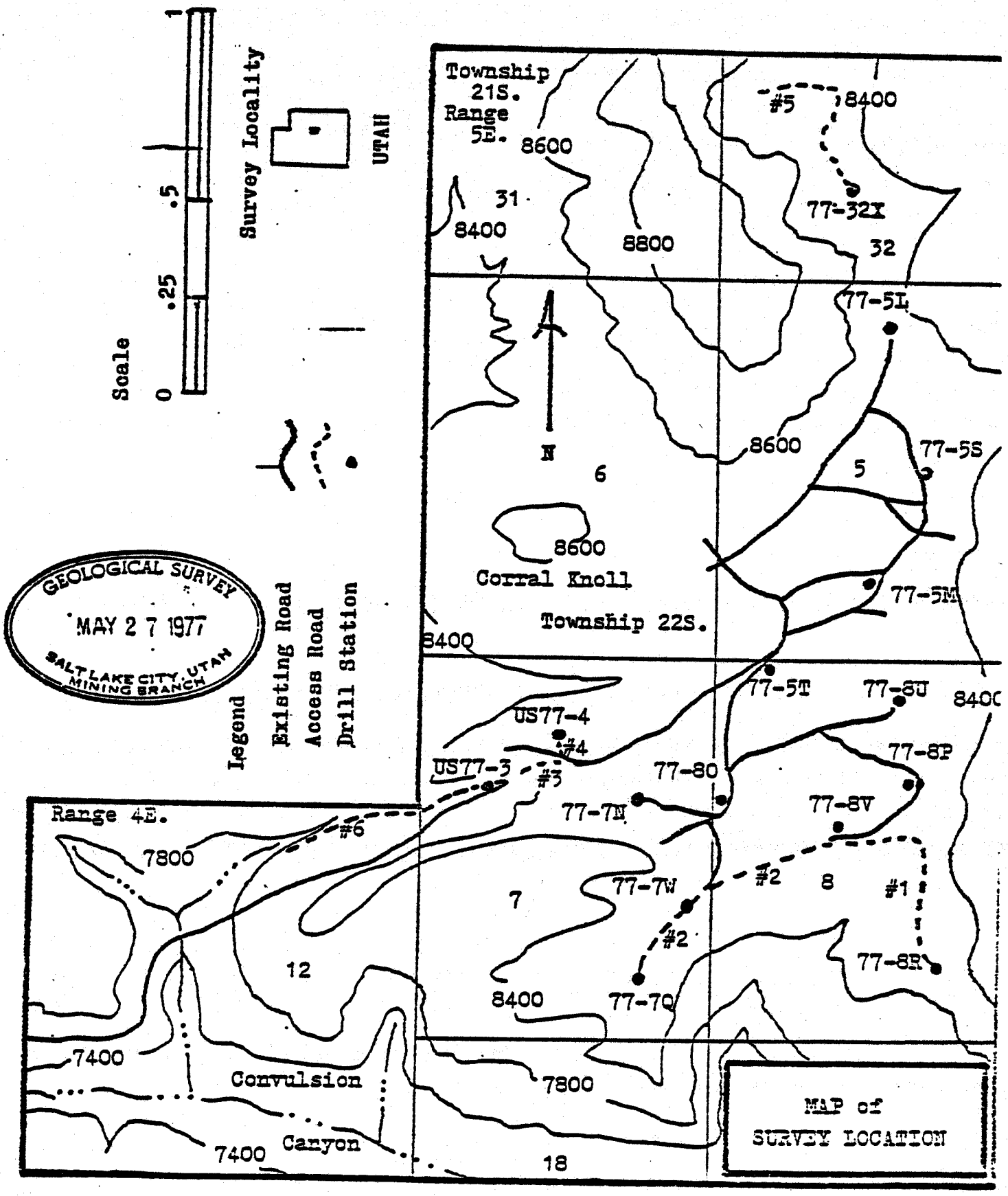
3) a qualified archeologist is consulted if cultural remains

improvement operations, or if the need arises to relocate or increase the number of drill stations in the locality which will not be on cleared routes.

With compliance to these recommendations, a complete cultural resource clearance for Coastal States Energy Company is recommended for the area surveyed.

J. L. Dykman, M.A.

F. R. Hauck, Ph.D.
President


Township 21S. Range 5E.
Township 22S.
Range 4E.
Scale
0
.25
.5
1
Survey Locality
UTAH
Legend
Existing Road
Access Road
Drill Station
GEOLOGICAL SURVEY
MAY 2 7 1977
SALT LAKE CITY, UTAH
MINING BRANCH
Corral Knoll
Convulsion Canyon
#5
#6
#4
#3
#2
#1
US77-4
US77-3
77-32X
77-5L
77-5S
77-5M
77-5T
77-8U
77-8P
77-8V
77-8R
77-8O
77-7N
77-7W
77-7O
8400
8600
8800
7800
7400
31
32
6
5
7
8
12
18
N
MAP of SURVEY LOCATION

ARCHEOLOGICAL-ENVIRONMENTAL
RESEARCH CORPORATION

P.O. Box 17544 – Salt Lake City, Utah 84117
Tel.: (801) 582-0313

May 9, 1977

Subject: Archeological Clearance of an Access Route and Two Drill Stations in Convulsion Canyon, Utah

Project: Joint Coastal States Energy Company and SUFCO 1977 Exploration Project in Sevier County

Dept. of Agriculture Permit: Renewable Blanket Permit issued by Robert Safran, Director of Recreation, Region 4, U.S. Forest Service

To: Mr. Ralph Blumer, U.S. Geological Survey, 8426 Federal Bldg., 125 So. State, Salt Lake City, Utah

Mr. Dennis Anderson, Coastal States Energy Company, 5 Greenway Plaza East, Houston, Texas 77046

Info: Mr. Roger Holland, Coastal States Energy Company, 1354 East 3300 South, Suite 303, Salt Lake City, Utah 84106

A two thirds mile long access road and two drill locations in Convulsion Canyon were examined for cultural materials on May 5, 1977, by D. Weder of AERC, working in conjunction with geologist Dennis Anderson. The surveyed areas lie in Section 7 of Township 22S., Range 5E. The access road begins at drill station 77-7-N in the center of the S½ of the NE¼ and runs west to the new location US-77-2 which lies in the SW¼, SE¼, NW¼ of the section. The second drill station is situated in the SE¼, NW¼, NW¼ of Section 7 (see Map).

A 20 meter wide corridor along the access route and a 35 meter radius around each drill station were evaluated for cultural materials. No archeological sites relating to prehistoric or historic activity in the area were discovered, nor were any isolated artifacts either observed or recovered.

CONCLUSIONS AND RECOMMENDATIONS

Road construction, drilling, and vehicle movement upon the access route and two drill stations noted above will have no adverse impact upon the cultural resources of Convulsion Canyon providing Coastal States Energy Company and its field representatives comply with the following recommendations:

1) All vehicle movement, road construction activity, and drilling be confined to the cleared areas;

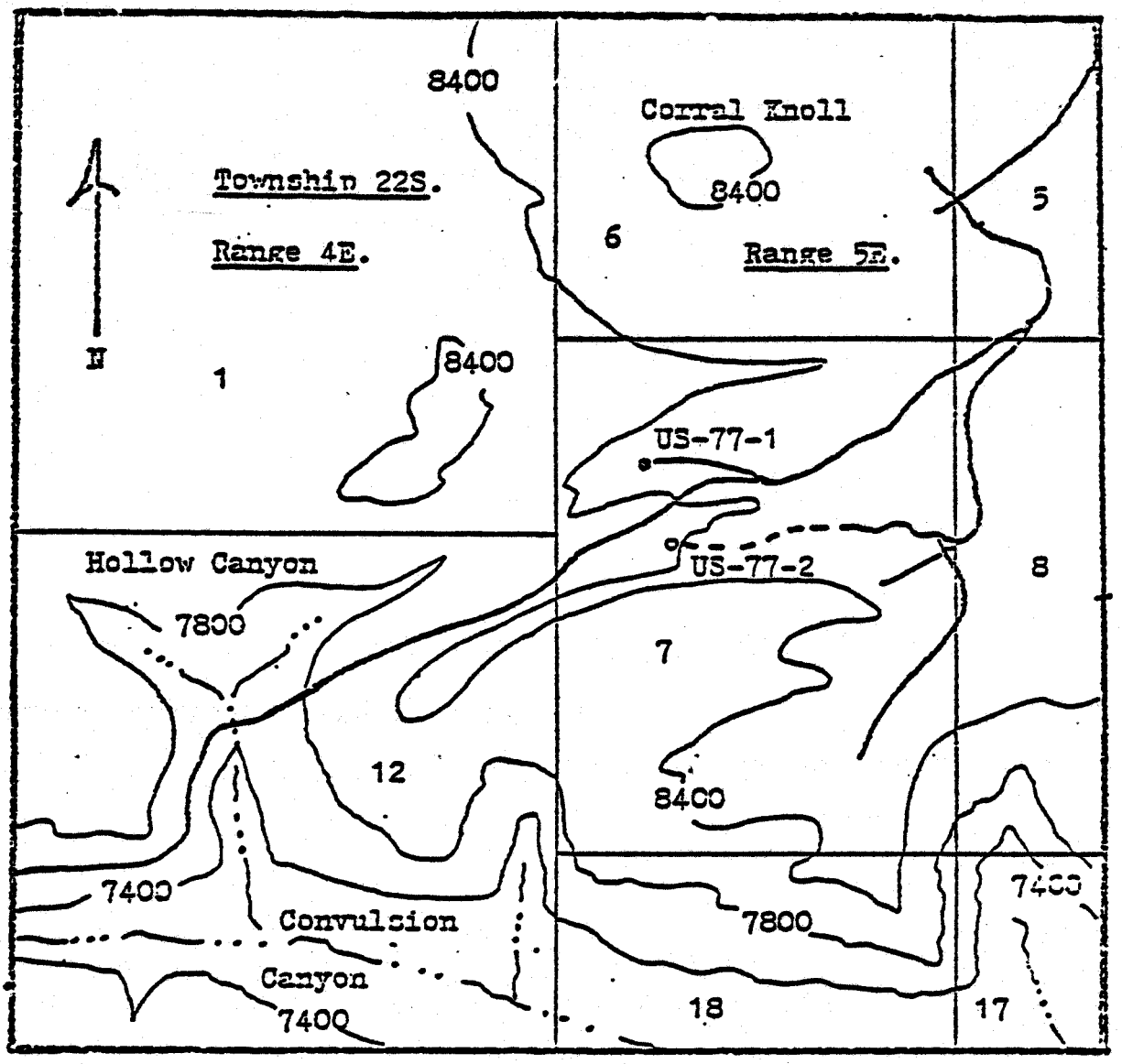
2) all personnel refrain from pilfering artifacts and from defacing any prehistoric or historic sites within the canyon; and

3) a qualified archeologist is consulted if cultural remains from subsurface deposits are exposed during construction operations, or if the need arises to relocate any segment of the drill locations or access road.

With adherence to these stipulations, a complete archeological and historical clearance for Coastal States Energy Company operations on sites noted above can be recommended.

F. R. Hauck

F. R. Hauck, Ph.D.
President



LEGEND

Existing Road

Access Road

Drill Location

SCALE (in miles)

0 .25 .5 1

MAP of
SURVEY LOCATION

Survey Locality

UTAH

ARCHEOLOGICAL-ENVIRONMENTAL
RESEARCH CORPORATION
P.O. Box 17544 – Salt Lake City, Utah 84117
Tel.: (801) 582-0313

ARCHEOLOGICAL RECONNAISSANCE REPORT

June 16, 1976

Subject: An Archeological Survey of Drill Locations and Access Roads in the Acord Lake Locality of Sevier County, Utah

Project: Southern Utah Fuels Company, 1976 Coal Drilling Program in the Blackhawk Formation

Dept. of Agriculture Permit issued June 10, 1976, by Robert L. Safran, Director of Recreation, U.S. Forest Service - Region IV

Utah State Permit: #181 (Survey), issued June 9, 1976

To: Mr. Robert Cracknell, U.S. Geological Survey, Conservation Division, 8426 Federal Bldg., 125 So. State St., Salt Lake City, Utah 84138

Mr. Ross Butler, U.S. Forest Service Offices, Richfield, Utah 84701

Mr. John Niebergall, U.S. Forest Service Offices, Ferron, Utah

Dr. Evan DeBloois, U.S. Forest Service Archeologist, Federal Bldg., 324 25th St., Ogden, Utah 84401

Mr. Vernal J. Mortensen, Southern Utah Fuel Co., 655 W. 1st South, Salina, Utah

Info: Mr. David Gillio, U.S. Forest Service Offices, Richfield, Utah 84701

Ms. Marilyn Malone, U.S. Forest Service Offices, Monticello, Utah

Dr. David Madsen, Utah State Archeologist, 603 E. So. Temple, Salt Lake City, Utah 84114

Mr. Loren A. Williams, Coal & Chemical Division, Coastal States Energy Company, 5 Greenway Plaza East, Houston, Texas 77046

Eight potential drill locations and one access road were examined for cultural remains on June 14 and 15, 1976, by F. R. Hauck working in conjunction with Geologist Vance Hall of Coastal States Energy Company (see Map). All drill pads and access roads are located on U.S. Forest Service administered lands. Seven of the drill locations and the access road are in the Fishlake National Forest; pad 76-28-K is located in the Manti-LaSal National Forest. The locations fall into three different township and range grids:

Township 21So., Range 5E.
Pad 76-31-G: located in the SW¼ of Section 31,
Pad 76-31-H: located in the NW¼ of Section 31,
Pad 76-32-J: located in the NW¼ of Section 32,
Pad 76-32-I: located in the SW¼ of Section 32,
Pad 76-28-K: located in the SW¼ of Section 28;

Township 21So., Range 4E.
Pad 76-36-E: located in the SW¼ of Section 36;

Township 22So., Range 4E.
Pad 76-1-D: located in the NW¼ of Section 1; and

Township 22Sc., Range 5E.
Pad 76-6-F: located in the NW¼ of Section 6.

A 30 meter diameter surface area at each drill location was examined for archeological artifacts and indications of prehistoric-historic cultural activity. An eight meter wide access road extending from the west-central boundary of Section 30, T.21So., Range 5 E. to Pad 76-32-I was also surveyed. Much of the access into drill locations 76-32-I was also surveyed. Much of the access into drill locations 76-32-J and 76-32-I is on an existing road. The segment of access road subjected to the most intensive examination extends between these two drill pads where no road exists or the existing road was not adequate for drill vehicle traffic. Cleared roads and drill pads were flagged in red.

Cultural remains were observed in three separate locations, all in Section 32, T.21So., R.5E. Two archeological sites, 42Sv671, and 42Sv672 were evaluated and site report forms prepared. Site 42Sv671 will not be endangered by vehicle traffic passing outside the site periphery and to the west, thus no mitigation to protect that site was initiated.

The original position for drill pad 76-32-J lay within the boundaries of Site 42Sv672. In order to protect that site, the drill pad location for 76-32-J was moved about 110 meters to the southwest, well outside the site periphery. The existing road passes between components A and B of Site 42Sv672; since a very marginal impact had already occurred

on the site, the access road was not rerouted. Site 42Sv672 is not readily identifiable and unless specifically pointed out, will not be in danger of secondary impact from drill personnel traveling along the existing road. Artifacts on the two sites were not collected; however, the most diagnostic tools observed on both sites were sketched for the benefit of the report (see Figures below). These tools consist of a biface blade fragment, a drill fragment and three projectile point fragments and are all very similar to Archaic period artifacts recently recovered in nearby western Emery County by AERC while surveying on a similar project for Consolidated Coal Company of Denver (the archeological report is currently in preparation).

The Pinto style point base fragment in Figure b was found on Site 42Sv671. In addition to the discovery of the two sites, a possible Paleo-Indian projectile point of the Cascade style was found about 60 meters southeast of Pad 76-32-I on an eroded surface of the eastern slopes immediately above the major drainage channel which flows to the east along the basin floor. This artifact, considered as an indicator of the prehistoric activity along the eastern slopes of the Wasatch Plateau, was collected; it and the Pinto base fragment will be retained within the special collection developed by AERC and maintained at the Weber State College facilities in Ogden, Utah.

Conclusion and Recommendations:

Drilling and equipment movement/operation upon the locations noted above will have no adverse impact upon the cultural resources of the Acord Lake locality if Southern Fuels Company, its field representation and its drilling contractors comply with the following recommendations:

1) All drilling operations and vehicle movement should be confined to existing roads, cleared drill locations, and cleared access roads;

2) field personnel should refrain from pilfering any known or unknown archeological site within the locality;

3) a qualified archeologist is consulted if subsurface cultural remains are uncovered during project activities, (such activities should be immediately suspended in the vicinity until mitigation procedures have been completed); and

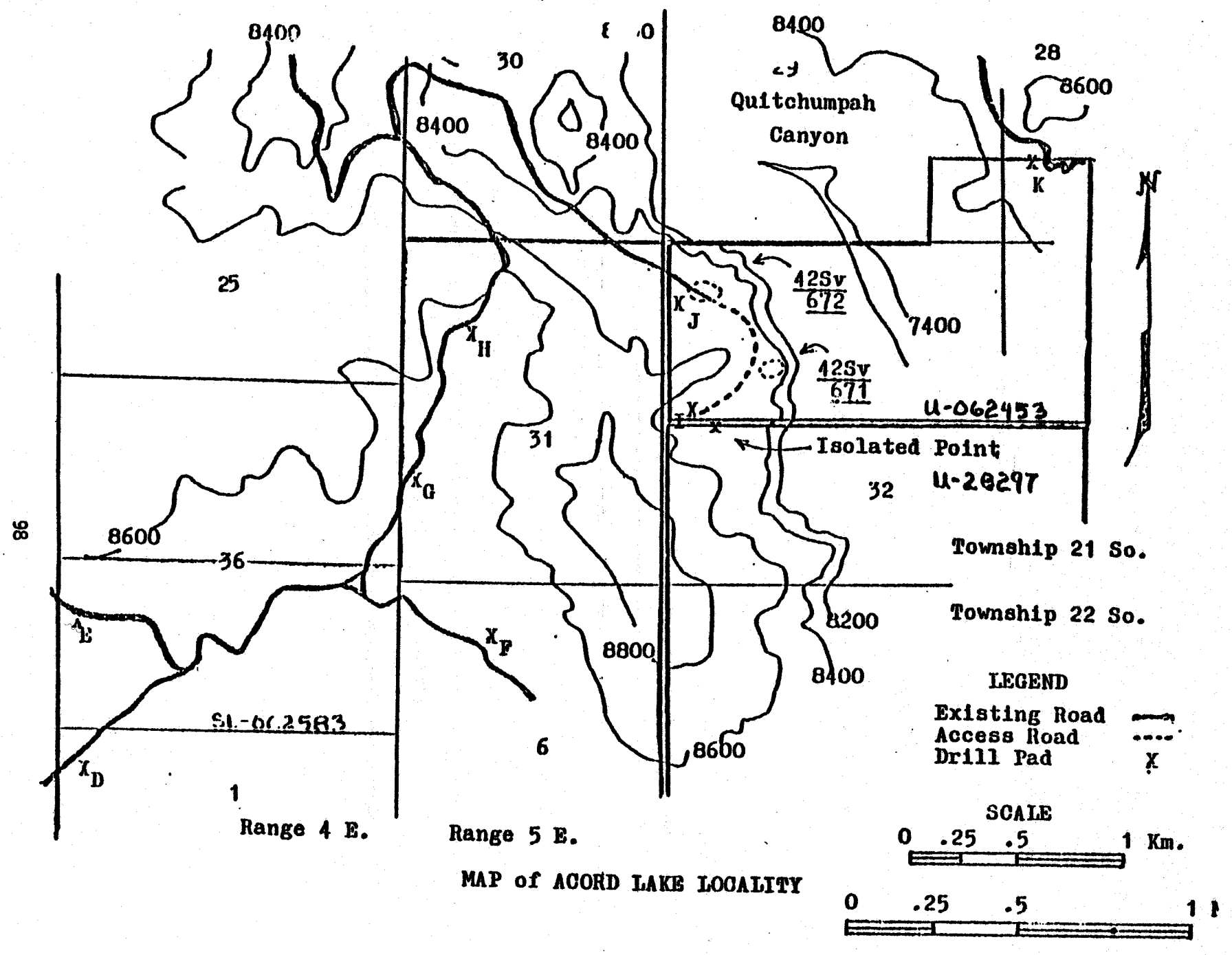
4) a qualified archeologist is consulted if the company desires to either relocate any cleared drill location/

access road, or to initiate any new drill locations/ access roads.

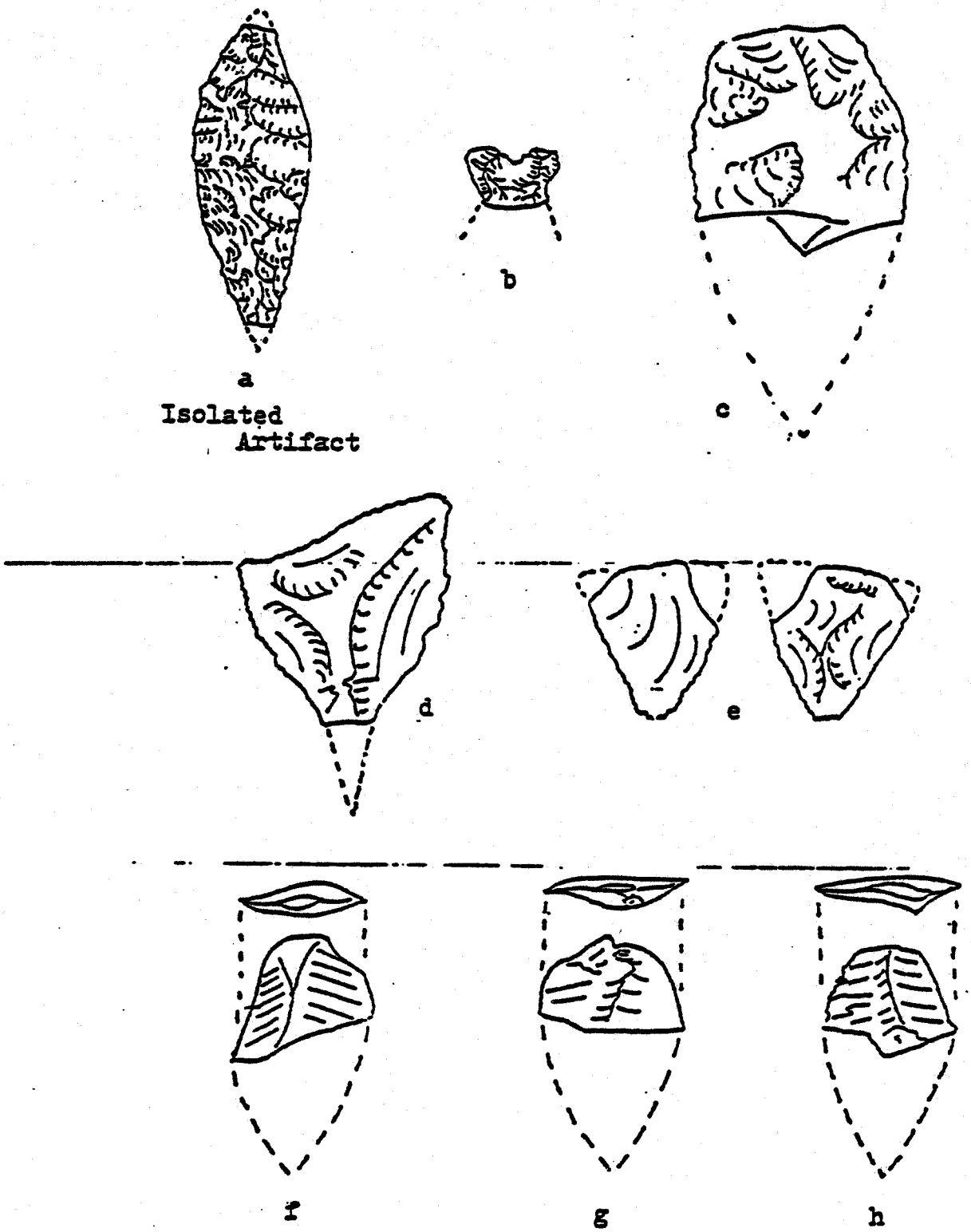
With adherence to these suggestions, a complete archeological clearance for Southern Utah Fuel Company and its field operations in the Acord Lake locality is recommended.

F. R. Hauck

F. R. Hauck, Ph.D.



MAP of ACORD LAKE LOCALITY



Scale: Actual Size

DEPARTMENTAL CORRESPONDENCE

Date September 15, 1977

Subject LEASE APPLICATION U-28297 DELAY EFFECTS ON MINE PLANNING

To Loren Williams Dep't. Resource Acquisitions

From Roland Heath RH Dep't SUFCo Engineering

The current mining plan submitted to the U.S.G.S. for mining practices on Federal Leases held by Coastal States Energy Company in the Convulsion Canyon area included plans inclusive of Lease Application U-28297. We included the lease application because of optimism at the lease outlook over the past three years and because of the logical mining unit that the addition of the application gives to the currently held leases.

The mine plan was developed with the following considerations:

1. Maximum Reserve Recovery
2. Mining method to give high production rates
3. Maximum belt efficiencies (size, re-use)
4. Even power distribution
5. Exhausting Fans at one location with intake air being introduced to the mine from punch outs at the outcrop in Convulsion and Quitchupah Canyons.
6. Product Quality Control
7. Water Drainage

Enclosed is Exhibit "A" showing mine development with acquisition of the lease. This plan was altered during August because of the lease delay. Development of the property has been based on the approved U.S.G.S. mining plan which has locked SUFCo into either mining with the plan without the lease, trying not to mine those areas which would close further development of the plan, thereby sacrificing recovery, increasing mining costs and decreasing mining efficiency; or, to develop a new plan which gives maximum recovery of the present lease but ignores any access into the lease to the east from present workings.

SUFCo is planning and using the first alternative, Exhibit "B-1" shows mine development on the present plan trying to maintain the integrity of the overall plan. With this alternative, as mining progresses, it too will mine areas that will close access to the lease application and reduce recovery. As the lease acquisition is delayed further, the lease will become a separate area having to be developed as a separate mine with only access at one east from present mine portals or from Quitchupah Canyon which will necessitate new portals and facilities.

Developing the lease as a new mine would probably be similar to the plan shown in Exhibit "B-2". This plan shows access from the Canyon or One East submain - if the lease is granted to SUFCo.

If SUFCo develops the lease as a separate mine it would involve the following losses:

1. Tonnage losses due to bleeders system and structural barrier pillars would be approximately 1,575,000 tons.

2. 2 East, 3 East and 4 East submain development for the original mine, (ventilation overcasts, belt drives, main transformers, etc.) would only obtain approximately 20 percent of the coal tonnage intended.

3. Belt drives, ventilation, overcasts, etc. would be reduplicated for the new lease.

4. The same portals and facilities would be reused, not contributing to any further environmental impact as long as it is developed before depletion of present leases.

There are several ways to develop a plan to mine the lease application. However, we feel the following is the least objectionable. Exhibit "B" shows the configuration of the layout with coal being shipped by truck to the town of Emery, Utah and possibly to the town of Price, Utah for train shipment.

This particular configuration would:

1. lose approximately 1,575,000 tons of coal from combined plan shown in Exhibit "A".

2. necessitate improving a one lane farm road for 5 miles. The road is located approximately 4 miles southwest from the town of Emery, Utah (portions of the road are private, the rest BLM) - shown on Exhibit "C".

3. at the mouth of the north Fork of Quitchupah Creek an access road would have to be constructed for approximately 2 miles up the canyon.

4. mine facilities could be constructed at this point - elevation approximately 6800 ft.

5. mined coal could be conveyed out of the mine and dropped through a chain drag chute to a collector and then conveyed overland to the mine facilities approximately 1500 ft. at slopes not greater than 18 degrees.

6. a road would have to be built from the mine facilities to the portals approximately 3/4 mile long and transcending a vertical sandstone cliff 300 ft. high.

7. Facilities would include:

   A. Power distribution
   B. Water system
   C. Sewer system
   D. Shop Building
   E. Bathhouse
   F. Coal storage and truck loading facilities
   G. Ventilation Fan

No attempt has been made to place a cost value to the cases above but it is very apparent that starting a new mine in Quitchupah Canyon would be environmentally difficult with very little operational life for the facilities. The loss in coal recovery adds to the environmental impact. SUFCo's present leases constitute a fair mining unit. The addition of the lease application to SUFCo contributes to a well balanced mine with good reserves for the facilities and development that has been established in east spring canyon.

IN REPLY REFER TO

United States Department of the Interior

BUREAU OF LAND MANAGEMENT
Moab District Office
Price River Resource Area
P. O. Drawer AB
Price, Utah 84501

3500
(U062)

Title: Public Meeting for Kanawha & Hocking Coal & Coke Company and Coastal States Energy Company Coal Leases

Date: December 21, 1976

Author: Leon Berggren

Leon Berggren welcomed the group and introduced some of the people who were in attendance from government agencies.

John Coleman, BLM, Moab District Office, made the presentation concerning the Kanawha & Hocking Coal & Coke Company. K & H Coal & Coke Company is a wholly owned subsidiary of Valley Camp Coal Company. On May 9, 1975, Valley Camp applied for a competitive lease sale for 160 acres on National Resource Land. The coal is located on 33.6 acres of National Resource Land. To date, there has been little public controversy concerning this lease. The Utah #2 mine is not presently mining federal coal. The additional acres of National Resource Land being applied for will have no additional impacts upon the area, except to briefly extend the life of the mine. It has been determined that economic access to the coal will be lost if the coal is not mined through the Utah #2 mine. Almost three-quarter million tons of coal would be lost if it is not mined now. Using a royalty rate of eight per cent, this would equal a loss to the federal government of $750,000.

Kanawha & Hocking Coal & Coke Company is applying for this lease under the criteria that the coal is needed now to maintain the existing operation and the area applied for is not an economic mining unit and if not mined now, the coal would be lost.

The surface of the lands in the proposed lease sale are in private ownership owned by George Telonis and Earl Thomas.

The Utah #2 mine employs approximately 75 people. The current production of Utah #2 is currently 1,500 tons per day or about 400,000 tons per year, with a five-day work week. This tonage level or a slightly higher level is expected to continue for about 12 years.

CONSERVE AMERICA'S ENERGY

Save Energy and You Serve America!

The proposed lease sale would lengthen the life of the mining operation for just over one year. The coal that is now being extracted from the mine is being sold to utilities in the eastern United States. If the coal is not extracted at this time, reasonable access to the coal would be lost due to the mining of the surrounding area.

The Bureau of Land Management is responsible for the issuance of the lease and has the lease responsibility for this action, with the participation of U. S. Geological Survey. By the issuance of the lease, the government would grant to the leasee exclusive rights and privileges to mine and dispose of the coal and other terms of the lease. The BLM does not recommend the sale of all the tracts that Kanawha & Hocking has made application for. The BLM recommends the sale of 120 acres instead of the full 160 acres due to the discrepancy in the location of the Scofield fault.

An Environmental Analysis Report Tech Exam has been written. The purpose of this exam is to assess possible impacts that development and mining activities would have on the existing environment and resource values and to mitigate the possible impacts. The tech exam also provided the setting of a bond which is proportionate to the magnitude of the potential surface disturbance in the event that the reclamation is not completed to the BLM's satisfaction. The following environmental impacts are contained in the E.A.R.:

Climate - No impact

Noise - No additional impacts than now exist

Topography - Possible slight subsidence

Soils - No impact

Geology - Beneficial impact -- mining of coal that would otherwise be lost

Water & Watersheds - None -- present effects will continue whether lease is granted or not

Vegetation & Livestock - None -- all mining activities are underground

Fish - Limited -- prolonged effect on turbidity and increased sediments

Wildlife - Accumulative effect detrimental to deer and elk from disturbance, harassment, poaching, and etc.

Effect on Local Economy - Beneficial

Social-Cultural Interests - No impact

Human Values - No adverse effect

Public Health & Safety - No additional problems

Land Use - No negative effect

Tex Williams, representing the Fishlake National Forest, Richfield, Utah, made the presentation concerning the Coastal States Energy Company.

On October 1, 1974, Coastal States Energy Company of Houston, Texas, asked that a special lease be made to them for a parcel of land east of their present mine holdings. This parcel of land contains 2,669 acres. Of this 2,669 acres, 202 acres are BLM land; 263 acres are on the Manti-LaSal National Forest; and 2,205 acres are on the Fishlake National Forest. All of this land is in Sevier County and in the Quitchempah Drainage.

This coal of the Star Point is in a sandstone formation and has been described within Wasatch Plateau Coal Field of Utah. The deposits are the same as is being mined by Southern Utah Fuel Company, a subsidiary of Coastal States Energy Company.

The thickness of the coal below the surface in the north area is from eight feet to sixteen feet. The coal is low sulphur high BTU western coal. It is estimated that from 10 to 19 million tons of coal can be extracted. The overburden is from 600 feet to 1,500 feet, with most of it in the 600 feet to 1,000 feet range.

The elevation of this land is from 7,000 to 8,500 feet. The slopes range from 0% on the benches to 100% on the scarp faces. The coal is located predominately in the southeast portion of land applied for. There is an annual rainfall of 12 to 16 inches. There is a frost free period of 80 to 100 days. This land is all located in the Salina Management Unit.

Sagebrush and Ponderosa Pine are found on the benches. Narrow stringers can be found in the canyon bottoms. Sagebrush, Gambels Oak, and Mountain Mahogony are found on the rolling hills.

There are two streams that cross the lease. One of these is in Convulsion Canyon and the other is North Quitchumpah Creek. There are no known springs on the lease, but there are some immediately west of the area to be leased.

This land is used by elk and deer. It is used as a winter concentration area for the elk and a summer use area by the deer. The recreation use of this area is primarily for one month for deer hunting; however, there is some elk hunting.

There is livestock on this area in the Quitchumpah Pasture of the Quitchumpah C & H Allotment. The Quitchumpah Grazing Association members are mainly from the Emery area. At least one spring on the area could be affected by disturbance of an acquifier.

The air quality in this area is very high. The only source of air pollution is dust from traffic on the mine road.

There is an increased chance of fire because of the increase of human activity.

There are archeologic remains present throughout the area. A survey will have to be done for any activity in this area. There are no other known minerals present in this area.

The Southern Utah Fuel Company, a subsidiary of Coastal States Energy Company, employs approximately 140 people. Most of these people are from the Salina area. If this lease is issued, there would be an increase of approximately 50 jobs plus the support in the Salina area. There would also be more stability by increasing the mine life.

The soil in this area is generally stable. The soil is shallow with a high percolation rate.

There are special use permits issued on this land. Two are issued to Utah Power & Light Company for power lines to service the Convulsion Mine.

There is low quality Ponderosa Pine on the benches with cutting limited to old, over mature trees. There is presently a sale for 760,000 board feet.

The lease area is served by low standard dirt roads. The vegetation changes with land forms. Sage, grass and Ponderosa Pine are grown on this lease area. There are openings with native grass, forbs and low brush species. Pinyon and Juniper trees grow on the steep slopes. Vegetation of native grass, low brush and forbs are found in the narrow canyon bottoms. Visual resources are seen from the Emery and Duncan Mountain Road.

For two million tons of coal, approximately 22,000 gallons of water is needed for the mine machinery. The mine is producing enough water to meet this need. 10,000 gallons of water a day for cullinary purposes is being met by the water rights on the spring near the mine.

No matter who gets the lease, exploration holes will have to be drilled. There is an estimated eight holes that will have to be drilled.

There are unavoidable adverse affects which include:

1. Increased dust
2. Increased carbon monoxide
3. Disturbance from drilling
4. Increased water turbidity from surface disturbance
5. Fire hazard increased by the increase of people
6. Increased road conflict with the elk migration
7. Sub surface water channels altered
8. Road constructed will leave permanent scars

The irreversible and irretrievable commitment of resources include the following:

1. Coal consumed
2. Underground water channels

The alternatives of taking no action would be that no new impacts would be made on the immediate vicinity and the coal reserve would still be there. The disadvantages of taking no action would be that the coal would be expensive to mine in the future and there would be several disadvantages to the company's mine development plans and operation.

The advantages of the lease to Coastal States Energy Company in a noncompetitive bid would include the following:

1. Many to Coastal States (life of mine machinery, etc.)
2. Desirable for surface managing agency
3. No new facilities
4. No increase in traffic
5. No increase in disturbance except for drilling

The disadvantages include the following:

1. Keeps other companies from having opportunity to bid
2. Extends time of disturbance in area by extending life of mine

The advantage of a lease by competitive bid with a stipulation that the coal must be retrieved through existing mine facilities is that allows other companies the opportunity to bid on the lease. The disadvantages include the following:

1. The coal is mined over shorter periods of time
2. The existing facilities are designed to handle only two million tons of coal. Increased production would cause new construction.
3. There would be a conflict between two companies
4. Higher cost of coal recovery

The advantages of a lease by competitive bid and allowing new mine facilities include the following:

1. It would allow for more competition
2. There would be more new jobs and economic stimulus in the area

The disadvantages include the following:

1. Environment impacts on the following:
   a. Wildlife
   b. Roads
   c. Powerlines
   d. People
   e. Special uses
2. Greater cost of recovery
3. Questionable if reserves are large enough to support new mine

The management requirements and constrants would include the following:

1. The leasee will provide an alternate water supply if the springs are dried up due to mining activity.
2. There will be no surface activity from November to April because of wintering elk.

The Forest Service recommends that the lease be granted to Coastal States Energy Company and that the coal be mined out of the existing portals. If someone else bids successfully, the Forest Service is not in favor of new roads and portals on National Forest Lands.

Denis Anderson, landman and environmental coordinator for Coastal States Energy Company made a presentation in behalf of his company.

"Southern Utah Fuel Company, a division of Coastal States Energy Company, is involved in mining federal coal at its underground mine in Sevier County, Utah.

Mine production has increased rapidly from 70,000 tons in 1970 to more than one million tons for 1976. An expansion program is underway which could result in two million tons or more per year by 1980. The operation currently employs 129 people with an annual payroll of $3.8 million, both of which are expected to increase.

In addition to the people and plants of Sevier Valley, Southern Utah Fuel Company (SUFCo) supplies coal to other area users. This mine is already an important fuel source and a significant part of the local and state economy and will become even more so.

SUFCo has a problem which threatens the orderly development of this resource. They recognized some time ago the need to secure additional reserves and in October of 1974 made application to the federal government for a coal lease on adjacent lands (BLM Application #U-28297). These lands are needed to replace depleted reserves, to provide a base for expanded operations and to assure an orderly, efficient operation.

The Forest Service with their Environmental Analysis Report suggested that mining through their portal is the only environmentally and economically acceptable means to develop this reserve.

Excessive boundary restrictions limit the concepts which may be employed in mine development. Already SUFCo is developing the mine in a manner prescribed by lease boundaries rather than in the manner which would result in the best recovery of reserves and in the best mining sequence for roof control.

The reasons for which SUFCo made application more than two years ago are ever more pressing and urgent now because of the mining that has occurred since, the accelerated rate at which mining is now being conducted, and the increasing market demand within the area they serve. The point of no return is fast approaching. They must make a decision in 60 days whether to by-pass this otherwise mineable block and thus render it nonrecoverable forever.

More than two years have passed since SUFCo made application and as of yet no lease has been issued. This situation must be cleared up very soon in order to avoid adverse affects on the production of a vital fuel source and the jobs this activity provides.

SUFCo strongly urges that BLM proceed to issue this coal lease."

The meeting was then turned into a question and answer period. Stewart Fausett asked if there was any specific reason why the BLM preferred to lease the 120 acres instead of the 160 acres. John Coleman stated that it was due to the undetermined discreptency of the Scofield fault. David Shaver asked which side of the fault is Valley Camp mining on. Roger Markle, Valley Camp of Utah, stated that they were mining on the west side.

Vard Johnson, Itel, asked if this lease was being applied for on a short term lease. Max Nielson, BLM State Office, stated that both leases were being applied for on a short term lease. Vard Johnson asked if the leases were going to be issued to the applicant's on the basis of this hearing. Max Nielsen stated that any coal sales in the future will be on competitive leases, except those on privilege use right applications. The situation is that the only way it can be leased is by competitive leasing.

Ray Christensen, Soldier Creek Coal, asked if this is the only activity that will be required before the lease is given. Max Nielsen stated that there would not be any more hearings before the lease sale.

J. A. Harvey asked if this is but one competitive lease, would they have to take in from the existing portals. Max Nielsen said that if someone else got the lease, it would have to be looked at again. The government would have to look at what the leasee wanted to do. On short term lease, the government cannot lease to anyone but the highest bidder. U.S.G.S. has an evaluation team in Denver and they estimate the fair market value. J. A. Harvey asked what is a fair market value. James Travis, U.S.G.S., stated that the fair market value differs in different areas.

Dave Shaver asked what the estimated recoverable tonnage would be. Tex Williams, Forest Service, stated that there is 20 to 30 million tons of recoverable coal. Dave Shaver asked where the existing work stopped. Tex Williams stated that the existing work stopped at the lease line. Dave Shaver asked if there was less than eight million tons of coal in the green block shown on the map. Tex Williams said that there was approximately 18 years of mining left in the green block. If they don't soon get the coal, they will have to change the angle at which they can get the coal.

With no further questions or statements, the meeting was adjourned.

Lisa E. Bryson

VISITOR'S ROSTER

WISH TO SPEAK YES	WISH TO SPEAK NO	NAME	OFFICE/ADDRESS	REPRESENTING
✓		C. [illegible]	[illegible], Utah	Private Consultant
	✓	Paul Buff	Price, Utah	BLM
	✓	Carl Winters	East Carbon, Utah	U.S. Steel
✓		[illegible]	Moab	BLM
	✓	[illegible]	Ferron, Utah	Forest Service
	✓	[illegible]	Salt Lake City, Ut	U.S.F.S. Conservation Div.
✓		[illegible]	Price, Utah	U.S. Forest Service
	✓	[illegible]	Richfield, Utah	U.S Forest Service
	✓	[illegible]	[illegible]	Valley Consultants
	✓	[illegible]	Richfield, Utah	Valley Cons. of Utah, Inc
	✓	[illegible]	Richfield Utah	Forest Service
	✓	[illegible]	[illegible]	BLM

VISITOR'S ROSTER

WISH TO SPEAK YES	WISH TO SPEAK NO	NAME	OFFICE/ADDRESS	REPRESENTING
	✓	Ray Lopo	Price	Swisher Coal Co.
	✓	Roger Marke	SLC	Valley Camp of Utah
		[illegible]		Swisher Coal Co
	✓	Stewart Fawcett	Price, Utah.	KOAL Radio.
		Brendan Steele	Price	
	✓	Robert J. Steele	Helper, Ut.	Valley Camp of Utah
	✓	J.W. Smith	Price	Deseret News.
	✓	Lupe Thomas	Price	Forest Service
	✓	Virgil Lamb	Price	Valley Camp of Utah
	✓	Glenn Sides	East Carbon	USS Steel
	✓	Ray Christensen	Price Coastal States Energy Co	Soldier Creek Coal
		[illegible]	Greenway Plaza E	Coastal States/Suf

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VISITOR'S ROSTER

WISH TO SPEAK YES	WISH TO SPEAK NO	NAME	OFFICE/ADDRESS	REPRESENTING
	X	Dan Austin	Carbonville, Utah	Valley Commissioner
		Vard Johnson	Price, Utah	Ind

VISITOR'S ROSTER

WISH TO SPEAK		NAME	OFFICE/ADDRESS	REPRESENTING
YES	NO			
	✓	Doug Tullis		Sun Advocate

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rehabilitation these acres could be brought back into production within a 2-3 year period.

Two springs located adjacent to the proposed lease area could dry up as a result of mining activities. Vegetation surrounding the springs could die and be replaced by a dryland vegetative type. Less than one-fourth of an acre of vegetation could be affected.

Any proposed threatened or endangered species in the area would be avoided when proper clearances are made prior to on-the-ground activities.

2. Alternate Ownership

In addition to those impacts described above, vegetation would be disturbed and removed on 75-100 acres. Much of this would extend for the life of the mine as the land would be used for haulage roads, mine sites, etc.

The probability of encountering possible threatened or endangered plant species would be enhanced with increased soil disturbance. However, if proper clearances are made, these species could be avoided.

I. Socioeconomics

1. Coastal States Proposal

The city and county tax base and total regional income associated with continued coal mining would contribute to the Salina and Sevier County business economy. Increases in the work force at the mine would increase the total regional income.

These additional jobs would induce some of the local young people, who would normally leave the area, to stay as well as providing additional sources of income for long-time residents. Support businesses such as food stores, gasoline stations, restaurants, etc., would benefit since much of the anticipated additional income would be spent locally. No significant housing shortages would be anticipated.

2. Alternate Ownership

Socioeconomic impacts are difficult to define since no proposal for another mine in the area has been made. Therefore, the number of people and kinds of equipment involved are not known. It can be assumed that the impacts would be similar to other mines in the general area; approximately 150 employees would be involved. An undetermined number of "outsiders" would probably move into the area bringing extra incomes and causing possible housing shortages.

J. History, Archaeology, and Paleontology

1. Coastal States Proposal and Alternate Ownership

Proper clearances made prior to on-the-ground activities would protect cultural values which otherwise could be damaged or destroyed.

K. Public Health and Safety

1. Coastal States Proposal and Alternate Ownership

Coal truck traffic would increase from an average of 9.6 trucks per hour to 11.1 trucks per hour for the life of the mine.

L. Timber Management

1. Coastal States Proposal and Alternate Ownership

The more extensive activities associated with alternate ownership would probably require the removal of some timber species. No tree removal is anticipated for Coastal States' proposal.

M. Range Management

1. Coastal States Proposal and Alternate Ownership

Should the lease be issued to Coastal States, less than 1 percent of the total forage or 2 AUM's would be temporarily lost. No existing range improvements would be affected. Reduction or loss of flow from the two springs near the proposed lease area would alter distribution of grazing livestock. Additional pressure would be placed on other water sources in the area.

An undetermined amount of forage would be taken out of production as a result of construction of new haul roads, mine facilities, etc. by an alternate lessee. Assuming that 100 acres of forage were taken out of production, the result would be the loss of about 7 AUM's which represents approximately 3.7 percent of the allotments affected. No permanent range improvements would be affected.

N. Recreation and Aesthetics

1. Coastal States Proposal and Alternate Ownership

Activity associated with alternate ownership would affect the aesthetic quality of the area by building access routes onto the lease area and the construction of new surface mining facilities.

Little, if any, interference with hunting activities would be anticipated.

Construction of four air intake portals on the vertical cliffs of Convulsion and Quitchupah Canyons would alter the visual quality of the topography near the portals. This disturbance is expected to be minor as similar portals in the area are difficult to see. Each portal would be 8 by 20 feet and enclosed by a wire cover.

O. Transportation

1. Coastal States Proposal and Alternate Ownership

Coal traffic would increase from 9.6 to 11.1 trucks per hour, 6 days a week, 20 hours a day.

P. Research, Administration, and Special Uses

1. Coastal States Proposal and Alternate Ownership

No environmental impacts are anticipated.

Q. Wilderness and Roadless Areas

1. Coastal States Proposal

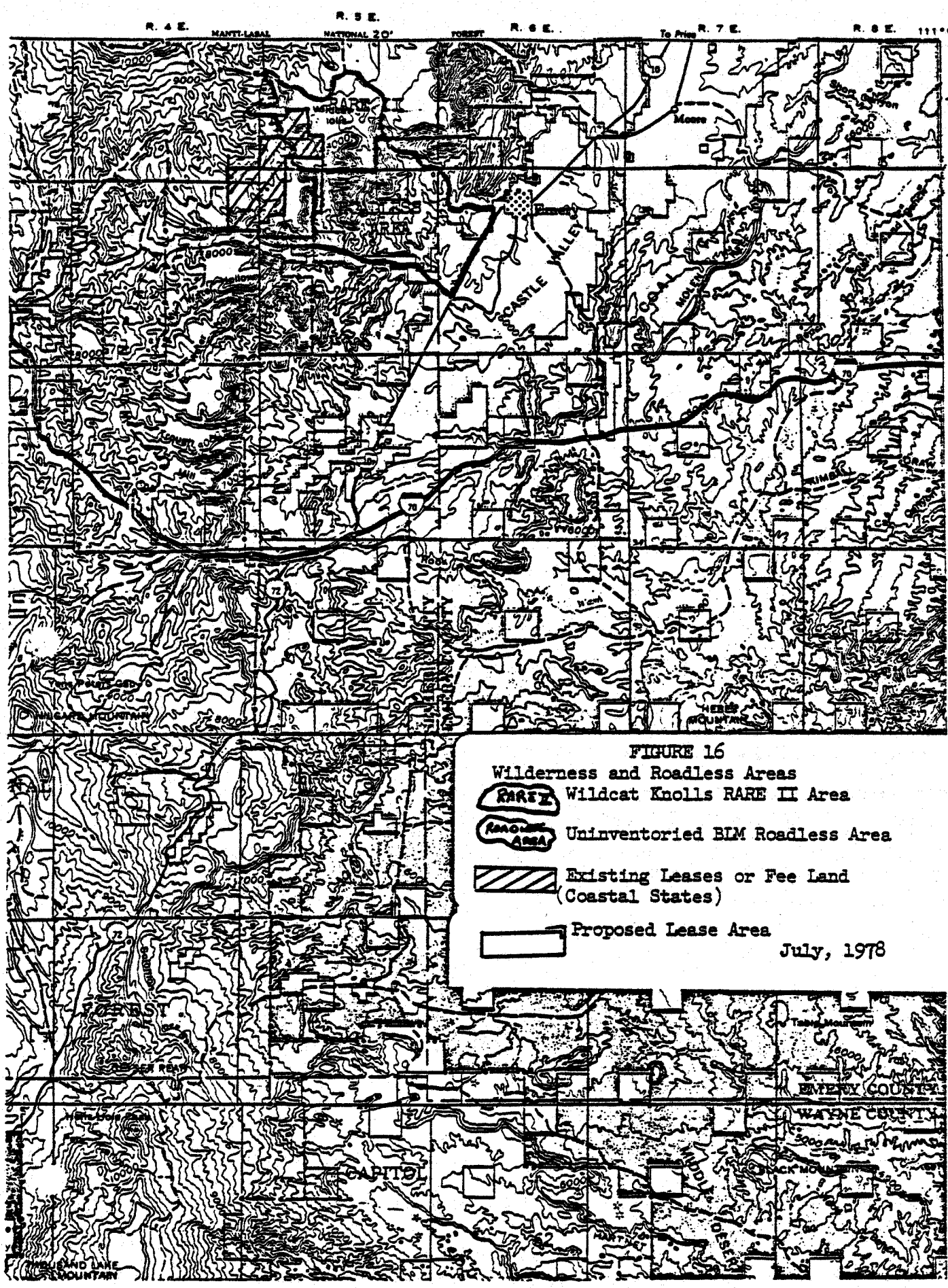
Phase I underground mining of coal from some 50 acres of the proposed lease area would not alter the wilderness characteristics of the area. There would be no additional surface facilities located on the lease sale tract if it is mined from the existing facilities.

Possible roadless and wilderness values of BLM administered lands on the proposed lease area likewise would not be affected by lease issuance. Phase I mining would occur on some 60 acres but no subsidence would be expected. No surface activities would occur.

2. Alternate Ownership

If an entity other than Coastal States obtains the lease, possible development on the RARE II area would be necessary. Should surface facilities be constructed in Quitchupah Canyon, loss of possible wilderness values would occur as access or haulage roads and mining facilities are inherently incompatible with wilderness values.

Possible roadless or wilderness values on BLM administered lands on the proposed lease area would be lost if surface disturbance were allowed.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T. 27 S.
CASTLE VALLEY
EMERY COUNTY
WAYNE COUNTY
CAPITOL
FIGURE 16
Wilderness and Roadless Areas
RARE II
Wildcat Knolls RARE II Area
Uninventoried BLM Roadless Area
Existing Leases or Fee Land
(Coastal States)
Proposed Lease Area
July, 1978

CHAPTER VI

RELATIONSHIP BETWEEN SHORT-TERM USE OF MAN'S ENVIRONMENT AND THE MAINTENANCE AND ENHANCEMENT OF LONG-TERM PRODUCTIVITY

Subsidence and surface fractures would be permanent surface deformation features directly related to mining. Approximately 922 acres would be subject to subsidence in addition to approximately 1,021 acres resulting from mining activities on existing leases (WESTECH, 1977). Proposed mining activities and resultant subsidence would preclude the placing of any permanent structures on the proposed lease area. Two springs located near tne proposed lease area may dry up or have reduced flows resulting from expanded mining. Some change in wildlife and livestock distribution would result, but is not expected to be significant.

Soils disturbed by the expanded mining activities (3-5 acres for Coastal States or 75-100 acres for alternate ownership) would be taken out of vegetative production and committed to mining activities. Duration would range from a single growing season (associated with exploration activities) to an essentially permanent loss resulting from construction of haulage roads, mine site, etc. which would be associated with alternate ownership. Those lands which could be revegetated would eventually return to previous production levels.

Development of possible oil and gas reserves on the proposed lease area may be made difficult by extraction of the coal. Coordination efforts between interested parties would be necessary.

Coastal States would hire an additional 51 employees in the near future from the local population in Sevier and Sanpete Counties. The city and county tax base and total regional income associated with expanded mining would contribute to the Salina and Sevier County business economy. It is assumed that under an alternate owner, approximately 150 employees would be required. Some of these would be brought into the area.

The purpose of the proposed action is to provide a supply of coal for the generation of electricity and other industrial uses. The use and commitment of about 21 million tons of coal (14 million tons recoverable, the remainder unrecoverable) involves a tradeoff between presently needed coal and other energy resources, some of which are in short supply. The use of this coal would help alleviate shortterm energy demands and would constitute utilization of a natural resource, thus contributing towards the nations self-sufficiency in energy.

Coal extraction represents an immediate commitment of the resouce. Improvement in underground mining techniques, resulting in greater recovery rates than experienced at the present, can be expected in the future. Coal-fired electric generating plants, such as the proposed Volmy Plant to which this coal would probably go, are relatively inefficient. About 33 percent of the fuel energy is converted into electrical energy (Karkheck, et al., 1977). Future technology could improve efficiency.

The construction of an access road into relatively undisturbed Quitchupah Canyon would affect the visual qualities of the area. The haulage roads and mine sites would probably be visible after mining activity ceases.

CHAPTER VII

ANY IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES

A. Geology and Topography

1. Coastal States Proposal

Mining the lease area following the issuance of a lease would result in the irreversible and irretrievable commitment of 922 acres (35 percent of the proposed lease area) to subsidence. Subsidence would be expressed as surface deformation caused by depressions 8 to 20 feet in depth, and as tension cracks on the ground surface. Such tension cracks most likely would not be expected to exceed 1 foot, either vertically or in width.

2. Alternate Ownership

Irreversible and irretrievable commitments of resources would be similar to those described for the Coastal States proposal.

B. Mineral Resources

1. Coastal States Proposal

The proposal would require the irretrievable commitment of 14 million tons of coal at a 66 percent recovery rate. The remaining 34 percent, or 7 million tons of coal would be permanently lost for use because of its inaccessibility after mining of the recoverable coal.

2. Alternate Ownership

Alternate ownership would result in the irretrievable commitment of coal at a recovery rate of 45 to 60 percent. The remaining 8.4 to 11.5 million tons of coal would be permanently unavailable for use because of the need to leave barrier pillars between Coastal States' operation and a new mine.

C. Hydrology

1. Coastal States Proposal

Subsidence may cause the irretrievable loss of flow from two local upland springs. The likelihood of this occurring cannot be accurately predicted as it is unknown whether these springs may heal themselves and again establish normal or near-normal flows.

2. Alternate Ownership

A similar irretrievable commitment of water resources may occur, as indicated for the Coastal States Proposal.

D. Fish and Wildlife

1. Coastal States Proposal

Should subsidence cause the irretrievable loss of flow from two local upland springs, there would be an accompanying irretrievable loss of wildlife habitat in an undetermined amount.

Deer mortality on I-70 in Salina Canyon would represent an irretrievable loss of 16 additional deer annually, or 320 deer during the 20-year life of the proposal. This loss would be in addition to losses attributable to the present level of mining by Coastal States.

2. Alternate Ownership

The irretrievable loss of wildlife habitat subsequent to subsidence would be similar to that described for the Coastal States Proposal.

Deer mortality associated with coal haulage on access roads and I-70 in Salina Canyon, and commuting miners would cause an irretrievable loss of animals. The number that would be lost cannot be quantified because of the lack of data on yearly tonnage production, coal haul route, and daily traffic attributable to coal production by an alternate lessee. The increased loss would continue for the projected 25-year life of the proposal.

In addition, an undetermined amount of deer and elk range would be irretrievably lost because of road construction and other surface disturbance.

E. Vegetation

1. Coastal States Proposal

The possible irretrievable loss of flow from two springs located adjacent to the proposed lease could cause an irreversible change in vegetation composition on less than one-fourth of an acre of vegetation around the springs.

2. Alternate Ownership

The irreversible change in vegetation composition around the two springs would be similar to that described for the Coastal States Proposal.

Additionally, an undetermined amount of vegetation would be irretrievably lost by road construction and other surface disturbance.

F. Range Management

1. Coastal States Proposal

No irretrievable or irreversible commitments of range resources would occur.

2. Alternate Ownership

An undetermined amount of AUM's would be irretrievably lost. This loss would be less than the 7 AUM's described in Chapter II.

G. Recreation and Aesthetics

1. Coastal States Proposal

No significant irretrievable or irreversible commitments of recreation and aesthetic resources would occur.

2. Alternate Ownership

The presence of access on the vertical cliffs of Convulsion and Quitchupah Canyons would cause a major irretrievable and irreversible commitment of aesthetic qualities.

H. Wilderness and Roadless Areas

1. Coastal States Proposal and Alternate Ownership

No irretrievable or irreversible commitment of wilderness or roadless values would result from lease issuance if no surface disturbance were allowed until a determination of wilderness character is made. If the areas are determined not to have wilderness values, then possible surface activities could proceed.

CHAPTER VIII

NO ACTION ALTERNATIVE

Adoption of this alternative would preclude mining the coal on the proposed lease area at this time.

Selection of this alternative would not result in any additional impacts on biological or physical components of the environment over and above those currently occurring in connection with existing operations and uses in the area.

No adverse impacts on the social economic component of the environment would occur, however anticipated jobs resulting from lease issuance and support services would not materialize.

Coastal States would continue to mine from existing holdings. Production levels would be reduced and some difficulty may be encountered in extending some of the existing contractural commitments. Coastal States estimates that they will lose an estimated 2,205,199 tons of otherwise recoverable coal from their existing reserves if the lease is not issued (Appendix 3). This coal would not be available to consumers.

CHAPTER IX

RECORD OF INVOLVEMENT

During preparation of the original EAR's, the following were consulted:

U.S. Geological Survey. Provided advice on actions and activities that would result from the proposal.

Utah Division of Wildlife Resources. Indicated that the proposal would have no significant increase of impacts over present mining activity so far as wildlife is concerned. They have no objection to the proposed action.

Local Residents of Aurora and Salina, Utah. Several persons were contacted individually. The consensus was favorable toward the proposal.

Emery Irrigation Company. Two efforts were made to contact them. One contact was made by letter, but no reply was received. One contact was made by phone, a message left for a return call, but there was no reply. This was interpreted as non-committal.

Quitchumpah Cattlemen. Their opinion was no objection to the proposed action.

U.S. Fish and Wildlife Service. The Salt Lake City office reviewed the draft EAR and agreed with the analysis and conclusions with regard to threatened and endangered species.

A public meeting was held on December 21, 1976, in Price, Utah, to discuss the Coastal States and Kanawha and Hocking Coal and Coke Company lease proposals. Copies of the U.S. Forest Service and BLM minutes are attached as Appendix 4. The public meeting was also intended to obtain information for inclusion in the original EAR. (Coastal States EAR dated March, 1976.) Representatives from the Fishlake National Forest presented information on the proposed lease, related proposal activities, existing environmental data, and anticipated environmental impacts. Representatives from Coastal States also presented information on the proposed lease and anticipated development.

Twenty-seven people attended the meeting. The majority of attendees represented governmental agencies and industry interests, No environmental interests were represented.

No adverse reaction to the proposed lease or any anticipated environmental impacts was expressed at the meeting. A review of U.S. Forest Service and BLM records reveal no public ocncern over leasing the proposed lease area.

Based upon an evaluation of the public meeting and a lack of expressed concern over the proposed lease, the U.S. Forest Service and BLM determined that another public meeting was not warrented. It is believed that no new significant issues and environmental concerns were suggested in this environmental assessment; thereby indicating a need for additional public involvement through another meeting.

Coastal States Energy Co.
Recommended Stipulations
Coal Lease

The following stipulations are recommended to be included as terms for coal lease application no. U-28297, Coastal States Energy Co.

The Area Mining Supervisor shall mean the authorized representative of the U.S. Geological Survey. The authorized officer of the surface management agency shall mean Forest Supervisor, U.S. Forest Service.

Lease Stipulations

(1) All operations will be conducted to protect the aesthetic and scenic values. Consideration will be given site selections to reduce adverse visual impacts. Where alternative sites are available, the alternative involving the least damage to the scenery and other resources shall be selected if it is comparable from a technical standpoint with the proposed development site. Permanent structures and facilities will be designed to be architecturally compatible with the surrounding landscape where possible, will harmonize with the natural landscape, and screening techniques will be employed to reduce scenic impacts. The use of a qualified landscape architect may be required by the Area Mining Supervisor in consultation with the authorized officer to design and achieve a final landscape compatible with the natural surroundings. Alteration or removal of the vegetative cover, specifically trees or shrubs, is to be accomplished to achieve the effect of natural-occurring vegetative openings. Construction practices requiring the alteration or modification of the existing topography will be accomplished in such a manner that the modified landscape will be compatible with and graded into the adjoining land form. The creation of unusual, objectionable, or unnatural land forms and vegetative landscape features will be avoided.

(2) Permanent and semi-permanent buildings and similar surface structures shall be painted a color that blends or conforms to the natural background color of the surrounding area.

(3) The lessee will be held responsible for compliance with state and federal laws pertaining to protection of cultural and paleontological values. Prior to entry upon the land to conduct surface disturbance activities, a complete inventory of all cultural and paleontological values of the area to be disturbed or occupied may be required by the authorized officer, surface management agency, or Area Mining Supervisor. The survey will be completed by a qualified professional approved by the authorized officer and Area Mining Supervisor. An acceptable report of the results and information of the survey will be provided to the authorized officer and Area Mining Supervisor. If any cultural values are observed during operations, they will be left intact and the Area Mining Supervisor and the authorized officer surface management agency notified.

The lessee will be required to take such measures as deemed necessary to preserve or avoid destruction of antiquities. This may include an intensive survey and salvage of artifacts, relocation of proposed facilities or other protective measures deemed necessary by the authorized officer to facilitate protection. All costs by the survey and salvage of artifacts will be borne by the lessee and all objects of antiquity salvaged will remain under the jursidiction of the U.S. Government.

(4) The lessee shall conduct his mining and exploration operations in such a manner as to minimize, as practical, the effects on water flow or the availability of waters for surface use. Loss of water due to the lessee's operations shall be prevented, replaced, or the situation corrected to the satisfaction of the authorized officer and Area Mining Supervisor. The lessee shall assume full responsibility and liability for damages due to the loss of surface waters resulting from the mining or other operations conducted under this lease.

(5) The lessee shall perform an adequate hydrologic study to secure baseline data concerning the surface and subsurface water occurring on or flowing through the lease area. The results of the study shall be furnished to the Area Mining Supervisor prior to approval of the mining plan. The study shall provide such data and information as considered necessary by the Mining Supervisor and authorized officer.

(6) The lessee will be required to establish a surface subsidence monitoring system to measure the effects of the underground mining activities on the land surface. A satisfactory series of monitoring points shall be established on the lease area. The monitoring shall be conducted by a method and in a manner approved by the Area Mining Supervisor. The results of the monitoring shall be reported periodically to the Mining Supervisor and authorized officer. The Area Mining Supervisor in consultation with the authorized officer, may require the lessee to employ such measures and precautions deemed necessary, including mining methods and extent and manner of coal extraction to assure that neither damage to man made structures nor loss of perennial streams occurs, nor hazardous conditions are created.

(7) All lease operations shall be conducted so as to comply with the Federal Water Pollution Control Act (33 USC 1151-1175) and the Clean Air Act (42 USC 1857 and following).

(8) The lessee will be held responsible for the protection of the habitat of any endangered plant species. Prior to entry upon the land to conduct surface disturbance activity, the lessee shall conduct an inventory for any threatened and endangered plant species that may occur in the area to be impactsd. The survey shall be completed by a qualified professional approved by the authorized officer and Area Mining Supervisor. An acceptable report of the findings including the location, distribution, and habitat requirements of the plants

on the lease area shall be provided to the authorized officer and Area Mining Supervisor. No facilities or surface disturbance activities will be located in areas considered by the authorized officer or Area Mining Supervisor necessary to protect the plant species. All costs of the survey will be borne by the lessee and all specimen collected will remain under the jurisdiction of the U.S. Government.

(9) In order to protect wintering and calving elk, exploration, drilling and other development acitivity will be allowed only during the period from July 1 through October 31. Exceptions to this limitation in any year may be specifically authorized by the authorized officer.

(10) Proper precautions will be taken at all times to prevent and supress fires. The lessee will be held responsible for suppression and rehabilitation costs for any fires on the national resource lands caused by the negligence of his operators, employees, contractors, or subcontractors. Fire lines and clearing shall be built and maintained in the vicinity of stationary machinery, portals, vents, and shafts or other facilities where fire could originate. All internal combustion engines shall be equiped with properly functioning spark arresters or mufflers.

(11) All survey monuments, witness corners, reference monuments and bearing trees must be protected against destruction, obliteration, or damage. Any damaged or obliterated markers must be re-established at the lessee's expense, in accordance with accepted BLM survey practices as set forth in the Manual of Surveying Instructions. A complete record of the monumentation and the methods used in re-establishment will be furnished to the Chief, Branch of Cadastral Survey at the appropriate State Director's Office, BLM.

(12) Upon cessation of the use of all or any part of the lease surface for constructions, exploration, or operations, all disturbed areas will be reclaimed and returned to a postmining land use consistent with those USCS defined in 30 CFR 715.13(c)(6) & (8).

(13) In accordance with Sec. 523 (b) of the "Surface Mining Control and Reclamation Act of 1977," surface mining and reclamation operations are to conform with the requirements of this Act and the regulations issued pursuant to this Act.

(14) It is mutually understood that portions of the following described lands embraced in this lease have been identified as roadless areas and must be evaluated for their wilderness potential:

T. 21 S., R. 5 E., SLM, Sevier County, Utah
Sec. 33 W½SW¼
T. 22 S., R. 5 E., SLM, Sevier County, Utah
Sec. 4 W½W½

Depending on the results of the evaluation, the areas in question may be determined as suitable for further wilderness study, or not suitable for wilderness. Those areas determined as suitable for wilderness may ultimately be classified as wilderness.

A. Existing roads, if any, may be used for temporary access in a non-destructive manner, but may not be reconstructed, improved, or graded.

B. Where temporary access is needed to an area not served by an existing road, methods of access not resulting in erosion, scars, or environmental damage shall be used.

C. Where long term access or development is desired, or where the method to be used will possibly cause environmental damage, an application for such access or development shall be filed with the Authorized Officer and the District Manager, BLM involved. Such application shall include the nature of the proposed access or development, any measures proposed to minimize the environmental impact, including proposed restoration measures, and a map of the location and the access or development. The Authorized Officer and District Manager, BLM will coordinate the porposal with the Area Mining Supervisor, and based upon such coordination and agreement reached with the United States Geological Survey, will either approve the proposal, conditioned upon necessary protective measures, or will disapprove the proposal.

D. This clause shall become inoperative in the event the area is determined as not suitable for wilderness.

E. If the area, or part of it, is determined as suitable for wilderness study, this clause shall remain in full force and effect until the area is either classified for wilderness or is formally rejected for such classification. If the area is classified as wilderness, this lease shall become subject to the provisions of the Act of September 3, 1964 (78 Stat. 893), and as appropriate, the Forest Service and Bureau of Land Management regulations and policies pertaining thereto.

United States Department of the Interior

BUREAU OF LAND MANAGEMENT
Sevier River Resource Area
P.O. Box 705
Richfield, Utah 84701

IN REPLY REFER TO
4510
2120
1791
U-503

STAFF REPORT

Title: Threatened and Endangered Plants: A Literature Search for the SUFCO Coal Lease U-28297

Date: April 10, 1978

Authors: Larry R. Greenwood and John C. Likins

Introduction

This report will discuss the literature search efforts made for threatened and endangered plant species in the SUFCO Coal Lease U-28297 area. This report will be incorporated into the EAR for the lease.

Coal Lease U-28297 is located in Sec. 32 and 33, T. 21 S., R. 5 E., and Sec. 5,6,7,8,17, and 18, T. 22 S., R. 5 E. This area is situated atop the Old Woman Plateau in Sevier County. The elevation ranges from about 7,000 to 9,000 feet in the lease. The lease area contains approximately 3,000 acres, with 2,800 acres on the Fishlake National Forest and 200 acres on public land. Soils for the lease area are mostly shallow and fall into the sandy to silty texture classes. Parent material is sandstone and limestone with shallow shale outcrops. The Quitchupah Creek area, in particular contains Mancos shale outcrops.

Since the majority of the lease area is on national forest land we consulted with the Richfield Ranger District, Fishlake National Forest for the vegetative community mapping and type write-up sheets. Darrell Hintze was very helpful in providing assistance and access to their files. An enclosed topographic map with a vegetative type overlay illustrates the present vegetative communities for the lease area. Copies of the type write-up sheets are also enclosed.

The vegetative communities within the lease area are sagebrush-grass (4), mountain shrub (5), grassland (1), and coniferous forest with openings of sagebrush-grass-forb (6). A large portion of the lease is rimrock (7) which forms the plateau boundary.

Analysis of the site write-up sheets indicates that Penstemon spp., Astragalus spp., Hymenoxys spp., and Festuca spp. are present in the vegetative communities atop the plateau. Threatened and endangered species of the above genera could possibly be present within the lease area, according to Dr. Stanley L. Welsh, BYU. (See enclosed staff report of 4-5-78 by Larry R. Greenwood).

Literature Search

We reviewed the literature listed in the reference section of this report to establish a probable list of T&E species which might be present within the lease area. This list (#1) contained sixteen species which, according to the literature have been found growing in Sevier County, Utah.

We expanded this initial list (#1) by consulting the final report by Dr. Stanley L. Welch on T&E plant species for the Cedar City and Richfield Districts of BLM, 1976, and the topographic maps showing the collection locations. We looked for similar habitats and elevations in other counties which we believed would be similar to the lease area.

From this expanded list (#2) of thirty species we analyzed the site conditions of previous collection locations and arrived at a list (#3) of nine species, which we felt had a good possibility of growing in the lease area. This list (#3) and the expanded list (#2) of the thirty species was discussed with Dr. Welsh at BYU in Provo, Utah by Larry R. Greenwood on April 5, 1978. The results of this consultation with Dr. Welsh will be discussed in the next portion of this report. (See appendix for species lists #1-3)

Personal Contact

On April 3, 1978, Dr. Stanley Welsh was contacted at his office at Brigham Young University. Preliminary lists 2 and 3 (Appendix) were looked at by Dr. Welsh. From these lists and from his unpublished manuscript (Welsh 1978) he identified seven plant species which would possibly be on the coal lease area. The species and their status are:

*Astragalus loanus	Threatened
Festuca dasyclada	Possibly extinct
Hymenoxys depressa	Threatened
*Penstemon abietinus	Threatened
Penstemon wardii	Threatened
Sclerocactus wrightiae	Endangered
Townsendia aprica	Endangered

All of these species are presently on the threatened and endangered list for Utah. However, two (*) have been recommended to be removed from the list (Welsh 1978).

Dr. Welsh was familiar with the area of the coal lease, Apparently he had worked as a private consultant in identifying threatened or endangered species for an adjacent coal lease area. He identified the top edge of the rimrock, which runs north and south across the lease, as having the greatest potential for possible T&E plants.

Dr. Welsh strongly recommended that a qualified private consultant be hired to make an on-site T&E plant inventory of the lease. Qualified private consultants in Utah are:

Dr. S. L. Welsh	Brigham Young University
Art Holmgren	Utah State University
Duaine Atwood	U.S. Forest Service

For further comments by Dr. Welsh see staff report dated April 5, 1978 in appendix.

Recommendations

We feel that the seven plant species that Dr. Welsh identified above are the most likely T&E species to be in the lease area. However, they may not be the only species present. A qualified private consultant should be hired to make an on-site T&E plant survey of the lease area. This will ensure positive determination as to the presence or absence of T&E plants in the area.

Larry K. Greenwood

John C. Likins

References Reviewed and Cited

U.S. Forest Service, Intermountain Region, 1977. Data summary of proposed endangered or threatened plant species.

Welsh, S.L., 1976. Proposed threatened, endangered, presumed extinct, or extinct and disjunct relict plants in the Cedar City and Richfield districts, Utah. Final Report, Bureau of Land Management, unpublished mss. 205 pp.

Welsh, S.L. 1977. Endangered and threatened plant species of the Central Coal Land, Utah. Final Report, Interagency Task Force on Coal, U.S. Geological Survey. 422 pp. (Topographic Maps).

Welsh, S.L. 1978. Endangered and threatened plants of Utah, a re-evaluation. Brigham Young University. Unpublished manuscript. 39 pp.

Welsh, S.L., N.D. Atwood, and J.L. Reveal. 1975. Endangered, threatened, extinct, endemic and rare of restricted Utah vascular plants. Great Basin Naturalist. 35: 327-376.

Personnel Consulted

Max Robinson	Range Conservationist, Richfield D.O. BLM
Mary Gillio	Botanist, Richfield D.O. BLM
Marv Turner	Range Conservationist, U.S. Forest Service
Stanley Welsh	Brigham Young University
Darrell Hintze	Richfield Ranger District, USFS
Chuck Horsburgh	Geologist, Richfield D.O. BLM
Rulon Duncan	Chief of Planning Staff, Richfield D.O. BLM

T&E Species List #1

1) Astragalus bodinii
2) Astragalus ioanus
3) Castilleja scabrida
4) Cymopterus coulteri
5) Cymopterus rosei
6) Eriogonum ostlundii
7) Geranium marginale
8) Lupinus marianus
9) Mentzelia argillaceae
10) Penstemon abietinus
11) Penstemon leiophyllus
12) Penstemon wardii
13) Phacelia demissa var. heterotricha
14) Phacelia utahensis
15) Sclerocactus pubispinus
16) Townsendia aprica

T&E Species List #2

1) Astragelus bodinii
2) Astragalus brandegei
3) Astragalus henri-montanensis
4) Astragalus lentiginosus var. chartaceus
5) Astragalus loanus
6) Castilleja scabrida
7) Cryptantha jonesiana
8) Cymopterus coulteri
9) Cymopterus rosei
10) Eriogonum intermontanum
11) Eriogonum ostlundii
12) Geranium marginale
13) Gilia caespitosa
14) Gilia mcvickerae
15) Hymenoxys depressa
16) Lesquerella rubicundula
17) Lomatium minimum
18) Lupinus marianus
19) Mentzelia argillaceae
20) Oxytropis jonesii
21) Penstemon abietinus
22) Penstemon leiophyllus
23) Penstemon wardii
24) Phacelia demissa var. heterotricha
25) Phacelia utahensis
26) Physaria grahamii
27) Sclerocactus pubispinus
28) Silene petersonii var. petersonii
29) Talinum validulum
30) Townsendia aprica

T&E Species List #3

1) *Astragalus bodinii*
2) *Astragalus loanus*
3) *Cymopterus rosei*
4) *Geranium marginale*
5) *Lupinus marianus*
6) *Penstemon abietinus*
7) *Penstemon leiophyllus*
8) *Penstemon wardii*
9) *Townsendia aprica*

IN REPLY REFER TO

4115
U-503

United States Department of the Interior

BUREAU OF LAND MANAGEMENT
Sevier River Resource Area
P.O. Box 705
Richfield, Utah 84701

STAFF REPORT

TITLE: Threatened and Endangered Plants - Dr. Stanley Welch

DATE: April 5, 1978

AUTHOR: Larry R. Greenwood, Range Conservationist

On April 3, 1978 I talked with Dr. Welch on possible threatened or endangered plants for coal lease U-28297, located east of the present Convulsion Mine (T. 22 S. R. 5 E.). He identified seven plant species which could possibly be on the coal lease area. The species are:

*Astragalus loanus	Threatened
Festuca dasyclada	Possibly extinct
Hymenoxys depressa	Threatened
*Penstemon abietinus	Threatened
Penstemon wardii	Threatened
Sclerocactus wrightiae	Endangered
Townsendia aprica	Endangered

Of these seven possible threatened or endangered species, two have been recommended to be removed from the T&E list for Utah (Welch 1978). They are asterisked above.

After discussing the above plant species, Dr. Welch made some general comments about threatened and endangered plant species, which I feel are well worth keeping in mind.

First, he stated that when dealing with coal leases, powerline right-of-ways or any other situation which requires threatened or endangered plant species clearance, a qualified private consultant should be hired. This, he said, will ensure the protection of you, your agency and the responsible company, from being sued for destruction of threatened or endangered plant species. Qualified private consultants in Utah are:

Dr. S. L. Welch	Brigham Young University
Art Holmgren	Utah State University
Duaine Atwood	U.S. Forest Service

Being able to positively identify T&E plants in the field, and through the various stages of growth, is the key to being a qualified consultant.

AMERICAN REVOLUTION BICENTENNIAL 1776-1976

The following is an example which emphasizes the importance of having a qualified person examine proposed sites.

Dr. Welch examined a proposed drill site and identified a threatened plant species. Through his knowledge and experience he knew that this plant species did well on disturbed sites. He therefore recommended to go ahead and drill at the site. In this specific instance, the disturbance of a few plants, resulted in a noticeable increase in plant number. Thus enhancing that particular species in the area.

Secondly, Dr. Welch stated that many companies and organizations have the wrong ideas and attitudes about the concept of threatened and endangered plant species. He said that he had personally worked with several companies which thought that if threatened or endangered species were found anywhere on the proposed site, that the whole operation would be dropped. This, he said is the wrong idea in almost every instance, simply because it would be a rarity to encounter enough T&E plant species to cancel out a proposed lease area etc, entirely. Or, as is explained in the preceding example, disturbance may enhance particular species. Dr. Welches concept of working with threatened or endangered plant species is as follows:

1) The proposed lease area etc. should be inventoried for T&E plant species by a qualified person or persons.

2) Specific T&E plant specie sites, if any, should be identified.

3) The companys plan of operation should then work around the T&E Plant specie sites.

   For example: Moving a proposed drilling site 20 feet away to avoid a colony, etc. of T&E plant species.

Dr. Welch felt that this method of management is very practical and sensible. He emphasized the fact that threatened and endangered plants are rare and most often localized and endemic. When considering all of the land area of Utah, the odds of encountering threatened or endangered plants are very small.

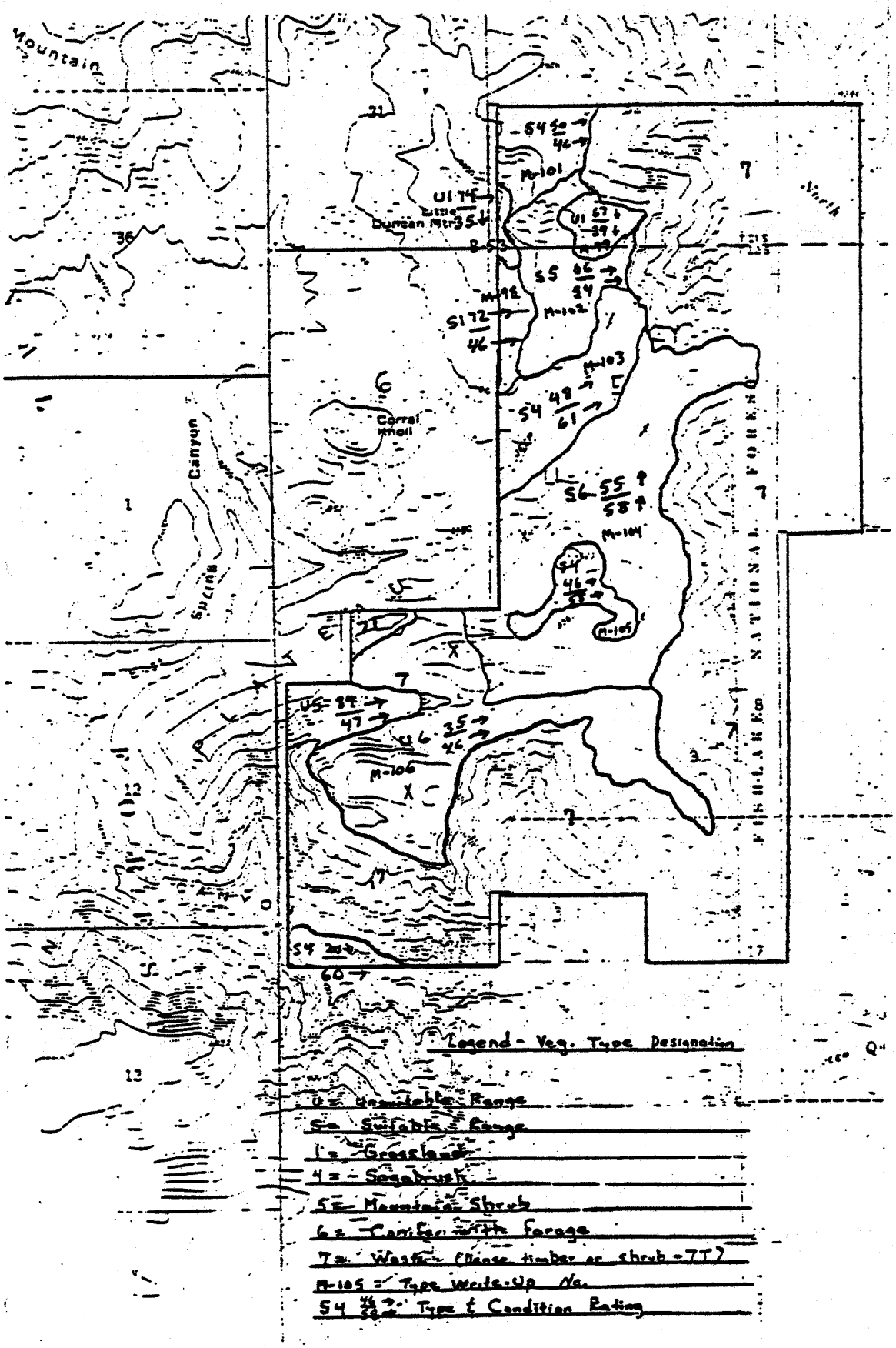
A third comment by Dr. Welch was that private consulting by qualified persons, helps to identify new populations of threatened or endangered species. Energy exploration, as well as other operations, is opening up areas which to date, have not been vegetatively sampled. Thus, private consulting provides a means of inventorying areas of the state for threatened or endangered species.

Dr. Welch also mentioned that the foothill regions around Glenwood and Sigurd contain several unique species and that these areas should be kept in mind with referance to threatened or endangered species.

A final comment was made concerning Otter Creek. Astragalus bodinii, which is an endangered species for Utah, occurs along Otter Creek. It should be noted, here, that this species is on the Utah endangered species list, but not on the national register list. Dr. Welch said that it is very common in the northern U.S. and Canada. Getting back to Otter Creek, Dr. Welch suggested that the fenced areas and the area to be fenced, should be searched for this species of Astragalus. He said that currently, Astragalus bodinii has been found only on privately owned, grazed land, in Utah. The possibility of this species occuring on BLM land, along Otter Creek, offers a good opportunity for protection of this plant. Thus, the existence of this species, if found, would definitely be reason to prevent livestock grazing within the fenced areas and also in the area which is proposed to be fenced. Although livestock would not directly feed on this species, trampling and other surface disturbances would be detrimental to the survival of the plant.

A key characteristic for identifying Astragalus bodinii is its spreading nature. Dr. Welch said that it will spread out over the top of adjacent forbs and grasses when the opportunity arises. Flowers are small and blue-purple.

Larry K. Greenwood


Mountain
Little Duncan Mtn
Corral Knoll
Canyon
Spring
M-101
M-102
M-103
M-104
M-105
M-106
Legend - Veg. Type Designation
6 = Unsuitable Range
5 = Suitable Range
1 = Grassland
4 = Sagebrush
5 = Mountain Shrub
6 = Conifer with forage
7 = Waste (Chaparral timber or shrub = 7T)
M-105 = Type Write-Up No.
54 = Type & Condition Rating

ARCHEOLOGICAL REPORT

The following archeological reports were prepared for exploration programs conducted by Coastal States. To our knowledge, there has been no comprehensive survey performed on the entire property.

These documents cover a number of individual sites scattered over the leased area. They in no way imply that there are no major significant sites in the area, they merely show that the areas surveyed revealed only minor significant archeological finds.

Archeological surveys will also be required for any future disturbances on the leased area.

See Forest Service letter in Appendix 3.c. dated July 5, 1977, for the Forest Service's archeological clearance.

ENVIRONMENTAL ASSESSMENT AND MONITORING FOR THE SOUTHERN UTAH FUEL COMPANY MINE NEAR SALINA UTAH -1978-

FOR:

Mr. Loren A. Williams
Coastal States Energy Corporation
Coastal Tower
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Houston, TX 77046

BY:

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WESTECH
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Helena, MT 59601
(406) 442-0950

March, 1979

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ENVIRONMENTAL ASSESSMENT AND MONITORING FOR THE SOUTHERN UTAH FUEL COMPANY MINE NEAR SALINA, UTAH -1978-

I. INTRODUCTION

As requested by Mr. Loren Williams of Coastal States Energy Company of Houston, Texas an environmental assessment and monitoring was completed on an underground coal mine operated by the Southern Utah Fuel Company near Salina, Utah. Hydrology, vegetation and wildlife were examined to further evaluate baseline conditions and to assess impacts of underground coal mining. A previous technical report (Botz, 1977) described the Southern Utah Fuel Company operation and described the environment, including hydrology, vegetation and wildlife. This report and accompanying maps provided a background for a continuing assessment and monitoring program in the area.

In 1978 detailed hydrological studies were conducted on the site and additional wildlife and vegetation assessments were made. This report describes the results of these 1978 environmental investigations and is a supplement to the 1977 baseline report.

II. SUMMARY AND CONCLUSIONS

The following summary and conclusions are based on the 1978 work at the Southern Utah Fuel Company Mine area near Salina, Utah. Monitoring and continued environmental assessments were made on hydrology, wildlife and vegetation in June to November, 1978. These investigations and data collection efforts are a supplement to the original baseline environmental survey of 1977. These efforts are designed to determine impacts of the SUFCo underground mine on the area's environmental resources.

1. Precipitation was slightly above normal in the mine permit area in 1978 and streamflow was higher than in 1977. Flows were measured at 8 stream sites and 4 springs. Springs flows were realtively constant from June to September, 1978 and in comparison with 1977 flows.

2. A Parshall flume was installed on the N. Fork Quitchupah Creek near its mouth and weirs were installed on the South Fork and upper end of the N. Fork of Quitchupah Creek. These measuring intallations will be used for flow measurements beginning in the summer of 1979.

3. A total of sixteen sites were sampled in June 1978 and nine in September 1978 to determine water quality in streams and springs. Eleven of the June samples and nine of the September samples were submitted for complete laboratory analysis.

4. Water quality in the area is generally fair to good and is a calcium-magnesium-bicarbonate type with low concentrations of metal and nutrients. Three samples had iron, 4 had manganese and 4 had total dissolved solids which somewhat exceeded recommended standards for drinking water. All other parameters and samples met all mandatory and recommended drinking water standards.

5. Water from springs had a relatively constant water quality and exhibited little seasonal fluctuations. Most streams had poorer quality water in the fall than in the spring.

6. There are several ephemeral streams, one perennial stream (N.Fk. Quitchupah Creek) and a few springs in the mining permit area. No subsidence impacts were observed on any springs or streams either in or peripheral to the mining permit area.

7. Examination was made for plant mortality, invasion of grasses and forbs and damage from rock falls in the subsidence area. Subsidence areas observed in 1977 were invensively covered in 1978 and known subsidence cracks revisited. Most subsidence cracks observed in 1977 were almost impossible to relocate in 1978 due to filling of the cracks. To date there are virtually no impacts of subsidence on vegetation.

8. The U.S. Forest Service has established several vegetation transects in and adjacent to the mining permit area.

9. No subsidence impacts on wildlife were observed in 1978. Big game use probably is more directly related to cover and browse than to water availability. Since subsidence impacts to hydrology and vegetation were minimal or absent there have been no impacts to wildlife.

III. HYDROLOGY

Hydrological investigations during 1978 included evaluation of groundwater, surface water and water quality, and examination of the subsidence area. Precipitation during the 1977-78 winter was slightly above average and was greater than the 1976-77 season. On June 3, 1978 approximately 30 percent of the mountainous area was covered by snow. Leaves were just beginning to appear on aspen trees along canyon rims but trees were still barren at higher elevations. Specific hydrological tasks completed during 1978 were:

1. Examination of the area from June 3-5, 1978 to determine hydrological conditions during spring runoff. Flows at all springs and streams examined in 1977 were measured in 1978. Sixteen sites were sampled and tested for water quality in the field and eleven were submitted for complete analysis. Examination of the subsidence area also conducted to assess hydrological impacts.

2. Examination of hydrological conditions during late summer/early fall low flow season (Sept. 26-27, 1978) to measure flows and obtain water samples. Nine sites were sampled and tested and nine were submitted for complete chemical analyses. Meet with U.S. Forest Service to coordinate location and installation of flume and weirs. Develop specifications and fabricate flume, weirs and crest gages.

3. Installation of one Parshall flume, two weirs and five crest gages in early November 1978.

Results of these activities are described in this annual monitoring and environmental assessment report.

A. Surface Water

Flows were measured at 8 stream sites, 4 springs and at the SUFCo mine in 1978 (Table 1). Flows generally were higher in all streams in 1978 than in 1977 probably reflecting the greater overall precipitation in 1978. Springs showed little change in flow probably reflecting the large storage in the groundwater system. All streams were accurately measured using either a small portable Parshall flume, a pigmy flow meter or stopwatch and a container of known volume. In the North Fork of Quitchupah Creek there was evidence of water flows slightly to moderately higher than measured in June 1978. The measured June flows were considered normal spring runoff. The channel shows geomorphic evidence of occasional very high flows which is typical of this part of the southern Wasatch Mountains.

The following sites were dry in September 1977, June and September 1978.

Site	Description
032	Mud Spring Hollow 2 mi. above mouth
-	Mud Spring Hollow at SUFCo Mine
-	East Spring Canyon at SUFCo Mine
-	Jolly Mud Hollow
-	Broad Hollow
-	Duncan Draw at Road (T22S,R45E,Sec.36CA)*
-	Mud Spring Hollow at Road (T22S,R4E,Sec.35CD)

Flow measuring sites are shown on Figure 1.

*See Appendix B

Table 1. Summary of Flows from Streams and Springs in the Vicinity of the SUFCo No. 1 Mine near Salina Utah.

Site No.	Site Description*	Date Sampled	Flow	Method Measured	Sept. 1977 Flow**
001	Spring in Duncan Draw	6-04-78	2 gpm	TIME/VOLUME	
001	Spring in Duncan Draw	9-26-78	2.2 gpm	TIME/VOLUME	1.7 gpm
005	Seep in tributary of E. Spring Canyon	6-04-78	1 gpm	Estimate	1 gpm (Est.)
006	S. Fork Quitchupah Cr.	6-04-78	.887 cfs	Flow Meter	
006	S. Fork Quitchupah Cr.	9-26-78	2 gpm	TIME/VOLUME	34.3 gpm
007	N. Fork Quitchupah Cr. above canyon	6-04-78	6.53 cfs	Flow Meter	
007	N. Fork Quitchupah Cr. above canyon	9-26-78	100 gpm	Flume	22.3 gpm
007B	Tributary to N. Fork Quitchupah above canyon	6-04-78	.179 cfs	Flume	Not Meas.
009	Tributary to N. Fork Quitchupah Cr. approx. 6 miles above mouth	6-04-78	11.8 gpm	TIME/VOLUME	16.5 gpm
013	N. Fork Quitchupah Cr. 5½ miles above mouth	6-04-78	-	Not Meas.	<1 gpm
017	N. Fork Quitchupah Cr. 3½ miles above mouth	6-04-78	-	Not Meas.	54.9 gpm
019	N. Fork Quitchupah approx. 2 miles above mouth	6-04-78	-	Not Meas.	32.6 gpm

* Locations shown on map

** See previous report by Botz (1977) for detailed 1977 data

Table 1
Page 2

Site No.	Site Description*	1978 Sampled	Flow	Method Measured	Sept. 1977 Flow**
021	SUFCo No. 1 mine effluent	6-05-78	280±gpm	VOLUME/TIME	Not Meas.
021	SUFCo No. 1 mine effluent	9-26-78	315±gpm	VOLUME/TIME	Not Meas.
033	Seep in tributary of E. Spring Canyon	6-04-78	.8±gpm	Estimate	Dry
041	Quitchupah Cr. above N. Fork	6-05-78	292 gpm	Flow Meter	
041	Quitchupah Cr. above N. Fork	9-25-78	525 gpm	Flow Meter	245 gpm
042	N. Fork Quitchupah Cr. near mouth	6-05-78	6.7 cfs	Flow Meter	
042	N. Fk. Quitchupah Cr. near mouth	9-25-78	88 gpm	VOLUME/TIME	2.5 gpm
045A	Quitchupah Cr. downstream from drainfield	6-03-78	-	Not Meas.	Not Meas.
046	Convulsion Canyon (above pumphouse)	9-26-78	8.4 gpm	VOLUME/TIME	3.8 gpm
047	Pump House Effluent	6-03-78	60 gpm	VOLUME/TIME	
047	Pump House Effluent	9-26-78	49.4 gpm	VOLUME/TIME	52.2 gpm
047A	E. Spring Canyon above Convulsion Canyon	6-05-78	-	Not Meas.	
047A	E. Spring Canyon above Convulsion Canyon	9-26-78	358 gpm	Flow Meter	Not Meas.

* Locations shown on map

** See previous report by Botz (1977) for detailed 1977 data

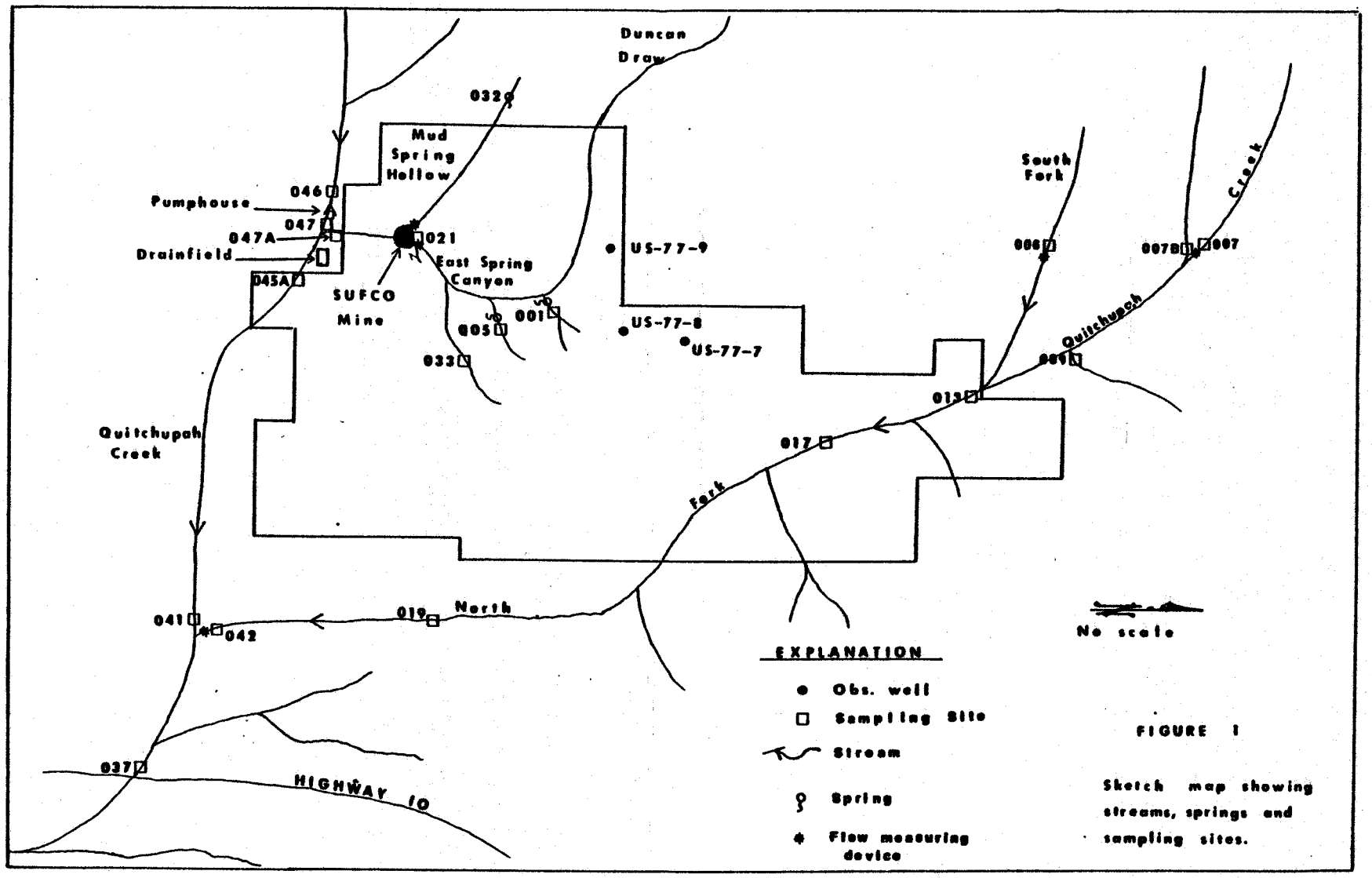


FIGURE 1

Sketch map showing streams, springs and sampling sites.

Flow Measurement Devices

In coordination with the U.S. Forest Service, Fishlake National Forest, two weirs and one Parshall flume were installed to provide a continuous flow record for the 1979 low flow period (July to Nov.). Installation sites are as follows:

1. Site 042. Parshall Flume. Located on the North Fork of Quitchupah Creek near the mouth.
2. Site 006. Weir located on South Fork Quitchupah Creek upstream from deep canyon.
3. Site 007. Weir located on North Fork of Quitchupah Creek upstream from deep canyon.

Installation sites are shown on Figure 1. At all three sites a crest gage was installed to measure stream flows that exceed the flume or weir capacity.

Streamflow measurement presented an unusual and difficult problem of accurate measurement of low flows and also accurate measurement of medium to high flows. Installation also should be cost effective. Flows in these drainages occasionally are very high and virtually any flow measuring device would be washed out. It was decided to use normal flow measuring devices with broad overflow areas adjacent to the devices. Such installations may wash out during extreme runoff events but could be replaced without undue cost. Large concrete flow measuring structures would last longer but would be much more expensive to install and probably would eventually fail during high flow events.

Measuring devices were sized and designed to handle expected normal flow ranges yet still accurately measure low flows.

Parshall Flume (Site 042)

A prefabricated Parshall flume was installed in North Fork of Quitchupah Creek approximately 300 feet upstream from its confluence with Quitchupah Creek. The flume is about 30 feet above the jeep trail crossing the stream (Site 042,T22S,R5E,Sec. 16DDA). The flume was installed using a backhoe to dig a diversion ditch in the terrace on the west bank and damming the stream to divert the flow. The flume was then installed with the bottom approximately level with the existing stream bed at the upstream end. Excavation in the terrace for installation revealed about 4 to 6 inches of silt overlying a coarse gravel. The backfill was hand tamped around the flume to provide a sound bed. The east upstream wing of the flume was anchored into the bank which rises very sharply to over 10 feet above the stream bed. The west wing is anchored into the stream bank with the top of the wing approximately 6 inches above the terrace elevation leaving a 10' wide overflow path. This allows flows in excess of the flume capacity without washing out the flume. The ends and wings were rip-rapped to prevent erosion. A crest gage was attached to a post set in the west bank of the stream approximately 20 feet upstream from the flume.

The flume has a 24 inch throat, is two feet in depth and has a maximum design capacity of about 25 cfs. Minimum flow that can be measured by this flume is about 0.1 cfs. Installation details are shown in Appendix A.

V-Notch Weir (Site 006)

A 90° V-notch weir was installed on the South Fork Quitchupah Creek about 100 feet upstream from the road and sampling Site 006 (T21S,R4E,Sec.24CAB). Metal weir plates were bolted to a piece of 3/4 inch plywood which had been

waterproofed with water seal and epoxy resin. The plywood was reinforced with 2 x 4's to achieve necessary rididity. The north end is anchored into a nearly vertical bank 8 feet high. The south end is anchored into the bank but was installed such that the top of the structure is about 6 inches above the terrace level on this side. Very little water was flowing so a temporary dam was installed above the site and the water held back during construction. The backfill was hand tamped and local rock was used to riprap the stream bank downstream from the weir. A 15-inch by 5 foot long section of aluminum culvert was set vertically in the south bank and connected to the stream by 2 pieces of 2 inch PVC pipe. One pipe is installed level with the stream bottom and the other is 6 inches higher. The culvert was capped with a metal plate. This culvert will be a stilling well for measurement of head on the weir. This weir has a depth of 1 foot, a width of 2 feet and maximum design capacity of 2.5 cfs and a minimum flow .004 cfs can be measured. Installation details are shown in Appendix A.

A crest gage was attached to a post set in the bank of the stream about 20 feet upstream from the weir.

Combination V-notch and Cippoletti Weir (Site 007)

A combination V-notch and Cippoletti weir was installed in the North Fork Quitchupah Creek about 250 feet downstream from the road crossing (Site 007, T21S,R4E,13ADC). Weir construction was similar to the first weir. The south end was anchored into a nearly vertical bank about 10 feet high. The north end was anchored into the bank of the stream with the top of the weir maintained about 6 inches above the adjacent terrace level. Local rock was used to riprap the bank on the north side. A 15-inch

diameter by 5 ft. long section of aluminum culvert was used to construct a stilling well. This culvert was set vertically into the bank on the south side of the stream. Two pieces of 2-inch PVC pipe were extended into the stream to transmit the water level in the pool to the stilling well. One piece of pipe was placed level with the stream bottom, and the other about 6 inches high. A metal cap was placed over the culvert top. A crest gage was installed about 20 feet upstream from the weir.

The Cippoletti weir has a 3.0 foot width, a depth of 1.0 feet and a maximum design capacity of about 11 cfs. The 6-inch deep by one foot wide 90^{o} V-notch will accurately measure a minimum low of about .004 cfs. Installation details are shown in Appendix A. The 90^{o} V-notch weirs have a standard calibration curve as does the Parshall flume. A 3-foot Cippoletti weir also has a standard calibration curve. The compound weir as installed, however will need calibration in the transition zone between the V-notch and shallow flows in the Cippoletti portion. At higher heads a good estimate of flow through the Cippoletti weir can be obtained from standard tables. This unusual installation will, after calibration, provide accurate measurements of both high and low flows.

Crest gages were installed upstream from the two weirs and the flume and also were installed in East Spring Canyon and Mud Spring Hollow where these streams enter metal culverts to be conveyed under the work area in front of the mine entrance (T22S,R4E,12BD). The crest gages at the metal culverts are attached to the metal debris catchers at the culvert inlets. Water from the mine is pumped into the East Spring Canyon therefore the gage was set so this water would not be measured.

Crest gages provide a measurement of stage and flow can be calculated by use of indirect techniques.

B. Groundwater

Springs and seeps are areas of groundwater discharge. There are few springs in the area and flow from these springs is small. The hydrogeological system apparently consists of very low to low permeability sandstone units containing substantial water storage but having small groundwater flows. Flow from springs (Table 1) in the mining permit area is small but tends to be steady and does not reflect short-term variations in precipitation. This suggests a large aquifer system with a small but consistent groundwater flow due to long-term recharge. There is little if any groundwater baseflow in streams in the mining permit area. Small seeps and springs generally are dry a short distance downstream from their appearance.

The infiltration system in Convulsion Canyon that supplies water to the SUFCo pumphouse is intercepting groundwater in Convulsion Canyon alluvium, however, the warm temperature of this water (24^{o}C) suggests its origin is probably from a deep aquifer. Flow to the pumphouse is relatively steady (Table 1).

Three groundwater observation wells constructed by Coastal States Energy Company in late 1977 and static water levels were measured in June, 1978 and are shown in Table 2.

Water is discharged from the SUFCo mine workings at about 250 to 325 gpm. This flow is intermittent due to pump cycling but the total volume pumped has been relatively constant for the past year.

Table 2. Groundwater Observation Well Data

STATION	PARAMETER	MONITORING DATES
		6-3-78
Drill hole US-77-7	Elevation of drill hole	8555 (From Map)
	Depth to water table	261 ft.
	Height of well casing	~1.5 ft.
	Elevation of water table	
	Method of measurement	M-Scope
Drill hole US-77-8	Elevation of drill hole	8540 (From Map)
	Depth to water table	145.6 ft.
	Height of well casing	2.5 ft.
	Elevation of water table	
	Method of measurement	M-Scope
Drill hole US-77-9	Elevation of drill hole	8395 (From Map)
	Depth to water table	>300 ft.
	Height of well casing	
	Elevation of water table	
	Method of measurement	M-Scope

C. Water Quality

A total of sixteen sites were sampled in the field in June, 1978 including measurement of flow, pH, specific electrical conductivity and temperature. Results are shown in Table 3. At eleven of the sites, samples were collected for complete laboratory analysis (Table 4). In September, 1978 nine sites were sampled in the field (Table 3) and 9 samples were submitted for complete laboratory analysis (Table 4).

Water in the area generally is of fair to good quality and is an alkaline, calcium-magnesium-bicarbonate type with low concentrations of nutrients and metals. A total of 4 samples exceed recommended US Public Health Service Drinking Water Standards for total dissolved solids; three samples exceed the recommended iron standard and 4 exceed the recommended manganese standard. All other parameters meet mandatory and recommended drinking water standards.

Water quality had little seasonal fluctuation in springs and effluent from the SUFCo mine, but was poorer in the fall in streams except Quitchupah Creek above the North Fork. This stream, for reasons unknown, had poorer quality in the spring than in the fall. Water quality declined slightly downstream in the North Fork of Quitchupah Creek in June, 1978. No data were available for downstream quality trends in other streams.

Table 3. Results of field measurements of water quality from waters in the vicinity of the SUFCO No. 1 mine near Salina, Utah.

Site No.	Site Description*	Date Sampled	Flow	Spec. Cond. (umhos/cm)	pH	Temp. °C
001	Spring in Duncan Draw	6-04-78	2 gpm	-	-	7.5
001	Spring in Duncan Draw	9-26-78	2.2 gpm	456	7.3	12.8
005	Seep in tributary of E. Spring Canyon	6-04-78	1 gpm	-	7.3	9.0
006	S. Fork Quitchupah Cr.	6-04-78	.887 cfs	564	8.4	15
006	S. Fork Quitchupah Cr.	9-26-78	2 gpm	939	8.3	15
007	N. Fork Quitchupah Cr. above canyon	6-04-78	6.53 cfs	353	8.3	6.5
007	N. Fork Quitchupah Cr. above canyon	9-26-78	100 gpm	540	8.2	18
007B	Tributary to N. Fork Quitchupah above canyon	6-04-78	.179 cfs	506	8.6	12
009	Tributary to N. Fork Quitchupah Cr. approx. 6 miles above mouth	6-04-78	11.8 gpm	509	8.3	8
013	N. Fork Quitchupah Cr. 5½ miles above mouth	6-04-78	-	407	8.5	8
017	N. Fork Quitchupah Cr. 3½ miles above mouth	6-04-78	-	463	8.6	-
019	N. Fork Quitchupah approx. 2 miles above mouth	6-04-78	-	466	8.6	11

Site No.	Site Description*	Date Sampled	Flow	Spec. Cond. (umhos/cm)	pH	Temp. °C
021	SUFCO No. 1 mine effluent	6-05-78	280 ± gpm	615	8.1	13.5
021	SUFCO No. 1 mine effluent	9-26-78	315 gpm	568	7.8	16.8
033	Seep in tributary of E. Spring Canyon	6-04-78	.8 ± gpm	-	6.2	-
041	Quitchupah Cr. above N. Fork	6-05-78	0.65 cfs	1086	8.7	17
041	Quitchupah Cr. above N. Fork	9-25-78	525 gpm	811	8.5	17.5
042	N. Fork Quitchupah Cr. near mouth	6-05-78	6.7 cfs	498	8.6	14
042	N. Fk. Quitchupah Cr. near mouth	9-25-78	88 gpm	642	8.6	17.5
045A	Quitchupah Cr. downstream from drainfield	6-03-78	-	896	8.2	15
046	Convulsion Canyon (above pumphouse)	9-26-78	8.4 gpm	945	8.2	8.5
047	Pump House Effluent	6-03-78	60 gpm	811	6.9	24
047	Pump House Effluent	9-26-78	49.4 gpm	830	7.0	24
047A	E. Spring Canyon above Convulsion Canyon	6-05-78	-	759	7.7	15
047A	E. Spring Canyon above Convulsion Canyon	9-26-78	.005 gpm	664	7.8	10.5

* Locations shown on map

Table 4. Results of Laboratory Determinations of Water Quality from Waters in the Vicinity of the SUFCo No. 1 Mine near Salina, Utah

Note: All Quantities in mg/l unless otherwise noted

* location shown on map

Site No.	Site Description*	Date Sampled	Flow	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Carbonate (CO_3)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Total Dissolved Solids (meas.)	Conductivity (μmhos/cm) at 25°C	Total Suspended Solids	pH (Lab)	Temp. °C
001	Spring in Duncan Draw	6/04/78	2 gpm	60.0	19.2	16.7	1.40	<0.01	244	20	30	263	410	<1		7.5
001	" " "	9/26/78	2.2 gpm	56.8	21.6	16.1	1.42	<0.01	244	36	20	278	420		7.93	7.5
005	Seep in Trib. of E. Spring Can.	6/04/78	1 gpm	76.0	43.2	22.5	1.60	<0.01	410	42	30	406	620	5		9.0
006	S. Fk. Quitchupah	6/04/78	0.887cfs	56.0	24.5	38.6	1.86	<0.01	290	68	18	353	540	162		15
006	" "	9/26/78	2.0 gpm	68.0	38.9	73.4	2.72	<0.01	402	120	26	525	810		7.59	15
007	Quitchupah Ck.	6/04/78	6.5 cfs	56.0	19.7	15.7	1.01	<0.01	253	22	12	256	390	86		6.5
007	" "	9/26/78	100 gpm	55.2	19.2	30.3	1.36	<0.01	288	17	19	284	435		7.88	18
009	Trib. to N. Fk. Quitchupah	6/04/78	11.8 gpm	51.0	21.1	20.2	2.02	<0.01	188	62	26	274	410	5		8.0
021	Mine Effluent	6/05/78	280± gpm	56.8	35.5	16.7	2.00	<0.01	278	80	16	339	510	14		14.5
021	" " .	9/26/78	315 gpm	55.2	38.9	21.6	2.08	<0.01	259	110	12	368	560		7.92	16.8
033	Seep in Trib. of E. Spring Can.	6/04/78	1.8± gpm	15.2	0.48	7.0	0.48	<0.01	41	8	12	60	100	<1		-
041	Quitchupah Ck. Above N. Fk.	6/05/78	.65 cfs	36.0	38.9	189.3	3.32	<0.01	329	238	42	712	1090	47		17
041	" " "	9/25/78	525 gpm	28.0	35.5	91.1	2.78	<0.01	271	150	28	470	770		7.57	17.5
042	N. Fork Quitchupah	6/05/78	6.7 cfs	52.0	21.6	23.6	1.37	<0.01	254	44	12	280	420	143		14
042	" "	9/25/78	88 gpm	48.8	34.5	42.0	2.05	<0.01	232	119	34	398	610			17.5
045A	Quitchupah ds from drain field	6/03/78	-	76.8	60.9	47.0	3.34	<0.01	376	172	40	580	900	5		8.0
046	Convulsion Can. above Pumphouse	9/26/78	8.4 gpm	75.2	60.5	40.0	5.03	<0.01	456	110	26	549	845			8.5
047	Pumphouse Effluent	6/03/78	60 gpm	88.0	42.7	37.6	3.45	<0.01	432	82	22	493	760	1		24
047	" "	9/26/78	49.4 gpm	85.6	90.7	25.1	3.14	<0.01	422	70	14	440	670			24.2
047A	E_{Can} Spring Can. above Convulsion	9/26/78	385 gpm	72.8	31.2	18.7	2.31	<0.01	290	90	12	370	568			10.5

Table 4
Page 2 of 2

Note: All quantities in mg/l unless otherwise noted.

* Location shown on map

Site No.	Site Description*	Date Sampled	Fluoride (F)	Nitrate Plus Nitrate as (NO_3-N)	Total Kjeldahl Nitrogen	Total Phosphate (PO_4-P)	Silica (SiO_2)	Total Iron (Fe)	Total Manganese (Mn)	Total Zinc (Zn)	Total Arsenic (As)	Total Cadmium (Cd)	Total Selenium (Se)
001	Spring in Duncan Draw	6/04/78	0.20	0.27	0.10	0.025	10.5	0.006	<0.001		<0.001	<0.001	<0.001
001	" " "	9/26/78	0.19	0.30	<0.10	0.024		0.683	0.004	0.019	<0.001	<0.001	<0.001
005	Seep in Trib. of E. Spring Can.	6/04/78	0.26	0.02	0.12	0.022	9.4	0.011	0.015		<0.001	<0.001	<0.001
006	S. Fork Quitchupah	6/06/78	0.45	0.02	0.40	0.024	5.9	0.393	0.074		<0.001	<0.001	<0.001
006	" "	9/26/78	0.30	0.07	0.20	0.026		0.206	0.043	0.009	<0.001	<0.001	<0.001
007	Quitchupah Ck.	6/04/78	0.26	0.05	0.20	0.035	5.4	0.168	0.036		<0.001	<0.001	<0.001
007	" "	9/26/78	0.25	0.02	<0.10	0.022		<0.001	0.015	0.012	<0.001	<0.001	<0.001
009	Trib. to N. Fk. Quitchupah	6/04/78	0.17	0.02	0.10	0.020	10.0	0.012	0.002		<0.001	<0.001	<0.001
021	Mine Effluent	6/05/78	0.20	0.02	0.13	0.022	9.3	0.008	0.005		<0.001	<0.001	<0.001
021	" "	9/26/78	0.25	0.06	<0.10	0.023		0.141	0.008	0.010	<0.001	<0.001	<0.001
033	Seep in Trib. of E. Spring Can.	6/04/78	0.04	0.02	0.10	0.020	7.0	0.068	0.009		<0.001	<0.001	<0.001
041	Quitchupah Ck. Above N. Fk.	6/05/78	0.32	0.03	0.14	0.035	9.9	0.121	0.010		<0.001	<0.001	<0.001
041	" " "	9/25/78	0.30	0.03	<0.10	0.020		0.035	0.011	0.004	<0.001	<0.001	<0.001
042	N. Fork Quitchupah	6/05/78	0.26	0.02	0.18	0.038	5.2	0.326	0.061		<0.001	<0.001	<0.001
042	" "	9/25/78	0.36	0.02	<0.10	0.023		<0.001	0.006	0.004	<0.001	<0.001	<0.001
045A	Quitchupah ds from drain field	6/3/78	0.19	0.03	0.14	0.026	10.5	0.121	0.033		<0.001	<0.001	<0.001
046	Convulsion Can above Pumphouse	9/26/78	0.23	0.03	<0.10	0.024		0.111	0.101	0.017	<0.001	<0.001	<0.001
047	Pumphouse Effluent	6/03/78	0.20	0.04	0.15	0.020	13.5	0.045	0.105		<0.001	<0.001	<0.001
047	" "	9/26/78	0.24	0.02	<0.10	0.020		0.201	0.069	0.007	<0.001	<0.001	<0.001
047A	E. Spring Can. Above Convulsion Can.	9/26/78	0.25	0.02	<0.10	0.045		0.234	0.027	0.014	<0.001	<0.001	<0.001

D. Subsidence Impacts

There is one ephemeral stream (E. Spring Canyon) but no known springs in or adjacent to present subsidence areas. Detailed on-the-ground examination of subsidence panels showed few if any additional rock fractures in sandstone outcrops. Open cracks at the ground surface in 1977 were difficult or impossible to find in 1978. Precipitation, micro-erosion and sedimentation processes had effectively filled the cracks. No hydrological impacts of any type were observed in the subsidence area.

IV. VEGETATION

A. Introduction

A vegetation reconnaissance of the SUFCO lease area was conducted during September, 1977 and major vegetation communities in the area were described (Botz, 1977). Communities identified in the area were:

Pinyon/juniper woodland	Mountain shrub
Sagebrush/grassland	Mixed conifer
Ponderosa pine	Aspen

Potential impacts of subsidence on vegetation were also discussed. These included:

1) Plant mortality along subsidence crevices
2) Invasion of annual grasses and forbs
3) Damage resulting from displacement of rocks along canyon walls and rims
4) Changes related to topographic modifications, especially depressions
5) Changes in vegetation related to alterations of the hydrologic system, i.e. springs and seeps and resulting changes in grazing pressure

B. Methods

The SUFCO lease area was revisited August 29-31, 1978. The purpose of this visit was to qualitatively evaluate impacts of subsidence on vegetation. Subsidence panels dropped in 1977 were intensively covered to ascertain whether impacts were evident. Areas walked in 1977 were also walked in 1978 with known subsidence crevices revisited. An effort was made to determine whether potential impacts listed above were occurring.

Additional baseline data on the vegetative resources of the area was obtained from the U.S. Forest Service in Richfield, Utah.

C. Results

Most subsidence cracks from 1977 were almost impossible to relocate during 1978. The sandy nature of the soils in the area of the first subsidence panel together with winter and spring precipitation events effectively filled in cracks created in 1977. There was no apparent mortality of plants along the cracks and no significant increase in annual grasses and forbs.

The rim of East Spring Canyon was inspected to determine extent of rock displacement and vegetation damage due to rocks rolling down the canyon wall. Damage was minimal although a small number of rocks had recently been dislodged resulting in trunk scars to trees. It was not possible to distinguish between natural displacement and displacement caused by subsidence.

There were no apparent changes related to topographic modifications (depressions). Dunrud (1976) in his study of subsidence at the Geneva mine in east-central Utah found that surface topography takes about three years to reach a final profile. Changes in vegetation related to topographic modification may occur after surface conditions had stabilized.

There were no changes in water sources that would affect livestock or wildlife distribution patterns. Inspection of vegetation at the spring in East Fork Canyon showed showed substantial livestock use.

The Fishlake National Forest has mapped range condition and suitability for most of the lease area. Range condition varies from 97% of climax on non-suitable, non-used grassland to 39% on suitable sagebrush areas. The majority of the area was rated in good range condition (50-75% of climax). Flatter sagebrush and grassland areas generally rated lower than tall shrub and tree dominated areas which occurred on steeper slopes. The area around the East Fork Spring Creek water development was rated at 61% of climax with no apparent trend (stable). The range condition and suitability map was prepared in October, 1971 and changes have probably occurred since then.

The Forest Service has established several vegetation transects both within and adjacent to the lease area. These transect locations are shown on Figure 2. Transects 1, 2 and 3 are part of the grazing impact analysis. Dominant grasses on the transects were Letterman's needlegrass (Stipa lettermanii), western wheatgrass (Agropyron smithii), and mutton grass (Poa fendleriana). Green rabbitbrush (Chrysothamnus viscidiflorus) and bitterbrush (Purshia tridentata) were common shrubs. Other species listed for the transects were blue grama (Bouteloua gracilis), sedge (Carex spp.), needle-and-thread (Stipa comata), squirreltail (Sitanion hystrix), big sagebrush (Artemisia tridentata), and several forbs. Vegetation and litter coverage was 82% with 18% bare ground. Average utilization of grasses was 70%. Total average production for the three transects was 1099 lbs/acre of which 937 lbs/acre was grasses, 120 lbs/acre shrubs and 42 lbs/acre forbs.

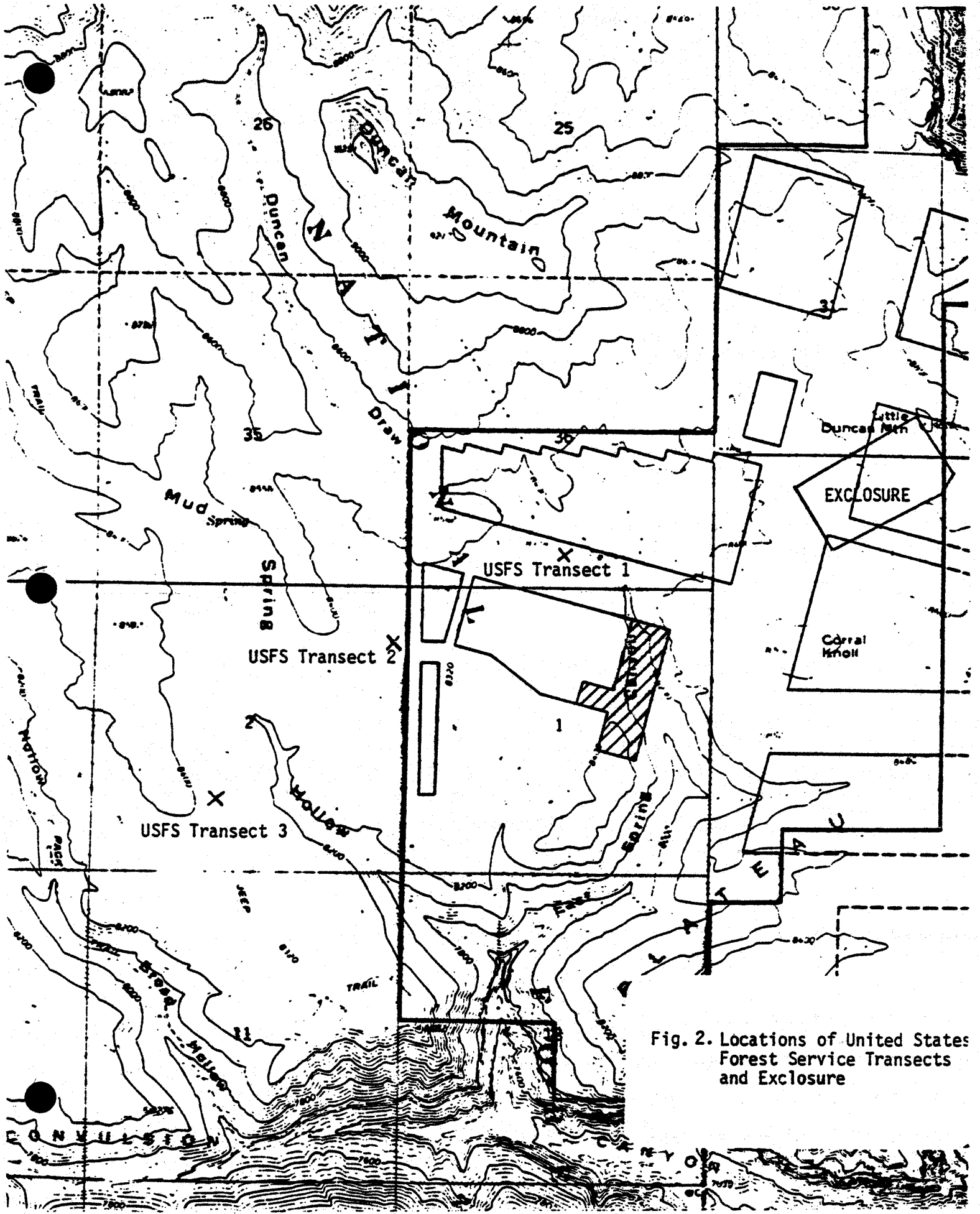


Fig. 2. Locations of United States Forest Service Transects and Exclosure

Table 5 lists the results for transects F 433 and F434 (Little Duncan). This area was dominated by shrubs, mainly big sagebrush, black sagebrush, and green rabbitbrush. Dominant grasses were western wheatgrass, desert needlegrass, and mutton grass. Common forbs were pussytoes, aster, Indian paintbrush, and Eriogonum. Plant cover and litter accounted for 79% while bareground and erosion pavement was 21%.

Table 5. Percent Composition of Vegetation, Little Duncan Transects

Species	Percent Composition
Grasses	
Agropyron smithii	8
Poa fendleriana	7
Stipa speciosa	8
	23
Shrubs	
Artemisia nora	17
Artemisia tridentata	24
Chrysothamnus viscidiflorus	27
Symphoricarpos spp.	1
	69
Forbs	
Antennaria spp.	3
Aster spp.	1
Castilleja spp.	2
Eriogonum spp.	2
	8
TOTAL	100%

Source: U.S. Forest Service, Fishlake National Forest unpublished data

Table 6 lists percent composition of species inside and outside of the Duncan Mountain exclosure. This exclosure was built in 1962 to examine the effects of trenching, pitting, sagebrush eradication and seeding of crested wheatgrass on the range (Laycock, 1969). Dominant shrubs in this area are big sagebrush and bitterbrush. Dominant grasses include mutton grass and Letterman's needlegrass.

Table 6. Percent Composition of Species, Duncan Mountain Exclosure (Transects F 409, F 410), 1978

Species	Percent Composition		
	Outside (F 409)	Inside (F410)	Average (Weighted)
Grasses			
Agropyron cristatum	-	3.8	2.4
Agropyron smithii	3.2	-	1.2
Poa fendleriana	22.5	22.6	23.2
Sifanion hystrix	6.5	5.7	6.0
Stipa lettermanii	29.0	2.8	12.5
	61.2	35.9	45.3
Shrubs			
Artemisia tridentata	6.5	28.3	20.2
Chrysothamnus viscidiflorus	6.5	5.7	5.9
Purshia tridentata	19.4	11.3	14.3
	32.4	45.3	40.4
Forbs			
Aster spp.	3.2	-	1.2
Astragalus spp.	-	3.8	2.4
Eriogonum spp.	-	15.0	9.5
Taraxacum officinale	3.2	-	1.2
	6.4	18.8	14.3
TOTAL	100.0	100.0	100.0

Source: U.S. Forest Service, Fishlake National Forest, unpublished data.

V. WILDLIFE

A. Introduction

Impacts of subsidence to wildlife in the SUFCo mine area were first investigated on September 13-14, 1977 and reported to the Coastal States Energy Company in a report by WESTECH in late 1977. The mine area was visited again on August 29-30, 1978 and impressions on wildlife use and impacts to wildlife from subsidence were updated.

B. Methods

Methods were identical to those used in 1977 (WESTECH, 1977). The assessment area was first examined by vehicle along access roads. The area was then divided into thirds and examined on foot. Weather conditions (temperature, wind speed and direction, cloud cover) were recorded approximately hourly during pedestrian surveys. Wildlife species actually observed or recorded by evidence were listed. Sightings of big-game species were mapped on U.S. Geological Survey 7½-minute topographic sheets. Sightings were recorded by species, time of day, vegetation type, number, sex, age and activity, when applicable.

General impressions of season and degree of habitat use by big game species also were recorded. To quantify these impressions somewhat, pellet group counts were run at three locations (Figure 3) using a method adopted from Lonner (1975). The observer followed a general route, counting numbers of paces walked and pellet groups within three feet of his route. Pellet groups of three species (elk, mule deer, cattle) were counted; when elk and deer pellet groups could not be differentiated, they were lumped as ungulate pellets. Pellet groups were subjectively separated into three age classes:

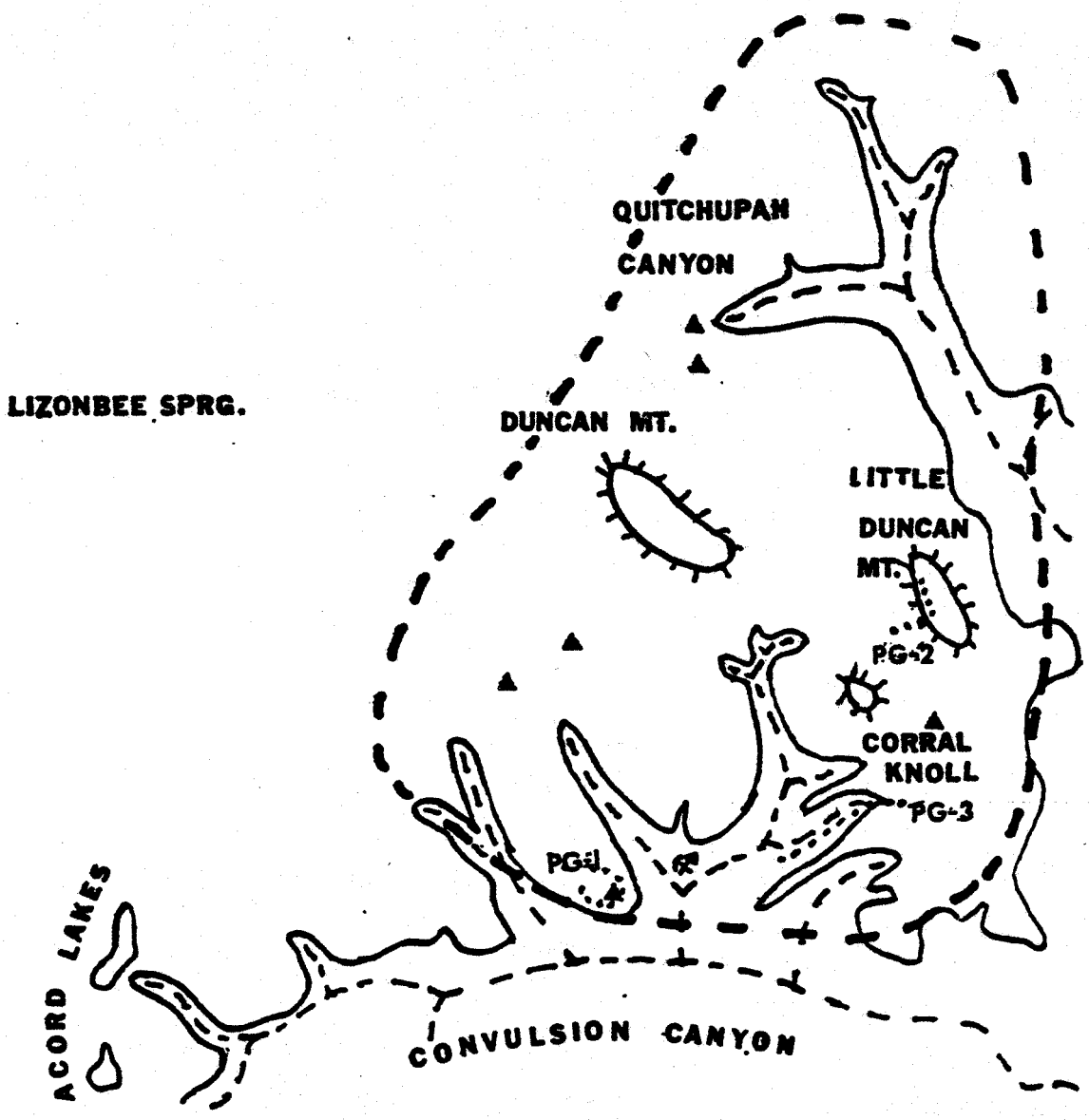


Fig. 3. SUFCo mine wildlife assessment area, August 29-30, 1978.

fresh (less than 48 hours), recent (probably deposited in summer), and old (the previous winter or older). Number of pellet groups was divided by number of paces to create a PG/pace/vegetation type of each age class.

Springs and seeps located during the pedestrian surveys also were examined for general use by the three species. Tracks, pellet groups, actual sightings, etc. were used as indicators.

C. Results and discussion

1. Habitat

The mine assessment area lies within the Old Mesas and Canyons Management Unit of the Old Woman Management Area. There are four major landforms (U.S. Forest Service, 1976), or habitats, within the Unit. All landforms provide habitat for a variety of wildlife; however the following discussion primarily concerns big game.

a. Sagebrush/grass and Ponderosa pine benches. This major landform includes several vegetation community types reported by WESTECH (1977). They are:

i. Sagebrush/grassland (Figure 4).

Found on plateaus and slopes above the canyons, this community is dominated by big sagebrush (Artemesia tridentata) and low sagebrush (Artemesia arbuscula), with bitterbrush (Prushia tridentata) and rabbitbrush (Chrysothamnus spp.) often abundant. Common grasses and grass-like plants in this type include slender wheatgrass (Agropyron trachycaulum), western wheatgrass (A. smithii),

prairie junegrass (Koeleria macrantha), needle-and-thread grass (Stipa comata), Letterman needlegrass (S. lettermanii) and sedges (Carex spp.). This type produces more forage for livestock and big game than most other types.

Except in years with deep snow accumulations, it is an important component of big game winter range. Winter range condition in the Old Woman Management Area is fair to poor (U.S. Forest Service, 1976). Browse condition determined by the Forest Service from permanent line transects near the assessment area is fair. Browsing of bitterbrush is apparent in most stands. Bitterbrush is highly palatable to most grazing animals (Plummer, Christenson and Monson, 1978), and generally responds well to grazing pressures (Ferguson and Basile, 1966; Ferguson, 1972). It is a preferred mule deer winter browse in some Utah winter ranges (Robinette et al., 1977; Smith, 1952; Smith and Hubbard, 1954), and may be a preferred browse in the mine assessment area.

Sagebrush is often considered an important browse on big game winter ranges (Smith, 1952; Plummer, Christenson and Monson, 1968), but its high amount of aromatic oils reduces its palatability and therefore its preference (Smith and Hubbard, 1954; Dietz and Yeager 1959; Dietz, Udall and Yeager, 1959; Dietz and Nagy, 1976). It seems to be most valuable on those ranges where other browse species provide a diet mix (Dietz and Yeager, 1959).

Rabbitbrush is sometimes considered poor browse (Smith and Hubbard, 1954), but other authors consider it valuable, particularly for elk (Plummer, Christenson and Monson, 1968).

Fig. 4. Sagebrush/grassland community in the Sagebrush/grass and Ponderosa pine landform.

ii. Ponderosa pine

This community is found on benches and at the heads of several draws and canyons. Shrubs associated with this type are curlleaf mountain mahogany (Cercocarpus ledifolius) and manzanita (Arctostaphylos patula). Mountain mahogany is a valuable browse (Plummer, Christenson and Monson, 1968) but at many sites in the assessment area has grown above the reach of big game animals. Manzanita receives light to moderate use by mule deer (Kufeld, Wallmo and Feddema, 1973). In severe winters, much of the manzanita in the assessment area will likely be below snow level.

Selective harvest of old growth Ponderosa pine was underway during the assessment. Pine regeneration is sparse and openings created by harvesting are being invaded by mountain mahogany, manzanita and other shrubs (WESTECH, 1977). This practice should improve browse quantity and quality for some time, but these gains will be difficult to sustain as tree canopy increases (Robinette et al., 1977).

b. Steep slopes and scarp-faced canyon walls

This major landform included three community types: pinyon/juniper woodland, mixed conifer, and mountain shrub.

i. Pinyon/juniper woodland (Figure 5)

The pinyon/juniper woodland community is found in lower elevations of Quitchupah, East Spring and Convulsion Canyons. Pinyon (Pinus edulis) and juniper (Juniperus osteosperma) vary in coverage; at some sites there are almost pure stands of juniper. Understory is generally sparse. Common grasses are bluebunch wheatgrass (Agropyron spicatum) and Indian ricegrass (Oryzopsis hymenoides), while yarrow (Achillea millefolium), Indian paintbrush (Castilleja linariaefolia), comandra (Comandra pallida) and daisies (Erigeron spp.) were forbs observed during the assessment period (WESTECH, 1977).

This community type is used year round by mule deer and appeared to be used seasonally by elk. The steep slopes probably have less snow cover during severe winters than more gentle areas, but the absence of preferred forage probably reduces its attractiveness as a feeding site to both species. It appears to be important escape/security cover for mule deer.

Fig. 5. Steep slope/canyon wall landform, with pinyon/juniper community type on opposite slope.

ii. Mixed conifer (Figure 6)

This community type was found along steep north and east aspects of the canyons, and on the north side of Little Duncan Mountain. White fir (Abies concolor), Douglas fir (Pseudotsuga menziesii) and Ponderosa pine dominated the overstory.

At wetter sites and along stream bottoms, Engelman spruce (Picea engelmanii) occurred (WESTECH, 1977).

This type provides good escape/security cover during spring, summer and fall for big game, and some forage. Snow depths probably preclude extensive use in severe winters.

Fig. 6. Steep slope/canyon landform showing mixed conifer community on opposite slope, and mountain shrub community on near slope.

iii.Mountain shrub (Figure 6)

The mountain shrub community type is dominated by scrub oak and curlleaf mountain mahogany. These two species may occur as separate stands, or together. Other shrubs are present, in varying degrees (WESTECH, 1977).

This type appeared to be used year-round by mule deer, but there were very few elk tracks or pellet groups observed in this type where it occurred in the steep slope/canyon landform. This type was also found in the rolling hills landform, where it showed considerably more use by both species.

c. Narrow stringers in canyon bottoms (Figure 7).

This landform featured small grassy meadows, sometimes with stands of sagebrush/grassland. Other community types from the steep slope/canyon landform also occurred in the bottoms. There was very little understory around developed springs, where cattle use was heavy.

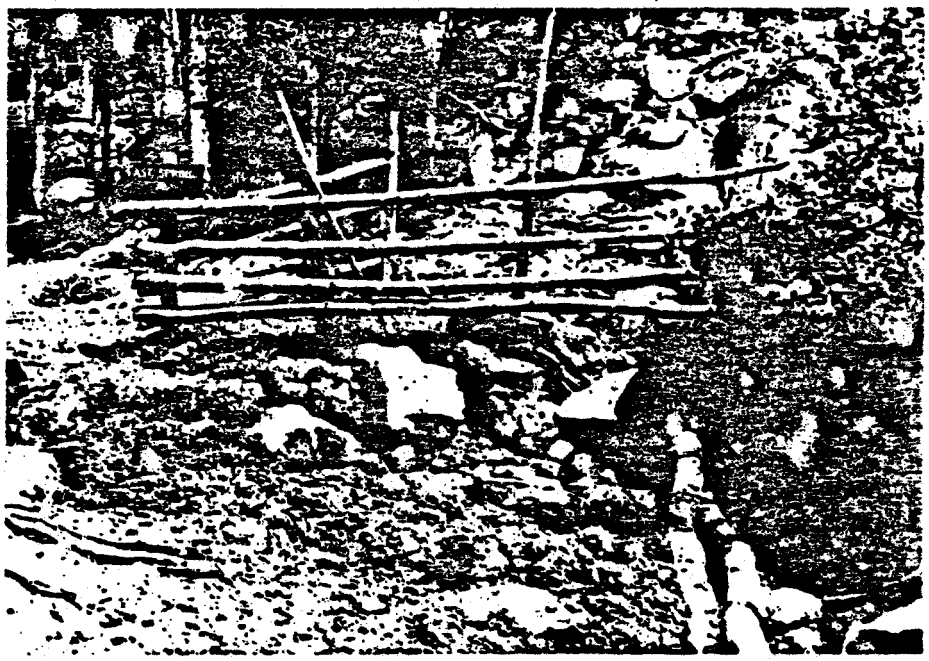


Fig. 7. Developed spring in canyon bottom showing absence of understory.

d. Rolling hills (Figure 8)

The rolling hills landform consists of four community types: mountain shrub (usually dominated by oak), mixed conifer, sagebrush/grassland and aspen. Aspen stands also occur in the other major landforms, but are most prominent in the rolling hills landform.

Due to its interspersion of communities and resulting "edge effect", this landform is valuable to big game in all seasons. Depending on aspect and slope, part of it may be unavailable in winter.

Fig. 8. Rolling hills landform, showing mixed conifer, aspen and sagebrush/grassland community types.

2. Birds

Seventeen avian species were identified in 1977 (WESTECH, 1977); 11 more were added in 1978, for a total of 28 (Table 7). The U.S. Forest Service (1976) listed 102 species of birds in the Salina Planning Unit, which includes the SUFCo mine assessment area. The assessment area list is con-

Table 7. Birds Observed in the SUFCo Mine Assessment Area.[a]

Falconiformes	
Cooper's Hawk	*Accipiter cooperii*
Golden eagle	*Aquila chrysaetos*
American kestrel	*Falco sparverius*
Falliformes	
Blue grouse	*Dendragapus obserus*
Columbiformes	
Mourning dove	*Zenaida macroura*
Strigiformes	
Great horned owl	*Bubo virginianus*
Piciformes	
Yellow-bellied sapsucker	*Sphyrapicus varius*
Common flicker	*Coloptes auritus*
Hairy Woodpecker	*Dendrocopos villosus*
Passeriformes	
Horned lark	*Eremophial alpestris*
Steller's jay	*Cyanocitta stelleri*
Scrub jay	*Aphelocoma coerulescens*
Black-billed magpie	*Pica pica*
Clark's nutcracker	*Nucifraga columbiana*
Mountain chickadee	*Parus gambeli*
White-breasted nuthatch	*Sitta carolinensis*
American robin	*Turdus migratorius*
Swainson's thrush	*Hylocichla ustulata*
Mountain bluebird	*Sailia currucoides*
Solitary vireo	*Vireo solitarius*
Pine siskin	*Spinus pinus*
Green-tailed towhee	*Chlorura chlorura*
Rufous-sided towhee	*Pipilo naculatus*
Vesper sparrow	*Pooecetes gramineus*
Lark Sparrow	*Chondestes grammacus*
Gray-headed junco	*Junco caniceps*
Chipping sparrow	*Spizella passerina*
Brewer's sparrow	*Spizella breweri*

[a] Nomenclature from A.O.U. (1957) and Skaar (1975).

siderably smaller due to the small amount of field time (four days in two years), influenced by the autumn season (few singing males, difficulty in identifying immature passerines, and possibly some migration out of the area).

Birds were observed in all habitats. No raptor eyries were located, but many potential nest sites are present along canyon rims, in Ponderosa pine snags and in living trees. The U.S. Forest Service has deleted many Ponderosa pine snags from timber harvest in the assessment area for the purpose of providing habitat for cavity-nesting birds and other species which utilize snags.

3. Mammals

Eleven mammalian genera were recorded from actual sightings or observations of evidence (Table 8). Several could not be identified to species.

Of 49 mammals potentially found in the Salina Planning Unit (U.S. Forest Service, 1976), 45 were included in Armstrong's (1977) list of distributional patterns of Utah mammals. These 45 species appeared to fit the SUFCo mine assessment area into the Northern High Plateaus Province, of the Central Highlands Faunal Area. This zoogeographic classification is based upon areographic patterns of mammalian distribution.

Elk were not observed in the assessment area in 1978, although they had been recorded in 1977 (WESTECH, 1977). The elk herd in the Salina Planning Unit has been increasing for several years. The area receives considerable hunting pressure for elk and deer, with the number of hunters increasing 122 percent from 1969-1972 (U.S. Forest Service, 1976).

Table 8. Mammals Recorded in the SUFCo Mine Assessment Area. [a]

Lagomorpha	
Black-tailed jackrabbit	*Lepus californicus*
Cottontail	*Sylvilagus* spp.
Rodentia	
Red squirrel	*Tamiasciurus hudsonicus*
Chipmunk	*Eutamias* Spp.
Pocket gopher	*Thomomys talpoides*
Wood rat	*Neotoma* spp.
Carnivora	
Coyote	*Canis latrans*
Badger	*Taxidea taxis*
Bobcat	*Felis rufus*
Artiodactyla	
Elk	*Cervus elephus*
Mule deer	*Odocoileus hemionus*

[a] Nomenclature from Jones et. al., 1975.

The U.S. Forest Service (1976) reported that part of the assessment area is considered an elk calving ground, most of the area is an elk winter concentration site, and the remainder is "normal" big game winter range (Figure 9). Winter range condition in the area, as determined from permanent line transects conducted by Fishlake National Forest personnel, is considered fair.

During severe winters, parts of the "normal" winter range and elk concentration site may not be used. There was 3-4 feet of snow on the plateau above the mine for part of the 1977-1978 winter; at this time, no deer or elk were sighted on the plateau (Dall Dumick, personal communication to M.K. Botz).

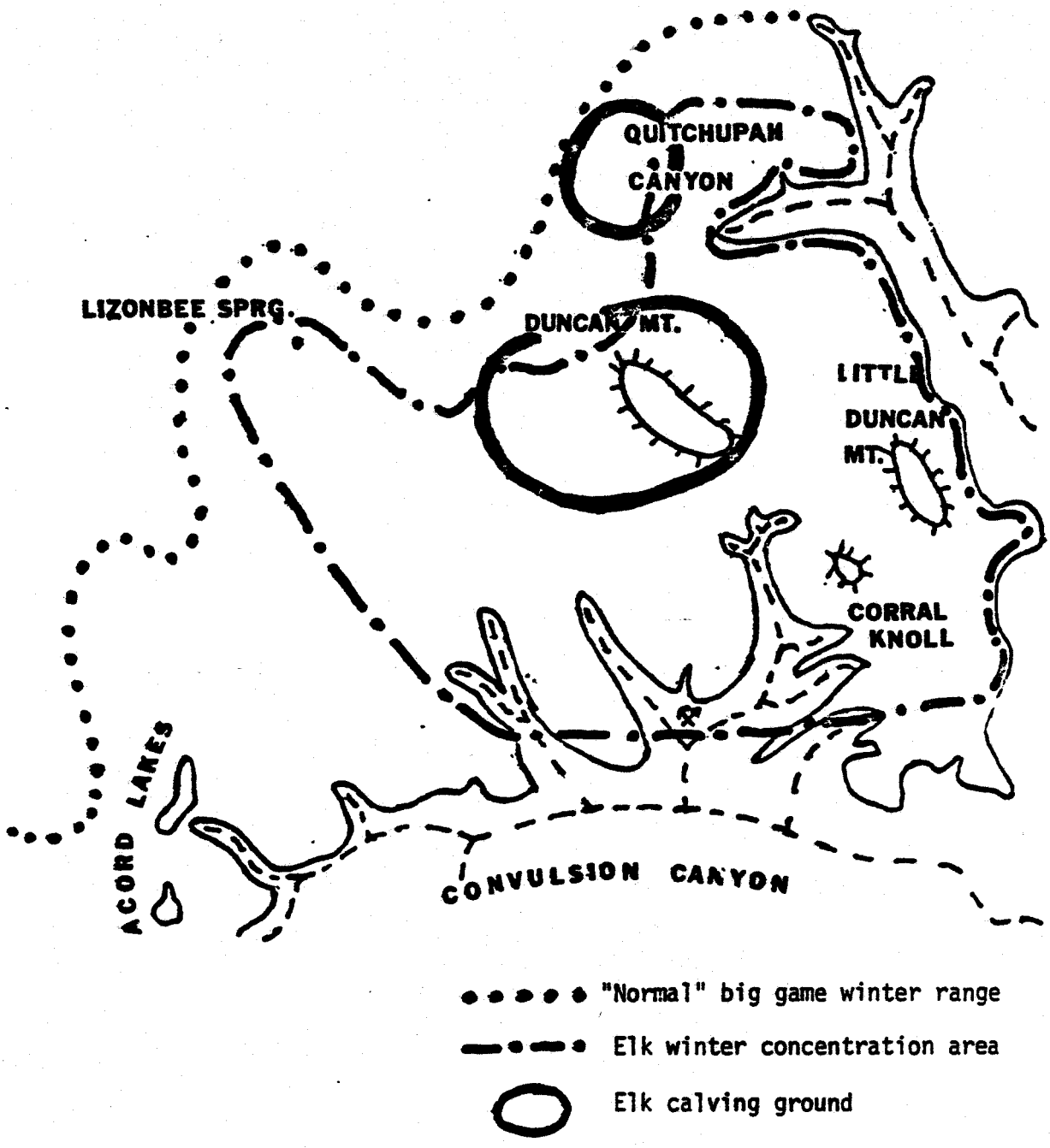


Fig. 9. Big game use areas in the mine assessment area (adapted from U.S. Forest Service, 1976).

By late winter-early spring, elk and mule deer were again observed on the plateau.

Numbers of mule deer in Utah have declined in recent years. The wintering population declined 34 percent between 1971-1972 and 1975-1976. The decline was attributed to a debilitating cycle of severe drought summers and high snowfall winter/springs, high percentage of doe kill in some hunting units, loss of winter range, and possibly predation (John, 1976). Within the Salina Planning Unit, the severe 1972-1973 winter contributed to the decline (U.S. Forest Service, 1976).

Mule deer sightings are shown in Figure 3. Six groups were observed: one doe in sagebrush/grassland, one doe and two fawns in mixed conifer, one buck in an aspen-sagebrush ecotone, two does and two fawns in mountain shrub, two bucks and one doe in Ponderosa pine, and one buck in Ponderosa pine. Three sightings were within one hour of sunrise, one within one hour of sunset, and two were of deer flushed from mid-day beds.

In addition, skulls of three mule deer (one buck, two does) were found during pedestrian surveys. These skulls were quite weathered; these animals had been dead for several years. Leg remains of three more deer were found at a hunting camp site. One dead mule deer was found along the paved haul road leading from the mine to I-70, and there were remains of three deer which were caught in the I-70 boundary fence, where it paralleled the haul road.

Pellet group count results are shown in Table 9. Only PG's estimated to be old in age were considered, since small sample size precluded PG/pace/type

values for more recent age groups. No fresh elk PG's were observed on any transect, and only a few were judged recent. These results support the conclusion drawn in the previous year (WESTECH, 1977) that the area is more important to elk in late autumn, winter, and early spring than in late spring, summer and early autumn. However, a number of factors including precipitation and solar exposure affect the rate at which PG's dissipate; in addition, observer error in judging age may have also affected the results. Nevertheless, the age conclusion supports the U.S. Forest Service (1976) statement that the assessment area is important big game winter range.

As in 1977 (WESTECH, 1977), the highest elk values were from PG-2. This transect was located both inside and outside the Duncan Mountain Experimental Plot (Figure 1). The Duncan Mountain plot comprises 70 acres on a southwest slope of Little Duncan Mountain; it was created in 1962, was seeded to crested wheatgrass after trenching, pitting and sagebrush eradication (Laycock, 1969). Cattle were excluded, but in recent years the fence has not been maintained and gates have been opened, allowing cattle to enter the exclosure.

In 1977 PG/pace/type values for PG-2 were considered only for inside and outside the exclosure. Low cattle values outside the exclosure were attributed to steep slopes, since the "outside" portion of the transect was run along the upper slope of Little Duncan Mountain (WESTECH, 1977). To verify this hypothesis, the "inside" values were divided by slope in 1978 (Table 9). Values for all three species were highest on the lower, relatively gentle slope where grasses predominated. Cattle and elk values were the same. However cattle PG's declined dramatically as slope increased, suggesting that steeper slopes were not as attractive to cattle as to big game species. In general,

Table 9. Pellet group count results (PG's considered old in age), SUFCo mine assessment area, August 29-30, 1978.

Transect	Vegetation Type	PG/pace Values Deer	Elk	Cattle
PG-1	Ponderosa pine-mountain mahogany-manzanita	0.019	0.000	0.000
PG-2	Sagebrush/grass (outside exclosure)	0.021	0.034	0.011
	Sagebrush/grass (exclosure-lower slope)	0.021	0.104	0.104
	Sagebrush/grass (exclosure-upper slope)	0.018	0.053	trace
PG-3	Mixed conifer	0.015	0.000	trace
	Aspen-Sagebrush/grass	0.022	0.013	0.044

elk values declined with increasing slope more than did deer values. This may be attributed to difference in food habits between the two species (elk possibly preferring the grasses more abundant at lower slopes during late autumn and winter), and to the fact that deer seem to be relatively more abundant year-round in the area and would therefore be more likely to cover all available habitat.

Results on the other two transects generally paralleled 1977 (WESTECH, 1977). Cattle values were highest in the relatively flat aspen-sagebrush/grassland of PG-3. Deer values were lower than elk values in open habitats, and higher in wooded habitats. There were no elk and cattle values from PG-1, a dramatic change from 1977. The reason for this change is unknown. Deer values were highest of all three species in rough terrain (PG-1 and mixed conifer of PG-3).

Part of this difference may be the lack of water sources which influenced cattle distribution in this topography.

D. Impacts of subsidence to big game populations

In 1977, it was suggested that subsidence might alter vegetation in affected areas thereby influencing big game use (WESTECH, 1977). By the 1978 field period, the subsidence fissures observed in 1977 had closed, and there was no apparent difference in vegetation survival between the subsidence area and nearby unaffected sites. It appears that vegetation will not be significantly affected by the physical action of subsidence. Effects due to altered soil moisture conditions, if any, have not yet become apparent.

Effect of loss of springs and seeps due to subsidence remains speculative. Developed springs observed in 1977 were still flowing in 1978, so that there was no water loss at these sources. Water was also available at small developed impoundments on intermittent drainages, and in natural "slick-rock" catchments.

Several factors may influence big game use of springs and seeps in the assessment area:

(1) Water use characteristics of local big game populations. Wood et al. (1970) showed that permanent sources of water affected mule deer distribution in a pinyon-juniper ecosystem in New Mexico. In their study, range use by mule deer decreased as distance from water increased. They also found deer densities fluctuating in response to the number of water sources available, suggesting that water location influences deer density as well as distribution.

Other authors have stated that water sources are important to big game. For example, ideal spacing of water for deer is reported to be at intervals of one mile or less (U.S. Forest Service, 1969). But some authors do not discuss water requirements (Robinette et al., 1977) while others (Grenston and Ryerson, 1973; Ogle and Ross, 1970) emphasize its importance in forage production rather than direct intake.

In contrast, Mackie (1970) also found that range use by mule deer and elk in the Missouri River Breaks of Montana decreased as distance from water increased, but concluded that this change was related more to seasonal changes in food habits than to water locations. Cattle distribution, however, was markedly influenced by water distribution.

In the SUFCo assessment area, most springs and seeps are located in canyons. General impressions and pellet group counts (Table 9) suggested very little elk use of canyons and considerable elk use of dry hillsides, implying that elk distribution is not significantly influenced by water sources.

While deer use of canyons was relatively high (Table 9), it was also high in other habitats. Although sample size was small, this result suggests that cover and browse availability may be more influential than water in determining deer distribution.

A developed spring (East Spring) near the head of East Spring Hollow, and an unmaintained spring and an undeveloped seep in the same drainage near the mine, were inspected for wildlife use. Cattle tracts and pellet groups were predominant at all three locations.

(2) Season of use. The SWFCo assessment area is a wintering ground for elk and mule deer (U.S. Forest Service, 1977). There were no springs in that portion of the area considered an elk calving ground. With most use occurring in winter, snow or runoff may decrease the importance of springs to game species. Wood et al. (1970) implied that water sources were less important on winter ranges than summer ranges.

(3) Runoff collection sites. Natural ponds or man-made reservoirs which hold water in dry periods may also decrease the importance of springs. There were several small reservoirs located in or near the assessment area, most of which were dry during the field period. There was rainfall collected in depressions on large flat rocks in several draws, another possible short-term water source.

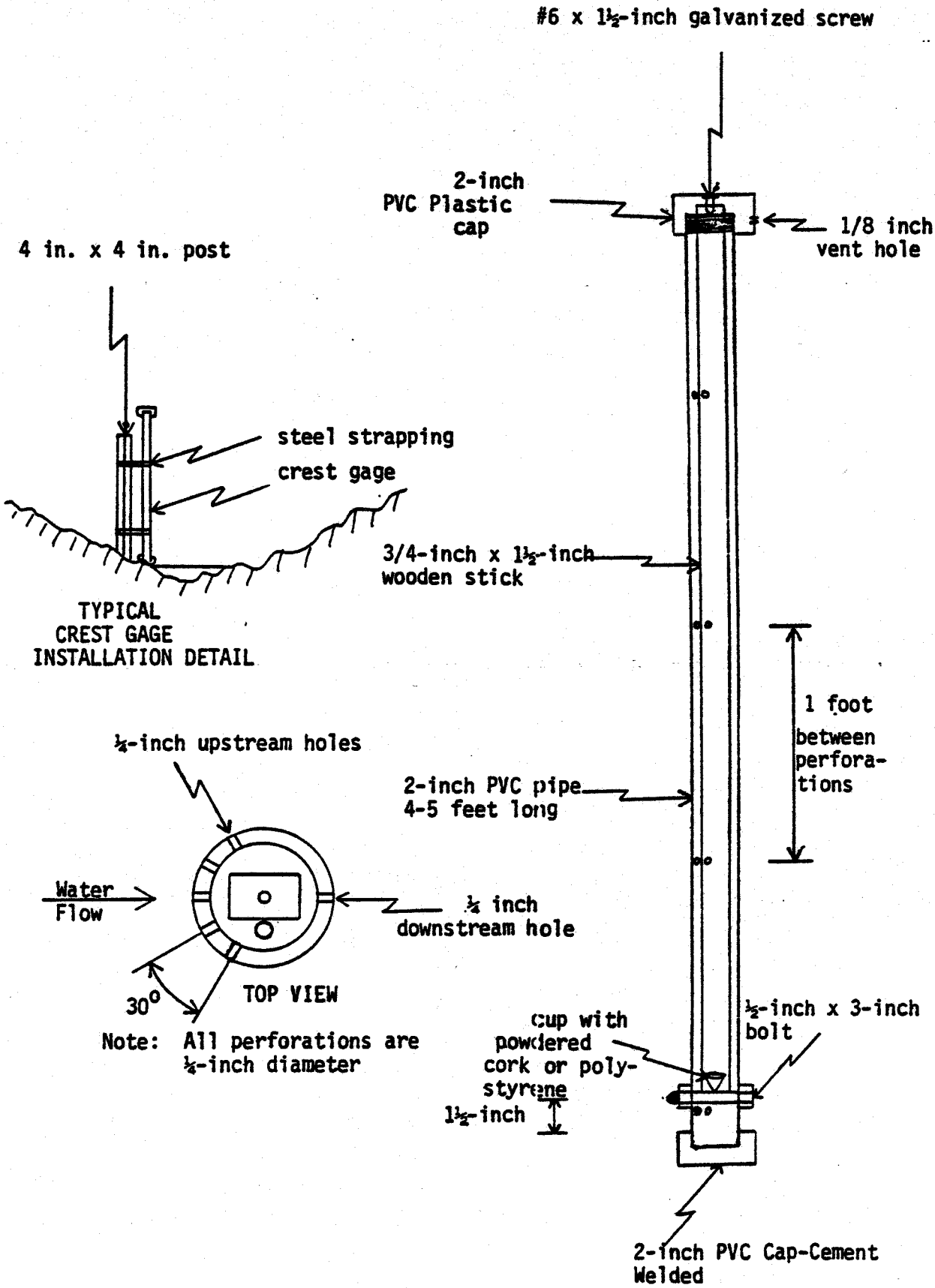
(4) Competition with cattle. Several studies (Lonner, 1975) have suggested that elk and cattle are socially incompatible. Others (Bickford and Reed, 1943; Stevens, 1966) have indicated that elk, deer and cattle may compete for food items. If cattle are the predominant users of water at springs and seeps, they will probably also dominate use of nearby plants, further reducing value of springs for big game species.

E. Mitigations

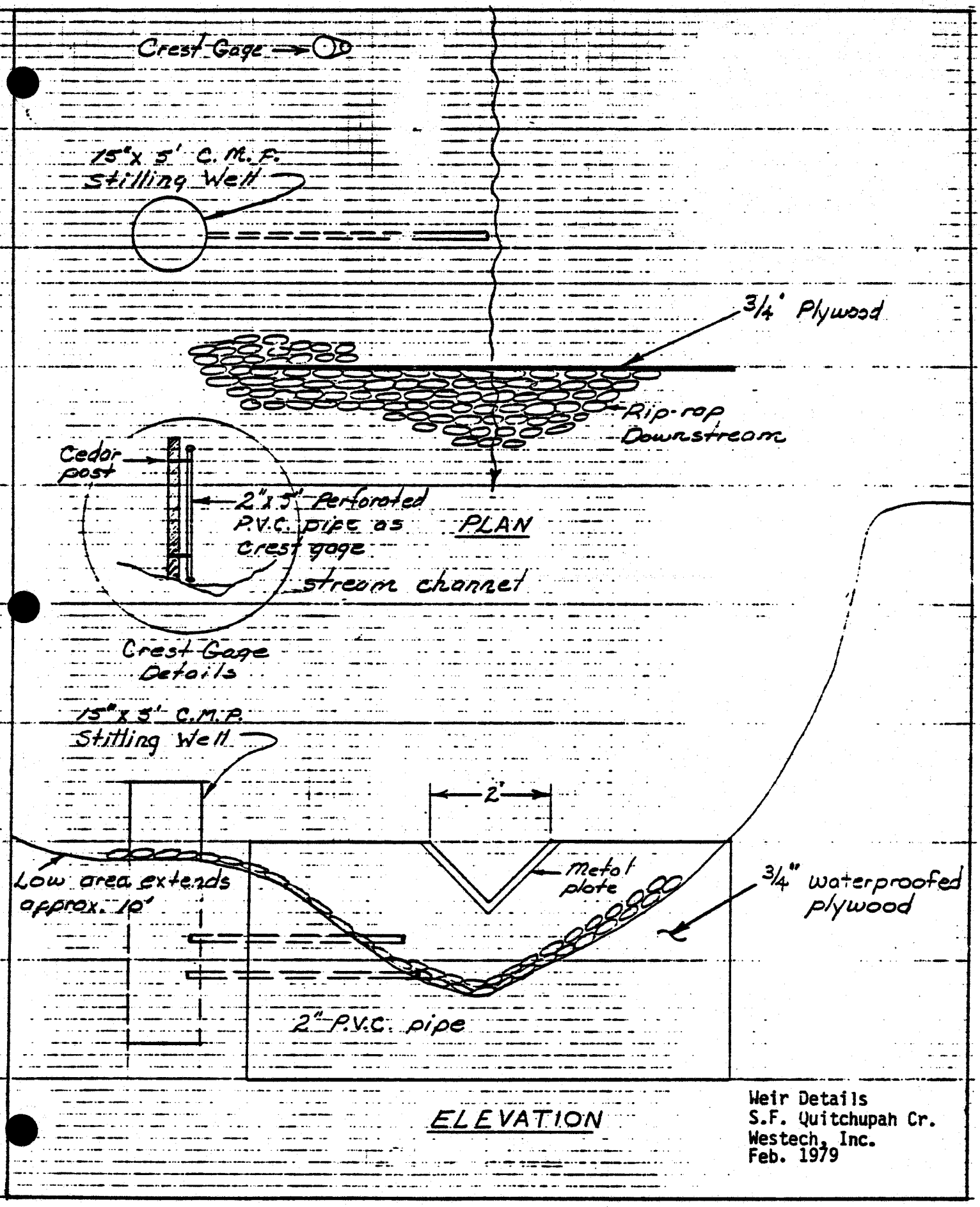
Suggested mitigations are identical to those recommended in 1977 (WESTECH, 1977) for combined impacts to hydrology, vegetation and wildlife.

VI. APPENDICES

Appendix A. Construction and Installation Details of Crest Gages, Weirs and Flume.



Crest Gage Construction Detail



Weir Details
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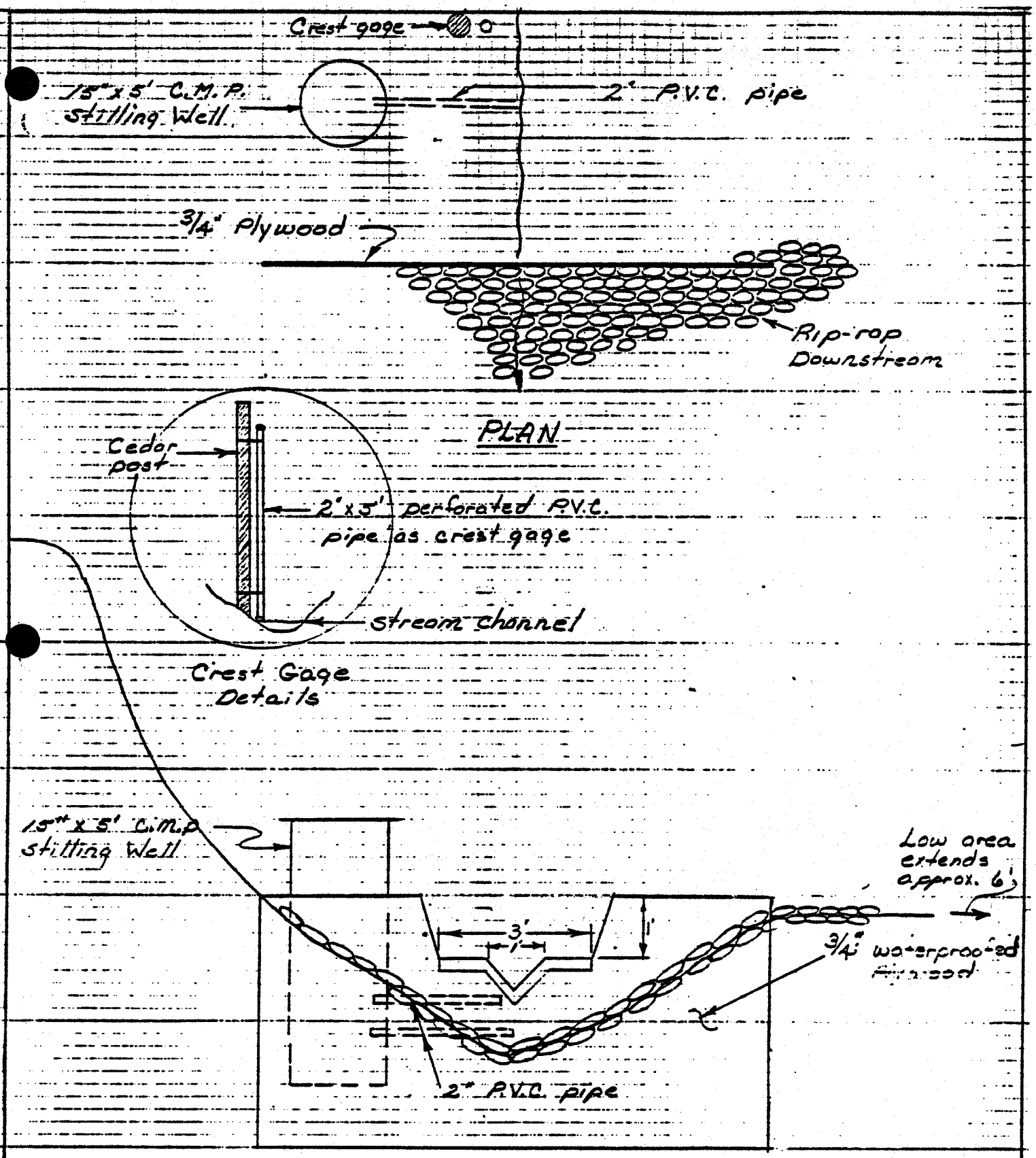
Westech, Inc.
Feb. 1979



Weir Details
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Westech, Inc.
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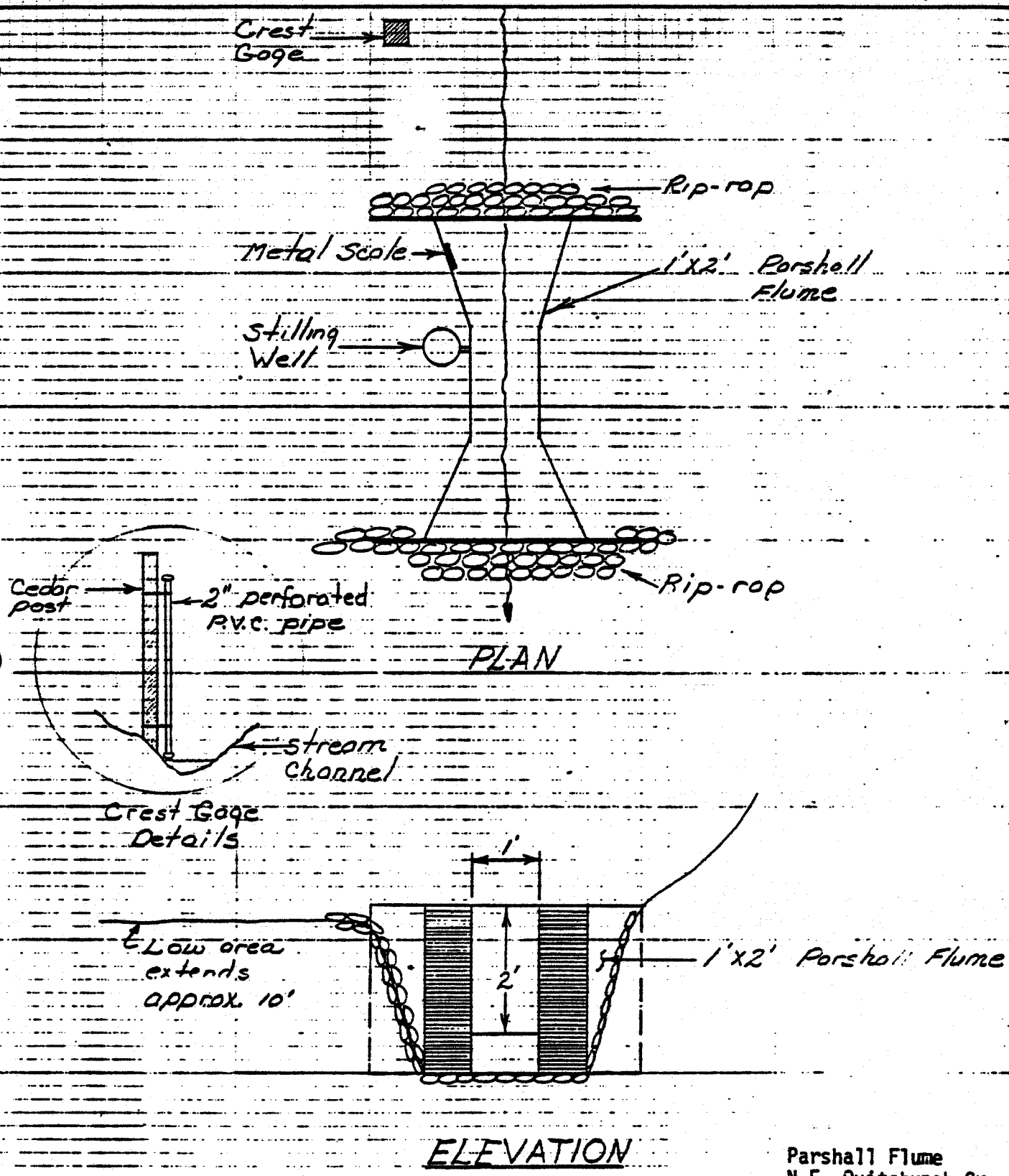
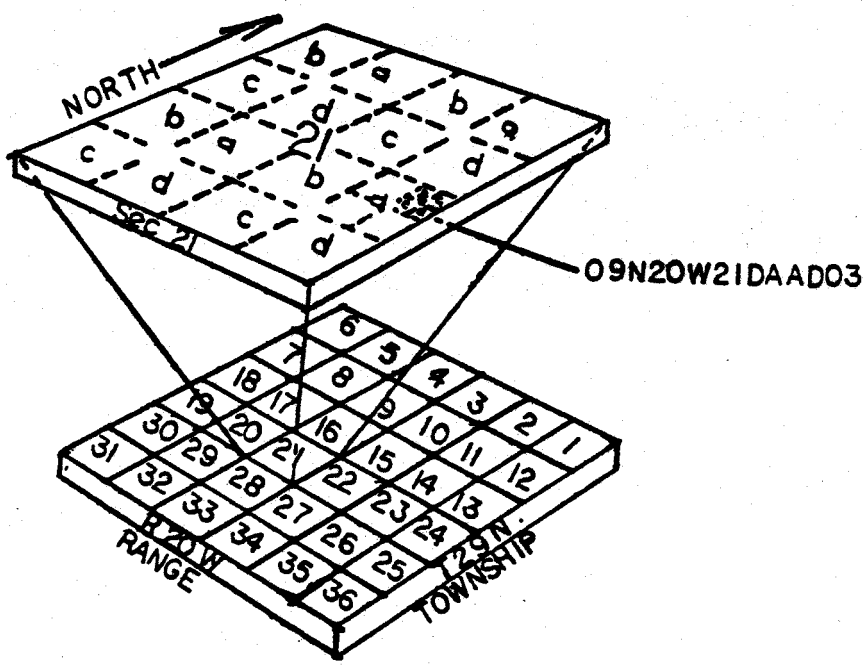


Parshall Flume
N.F. Quitchupah Cr.
Westech, Inc.
Feb. 1979

Appendix B. System for Geographical Location of Features.

SYSTEM FOR GEOGRAPHICAL LOCATION OF FEATURES

Features such as water sampling sites, wells, and springs are assigned a location number that is based on the system of land subdivision used by the U. S. Bureau of Land Management. The number consists of fifteen characters and describes the location by township, range, section and position within the section. The figure below illustrates this numbering method. The first three characters of the number give the township, the next three the range. The next two numbers give the section number within the township, and the next four letters describe the location within the quarter section (160-acre tract), and quarter-quarter section (40-acre tract), and a quarter-quarter-quarter section (10-acre tract), and the quarter-quarter-quarter-quarter (2 1/2-acre tract). These subdivisions of the 640-acre section are designated as A, B, C, and D in a counterclockwise direction, beginning in the northeast quadrant. If there is more than one feature in a 2 1/2-acre tract, consecutive digits beginning with the number 02 are added to the number. For example, if a water quality sample was collected in Section 21, T29N, R20W it would be numbered 29N20W21DAAD02. The letters DAAD indicate that the well is in the southeast 1/4 of the northeast 1/4 of the northeast 1/4 of the southeast 1/4, and the number 02 following the letters DAAD indicates that there is more than one site location in this 2 1/2-acre tract.



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ENVIRONMENTAL MONITORING PROGRAM
FOR 1979
SUFCo MINE - SALINA, UTAH

For

LOREN A. WILLIAMS
COASTAL STATES ENERGY CORP.
COASTAL TOWER
NINE GREENWAY PLAZA
HOUSTON, TEXAS 77046

By

MAXWELL K. BOTZ
HYDROMETRICS
1300 Cedar St.
Helena, Montana 59601

and

WESTECH
2301 Colonial Drive
Helena, Montana 59601

MAY 18, 1979

ENVIRONMENTAL MONITORING PROGRAM
FOR 1979
SUFCo MINE - SALINA, UTAH

It is planned to conduct water resources, wildlife, vegetation and other environmental monitoring in the vicinity of the SUFCo #1 mine near Salina, Utah. This provides the third year of baseline environmental assessment and impact evaluation from the SUFCo #1 mine area. The 1979 program is designed to meet environmental requirements of the new OSM Permanent Regulatory Program for underground coal mines. The State of Utah currently is developing the required regulatory authority to administer this mining program. This 1979 monitoring program also will satisfy the U.S. Forest Service environmental requirements for underground coal mines.

WATER RESOURCES

The 1979 monitoring plan will include evaluation of surface water, groundwater and water quality. The snowpack is about 125% of normal and peak run-off should occur in June. To meet the water resources requirements of regulatory agencies, the following will be completed in 1979.

1. Instrument and activate streamflow recording stations installed in 1978. This will include calibration of the combination weir on the N. Fork of Quitchupah Creek.
2. Conduct a well and spring survey to determine baseline conditions and assess subsidence impacts. In addition to flow measurement, a photo record will be started for each station.
3. Measure groundwater levels in all monitoring wells and coordinate with Coastal States Energy Company geologist in development of additional monitoring sites. This will be in conjunction with the summer exploration drilling program.

4. Conduct examination of subsidence areas to determine possible hydrological impacts.
5. Evaluate mine water inflow information and pumping records.
6. Obtain water quality samples in July and early fall. The July samples will be for a few selected constituents and the fall samples will be tested for a complete set of parameters. This will allow comparison with 1978 water quality data. As required by OSM, results of water quality analysis will be submitted to OSM within 60 days of sampling. This will include a description of analytical quality control used in the field and laboratory.
7. Assessment of surface water drainage facilities and treatment of run-off from disturbed areas.

VEGETATION

Since vegetation monitoring in 1977 and 1978, the Office of Surface Mining has promulgated rules pertaining to underground coal mining. These rules contain specific references to vegetation monitoring. This 1979 program attempts to incorporate provisions of the new Permanent Regulatory Program in addition to requirements of the U.S. Forest Service. Monitoring for the 1979 field season has been separated into tasks to identify important components of vegetation monitoring.

Task 1. Establish quantitative transects to identify pre-disturbance conditions over proposed subsidence panels

Transect locations will be cooperatively selected by SUFCo, U.S. Forest Service and Westech. Specific methods to be used should also be agreed upon by the three parties. Several locations should be selected and sampled to provide analysis of different vegetative community types.

Task 2. Establish reference areas or obtain USDA or USDI data for eventual analysis of reclamation success

Federal rules require the collection of data to be used as a comparison of revegetation success prior to bond release. A company may use data from reference areas or data from USDA or USDI agencies, if it is available. If existing information on ground cover and productivity is available from the federal agencies it should be assembled and summarized for later use. If this information is not available, reference areas should be selected and sampled for various vegetation types that

are to be disturbed. A detailed study plan should be prepared to show how and when the reference areas will be sampled. Existing Forest Service transects (off-site) could fulfill part of this requirement.

Task 3. Long range study plan design for assessment of subsidence impacts

After the baseline data for Task 1 has been summarized a long range study plan should be developed to detail methodology and timing for analysis of impacts due to subsidence. Responsibilities for data collection should be worked out between SUFCo and the Forest Service.

WILDLIFE

The wildlife survey will be a continuation of the wildlife surveys performed in 1977. It will include vehicle traverses and pedestrian surveys. The objective will be to expand the species list and to map wildlife sitings. For a more quantitative estimate, a continuation of the pellet group counts will be made including separation by age class, and vegetation type. These data will provide a trend in wildlife in the area. Methods used will be those listed in WESTECH's previous assessments.

AIR AND SOILS

To answer OSM concerns on air quality, a dust control plan will be developed for the mine area and the air quality monitoring program will be described.

A soils map will be prepared for the disturbed mine area (exclusive of subsidence areas). This will include a program to reclaim the final tipple site.

940 River Heights Blvd.
Logan, UT 84321

May 19, 1979

Mr. Wes Sorensen, Mining Engineer
Southern Utah Fuel Co.
PO Box P
Salina, UT 84654

Dear Mr. Sorensen:

Re: Water and Soil Data Report from SUFCO Mine

Enclosed are data and interpretations from samples collected on May 4, 1979.

The data show the water quality to be good, with no evidence of toxicity of heavy metals from spoils. There is evidence of some increase in amount of suspended sediment in the stream.

I have also included a revegetation plan for the cut bank east of the office complex.

If I can be of further service, please call me.

Yours very truly,

Alvin R. Southard

Alvin R. Southard
Certified Professional
Soil Scientist
ARCPACS #528.

Enclosure
ARS/mh

WATER AND SOIL DATA REPORT FROM SUFCO MINE

SAMPLING STRATEGY.

Water. Water samples were collected as follows:

#1 - above the mine operation.

#2 - at the culvert exit from under the spoil.

#3 - above the culvert on the trail south of the power line.

Spoil. Spoil samples were collected as follows:

Starting at a point near the culvert exit under the spoil, and working in a west-southwest direction, samples #1, #2, and #2A were collected about 30 feet below the top of the spoil bank; sample #3 was from the yellow "gob" about 35 feet below the top of the spoil bank; sample #4, high in fine coal, was collected 15 feet above the stream. That is evidently the place of most recent dumping of coal waste. Sample #5 was collected downstream at the site where slumping had created a blockage of the stream. The sample was taken about 10 feet above the stream. This sample contained coal and small pieces of shale.

Soil. Soil samples were collected as follows:

#6 - east of the office complex on the cut bank just above the coal seam.

#7 and #8 - These represent the A and B horizons, respectively, of the soil under the conifers east and above the office complex.

INTERPRETATIONS.

Water Quality. (Table 1.)

Sample #1 was taken above the mine operation. It is class C-1. It shows 46 ppm suspended sediment. Samples from the culvert as it emerges from the spoil bank show an increase in sodium and rate as class C-2, with 66 ppm sediment. Sample #3, collected below the mine operations, shows an increase in salinity and sediment, but is still in class C-2. The sodium is low at all sample points. The water is of good quality, even at the most salty site, and is adequate for most agronomic crops.

It is important to note that water quality is not adequately assessed from one sampling, and that daily monitoring for substantial periods is required to determine the exact quality of the water, especially in streams where volume of flow fluctuates widely during a season as well as annually.

Spoil. Chemical Properties of the Spoil. (Table 2.)

Samples #1, #2, and #2A are only mildly saline (EC_e), the pH is moderately alkaline, and they have low SAR values (SAR = 15 is considered the threshold of concern). These samples show a reaction with hydrochloric acid indicated as ++ under Lime in Table 2. Water-soluble cations are low. Extractable heavy metals are low. With additions of nitrogen and phosphorus, and with irrigation, these materials should support grass and legumes. Spoil sample #3, from the yellowish "gob", is moderately saline and moderately alkaline. The SAR approaches the threshold of concern, but is below. This material, with fertilization and irrigation, should support plant species tolerant of moderately saline and sodic conditions. Spoil samples #4 and #5 are mildly saline and alkaline, and show no problem with sodium (SAR). These materials, if mixed and covered with spoils from samples #1, #2, and #2A, should support vegetation if fertilized and irrigated.

Soil. Chemical Properties of the Soil. (Table 2.)

Soil sample #6, just above the coal seam, is moderately saline and alkaline, and shows no more than moderate SAR values. This material, if fertilized and irrigated, should support grasses and legumes. Soil samples #7 and #8 were collected under the trees east of the office complex, and are nonsaline and moderately alkaline (pH). There is no indication of sodic problem. These soils are low in nitrogen and phosphorus. The A horizon, 0-6 cm, is thin, and has a wide C:N (17:1) ratio. This surface soil needs fertilization to support vigorous growth of grass and legumes. The B horizon, 6-20 cm, has a narrow C:N ratio (~11:1), considered to be about normal in soil-biological systems.

None of the soil or spoil samples contains heavy metals at concentrations which would cause toxicity concerns. The soils and spoils are calcareous, and in such systems most heavy metals are insoluble.

If SUFCO's operations preclude entry of sediment from the spoil and cut banks into the stream, the sediment load would be reduced and the quality of water sample #2 can be maintained.

REVEGETATION STRATEGY.

Seeding of the cut bank east of the office complex can be accomplished as follows:

Construct 6-inch-wide row-terraces along the contour (across the slope). Terrace rows should be about 1 foot apart vertically. Apply nitrogen fertilizer at the rate of 100 lbs. N per acre, and phosphorus at the rate of 50 lbs. P per acre. Seed yellow sweet clover, crested wheatgrass, and Russian wild rye, at the rate of 2 lbs. each per 1,000 square feet. Cover the seeds with a thin covering of soil and irrigate (sprinkle) lightly and often until seedlings emerge and the plants reach a height of about 2 inches. Then irrigate to maintain the plants in an actively growing condition.

It is important to inoculate the clover seed before planting to insure adequate N for the grasses in future years.

(Note: A "thin covering of soil" as mentioned above should be not more than 1/2 inch thick.)

#

UTAH STATE UNIVERSITY LOGAN UTAH 84322

SOIL, PLANT and WATER
ANALYSIS LABORATORY
UMC 48

May 18, 1979

Name A.R. Southard / Sufco

Street _____

City _____
State Zip

TABLE 1. WATER ANALYSIS REPORT

USU No	Collector's Description	Salinity µmhos/cm	Sodium meq/l	SAR	Class	Ca + Mg meq/l	SAR_{adj}	Residual Carbonate meq/l	Chloride meq/l	Boron ppm	pH	ppm Sedim
1555	above mine	148	.1	.2	C1-S1	1.3	<.1	0	.13	.05	8.1	46
1556	below culvert	425	.6	.4	C2-S1	3.8	.8	0	.33	.17	8.2	66
1557	culvert bottom	488	.7	.5	C2-S1	4.7	.9	0	.39	.17	8.2	342

The end effect of using a particular water for irrigation depends upon several factors besides the water quality: *type of soil*, its *salt content* and *drainage; crops* to be grown; *climatic factors;* and *management practices*. The user must make the final evaluation of water quality test results with these factors in mind, according to his situation.

Research has yielded useful guidelines, which are summarized on the enclosed sheet. Two systems of water quality evaluation are given: The USDA Handbook 60 (1954), and a more recent system that places more emphasis on the sodium hazard. The principal value of each is in alerting the water user so that he can make appropriate adjustments in his water management before serious problems develop.

If possible problems are indicated by either of these evaluation methods, we suggest you consult a qualified adviser.

Reuel E. Lamborn
Director

(See Key to Abbreviations, page 7.)

Dr. A.R. Southard
UMC 48

UTAH STATE UNIVERSITY · LOGAN, UTAH 84322

SOIL, PLANT and WATER
ANALYSIS LABORATORY
UMC 48

Data report on So. Utah Fuel Co. soil samples received 5/7/79.

TABLE 2.

Log #	Ident		ECe mmhos/cm	pH	ppm $NaHCO_3$-P	ppm $NaHCO_3$-K	%O.C.	%N	meq/l Na	meq/l Ca+Mg	SAR
79-											
1558	sufco	1 of 9	3.4	7.8	1.5	43	7.1	.18	10.4	28.5	2.8
1559		2 of 9	2.0	7.7	.3	62	16.7	.43	4.0	18.6	1.3
1560		2A	5.5	7.9	.8	90	1.6	.08	15.2	54.2	2.9
1561	Gob	3	9.1	7.7	.1	82	7.4	.33	59.1	47.0	12
1562	mostly coal	4	3.6	8.0	.1	54	9.5	.12	16.1	21.3	4.9
1563	sediment Dam	5	2.6	7.9	.1	81	10.9	.37	2.2	25.7	.6
1564	rk above c.str	6	6.0	8.3	<.1	32	.3	.02	33.0	35.0	7.9
1565	0-6	7	.7	8.1	2.0	353	3.9	.22	1.0	9.8	.6
1566	6-20	8	.6	8.3	.3	382	1.4	.12	1.4	7.7	.6

	meq/100g water-soluble Na	K	Ca	Mg	Lime	ppm Fe	Zn	Cu	Mn
1558	.5	<.1	.7	.9	++	21	1.7	.4	2.2
1559	.2	<.1	.7	.6	++	46	1.3	.6	2.2
1560	.5	<.1	1.0	1.3	++	6.0	2.0	.6	4.4
1561	2.5	<.1	1.2	1.2	++	8.6	2.8	1.0	11
1562	.7	<.1	.7	.6	++	7.6	2.6	1.0	8.0
1563	.1	<.1	.7	.5	++	16	2.3	1.0	10
1564	1.2	<.1	.3	1.2	++	2.0	.8	.6	2.0
1565	<.1	.1	.3	.1	++	4.0	1.6	.6	4.2
1566	.1	<.1	.2	<.1	++	2.0	.6	.6	2.2

(See Key to Abbreviations, page 7.)

KEY TO ABBREVIATIONS

Atm.	Atmosphere
CEC	Cation Exchange Capacity
CO_3	Carbonate
EC	Electrical Conductivity (water) (millimhos/cm or micromhos/cm)
ECe	Electrical Conductivity of Saturation Extract
ESP	Exchangeable Sodium percentage
Exch.	Exchangeable
Ext.	Extractable
HCO_3	Bicarbonate
H2O-Sol	Solubility in saturation extract
Lime	$CaCO_3$
MAh	Mechanical Analysis (hydrometer)
VCS	Very Coarse Sand
CS	Coarse Sand
MS	Medium Sand
FS	Fine Sand
VFS	Very Fine Sand
MAp	Mechani l Analysis (pipet
meq/l	milliequivalents per liter
meq/100g	milliequivalents per 100g of soil
NO_3-N	Nitrogen (Nitrate)
TN	Nitrogen (Total-Kjeldahl)
O.C.	Organic Carbon
O.M.	Organic Matter
TP	Total Phosphorus
ppm	Parts per million
pH	Acidity-Alkalinity
SAR	Sodium Adsorption Ratio
Sat. Ext.	Saturation extract
SP	Saturation Percent ($\%H_2O$)
SO_4	Sulfate

ELEMENTS

Al	Aluminum	K	Potassium
B	Boron	Mg	Magnesium
Ca	Calcium	Mn	Manganese
Cd	Cadnium	Na	Sodium
Cl	Chloride	P	Phosphorus
Cu	Copper	Pb	Lead
Fe	Iron	Zn	Zinc
		S	Sulfur

L.L.	Liquid Limit
P.L.	Plastic Limit
P.I.	Plasticity Index

WATER QUALITY ANALYSIS
(For Irrigation)

Total Salt (Salinity)

Plants remove much water from the soil but only a small amount of soluble salt. Evaporation also removes water, but no salt. Salts contained in irrigation water can therefore be removed effectively only by applying enough excess water to leach them downward, out of the root zone and into the underground drainage system. Indicated "leaching requirements" give the amount of water (%), in *excess* of crop requirements, which must be applied and drained down through the root zone in order to control salt accumulation. Crops vary widely in their salt tolerance, as indicated in the table on the reverse side of this sheet.

Sodium Hazard

Soils high in adsorbed sodium (sodic soils) are hard to wet when irrigated, tend to run together when wet, have low permeability and are difficult to drain. When dry, they form hard clods and large cracks. A good soil can be converted to a sodic soil by irrigation with water that is high in sodium relative to calcium and magnesium (a high sodium adsorption ratio or SAR). Also, bicarbonate in the water can convert the calcium and magnesium to insoluble forms in the soil and thus increase the sodium hazard. If the amount of bicarbonate is greater than the Ca + Mg, the difference is called "Residual Sodium Carbonate."

USDA Handbook 60 Evaluation

Electrical Conductivity (Salinity)

Class C1 (Conductivity 0-250). This LOW SALINITY water can be used to irrigate all crops on all soils with little likelihood that soil salinity will develop. Some leaching is required, but this usually occurs under normal irrigation practices. Application of this water to new land high in sodium salts may cause a sodic condition to develop.

Class C2 (Conductivity 250-750). This MEDIUM SALINITY water can be used on most soils. Plants with moderate salt tolerance can be grown in most cases without special practices for salinity control. Leaching requirement 5-15%.

Class C3 (Conductivity 750-2250). HIGH SALINITY water should not be used on soils with restricted drainage. It can be used with crops having medium to high salt tolerance on light soils having good drainage and with irrigation practices which provide appreciable leaching. Leaching requirement 15-25%.

Class C4 (Conductivity 2250-5000). VERY HIGH SALINITY water is not suitable for irrigation under ordinary conditions. It may be used successfully with crops of high salt tolerance, on light and well-drained soils, and with very carefully conducted soil and water management practices. Leaching requirement 25-65%. Winter or early spring leaching should be practiced on most soils to insure removal of salts remaining from the previous season.

Class C5 (Conductivity over 5000). This water is generally unsuitable except in an emergency to prevent loss of a crop on soils with good drainage. Any such use should be followed by leaching with better water.

Sodium (Alkalinity)

Class S1. LOW SODIUM water can be used on all soils with little sodium hazard.

Class S2. MEDIUM SODIUM water will present an appreciable sodium hazard in fine-textured soils, especially under low-leaching conditions, unless gypsum is present in the soil. This water may be used on coarse-textured or organic soils having good permeability.

Class S3. HIGH SODIUM water may produce harmful levels of sodium in most soils and will require special soil management—good drainage, high leaching, and addition of organic matter. Soils high in gypsum may not develop harmful effects from such water, and the effects may be less in soils high in lime. Chemical amendments may be of benefit if the water is not too high in salinity (C3 or better).

Class S4. VERY HIGH SODIUM water is generally unsatisfactory for irrigation purposes except at salinity levels C1 and perhaps C2, where addition of amendments or dissolving of calcium from the soil may reduce the proportion of sodium in the soil solution.

Residual Sodium Carbonate

0 to 1.25 meq/1: probably safe
1.25 to 2.5 meq/1: marginal
More than 2.5 meq/1: not suitable for irrigation

SUPPLEMENTAL EVALUATION

Sodium Hazard

The term "Adjusted Sodium Adsorption Ratio" (SAR_{adj}) is calculated to take into account the total salinity and the concentration of sodium relative to calcium + magnesium, and the bicarbonate.

Root absorption of sodium can also cause specific toxicity problems, primarily for trees, vines, and woody ornamentals. Annual crops are usually not affected by sodium except for its contribution to total salt content. Water with SAR_{adj} below 3: no problem; from 3 to 9: problems increase; above 9: problems are severe.

Leaf absorption of sodium (from sprinklers) can cause toxicity symptoms under some conditions if the sodium exceeds 3 meq/1.

Chloride Hazard

Chlorides are found in all natural waters, and normally cause no problems. In high concentrations, however, chlorides can inhibit plant growth and they are specifically toxic to some plants.

Chlorides (meq/1)	
0-2	Generally safe for all plants.
2-4	Sensitive plants may show slight to moderate injury.
4-10	Moderately tolerant plants usually show slight to substantial injury.
10+	Severe problems.

3 or more (sprinklers) may cause problems under adverse conditions.

Sprinkler Irrigation

When the rate of evaporation is high (low humidity, high temperature, high wind), leaf burn may occur at levels of salinity, sodium and chloride that would be safe under less severe conditions. Usually there is no problem if salinity is less than 1200 umhos/cm and sodium and chloride are less than 3 meq/1. At higher levels, it may be advisable to increase rate of rotation or to sprinkle only at night during periods of hot, dry weather.

SOIL PROBLEM	DEGREE OF PROBLEM		
	None	Increasing	Severe
Salinity (µmhos/cm)	0-750	750-3000	3000+
Sodium (SAR_{adj})	0-6	6-9	9+
Residual carbonate (meq/1)	0-1.2	1.2-2.5	2.5+

TOXICITY TO CROPS	DEGREE OF PROBLEM		
	None	Increasing	Severe
Furrow or flood:			
Sodium (SAR_{adj})	0-3	3-9	9+
Chloride (meq/1)	0-4	4-10	10+
Boron (ppm)	0-.5	.5-2	2+
Sprinklers:			
Sodium (meq/1)	0-3	3+	--
Chloride (meq/1)	0-3	3+	--

CROP TOLERANCE TO SALINITY* and LEACHING REQUIREMENT

Crop	EC water µmhos/cm	ECe Soil mmho/cm	Leach. Req. %	Crop	EC water µmhos/cm	ECe Soil mmho/cm	Leach. Req. %
FIELD CROPS							
Barley	5300	8.0	12	Soybean	2500	3.7	10
Sugar beet	4500	6.7	11	Corn	2200	3.3	12
Wheat	3100	4.7	8	Beans	700	1.0	6
VEGETABLE CROPS							
Beets	3500	5.3	11	Onion	900	1.3	8
Tomato	1800	2.7	8	Carrot	700	1.0	6
Potato	1100	1.7	6	Beans	700	1.0	7
Sweet Corn	1100	1.7	6				
FRUIT CROPS							
Apple/pear	1100	1.7	7	Raspberry	800	1.8	8
Apricot/peach	1100	1.7	7	Strawberry	700	1.0	7
FORAGE CROPS							
Tall wheatgrass	4900	7.3	11	Alfalfa	1300	2.0	5
Barley (hay)	3500	5.3	10	Orchard grass	1300	1.7	4
Tall fescue	--	3.9	--	Alsike, Ladino, Red, Strawberry	900	1.5	4-6
Reed canary grass	--	--	--				
Brome grass	--	--	--	Sweet clover	--	--	--

*Values shown are maximum for no appreciable loss in yield. For approximately 10% yield reduction, multiply each value by 1.5.

BORON HAZARD

A small amount of boron is necessary for plant growth. Most Utah soils have adequate boron for crops, and most surface waters carry it. Some wells and saline waters contain toxic levels, and should be avoided.

Boron (ppm)	Toxicity
0.0-0.5	Safe for all crops
0.5-1.0	Sensitive crops show slight to moderate injury
1.0-2.0	Semitolerant crops show slight to moderate injury
2.0-4.0	Tolerant crops show slight to moderate injury
4.0+	Unsatisfactory for all crops

Relative Tolerance of Plants to Boron

(In each group the plants first named are considered as being more sensitive and the last named more tolerant)

Sensitive	Semi-Tolerant	Tolerant
0.5 ppm	1 ppm	2 ppm
Apricot	Tomato	Carrot
Peach	Oat	Lettuce
Cherry	Corn	Cabbage
Grape	Wheat	Onion
Apple	Barley	Alfalfa
Pear	Field Pea	Sugar Beet
Plum	Potato	
1 ppm	2 ppm	10 ppm

Adapted from USDA Tech. Bul. No. 448.

Ford Chemical
LABORATORY, INC.
Bacteriological and Chemical Analysis
40 WEST LOUISE AVENUE
SALT LAKE CITY, UTAH 84115
PHONE 485-5761

DATE: 08/15/79

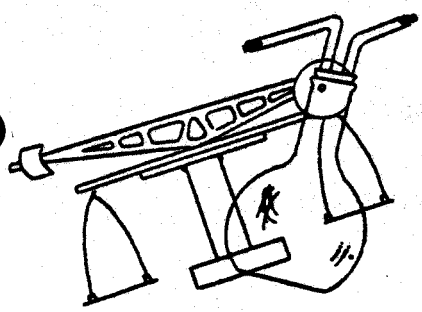
CERTIFICATE OF ANALYSIS

HYDROMETRICS, INC.
1300 CEDAR STREET
HELENA, MT
59601

79-005384

SAMPLE: WATER RECEIVED 7/10/79.

	#100 (021) MINE DISCHARGE 7/3/79	#101 046 CONV. CANYON ABOVE 046 PUMP HOUSE 7/3/79	#102 047 A E SPRNG C. ABV CONV CAN. 7/3	#103 007 NORTH FRK QUITC HUPAH ABV CAN. 7/3	#104 006 SOUTH FRK QUITC HUPAH. 7/3/79
Arsenic as As mg/l	<.001	<.001	<.001	<.001	.002
Bicarbonate as HCO3 mg/l	251.32	502.64	285.48	209.84	229.36
Cadmium as Cd mg/l	<.001	<.001	<.001	<.001	<.001
Calcium as Ca mg/l	61.60	96.00	64.80	45.60	55.20
Carbonate as CO3 mg/l	<.01	<.01	<.01	<.01	<.01
Chloride as Cl mg/l	12.0	34.0	14.0	2.0	6.0
Conductivity umhos/cm	C2 580	C3 1,000	C2 610	C2 670	C2 500
Fluoride as F mg/l	.33	.26	.31	.23	.42
Iron as Fe mg/l	.110	1.230	.330	.170	.470
Magnesium as Mg mg/l	35.52	74.40	40.32	64.32	29.76
Manganese as Mn mg/l	.004	.181	.025	.020	.050
Nitrate as NO3-N mg/l	.25	.10	.05	.02	.04
Phosphate as PO4-P (Total) mg	.060	.100	.060	.100	.060



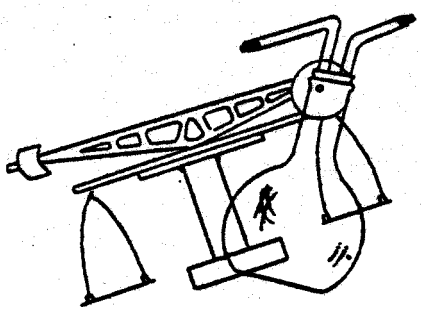
Ford Chemical
LABORATORY, INC.
Bacteriological and Chemical Analysis

40 WEST LOUISE AVENUE
SALT LAKE CITY, UTAH 84115
PHONE 485-5761

CERTIFICATE OF ANALYSIS

79-005384

	#100 (021) DISCHARGE 7/3/79	#101 047 PUMP HOUSE 7/3/79 (047 CONV. CANYON ABOVE)	#102 047 A E SPRNG C. ABV CONV CAN. 7/3	#103 007 NORTH FRK QUITC HUPAH ABV CAN. 7/3	#104 006 SOUTH FRK QUITC HUPAH. 7/3/79
Potassium as K mg/l	2.163	4.310	2.420	.678	1.276
Selenium as Se mg/l	.001	<.001	<.001	<.001	<.001
Silica as SiO2 mg/l	3.50	5.10	2.90	1.50	6.30
Sodium as Na mg/l	20.90	34.37	21.47	12.73	17.90
Sulfate as SO4 mg/l	116	157	114	210	100
Suspended Solids mg/l	33.0	95.0	59.0	45.0	87.0
Total Dissolved Solids mg/l	380	652	400	438	328
Total Kjeldahl Nitrogen mg/l	.30	.25	.18	.20	.25

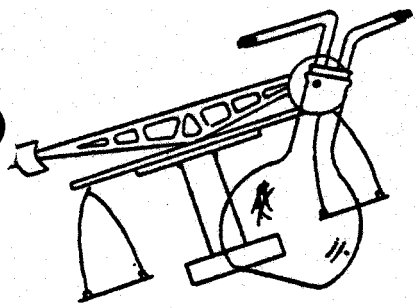


Ford Chemical
LABORATORY, INC.
Bacteriological and Chemical Analysis
40 WEST LOUISE AVENUE
SALT LAKE CITY, UTAH 84115
PHONE 485-5761

CERTIFICATE OF ANALYSIS

79-005384

	#105 001 EAST SPRING 7/4/79	#106 041 QUITC HPAH CRK AB NO FK 7/4/79	#107 042 NO. FK.QUITCH PAH 7/4/79
Arsenic as As mg/l	<.001	<.001	.001
Bicarbonate as HCO3 mg/l	251.32	265.96	219.60
Cadmium as Cd mg/l	<.001	<.001	<.001
Calcium as Ca mg/l	58.40	45.60	46.40
Carbonate as CO3 mg/l	<.01	<.01	<.01
Chloride as Cl mg/l	20.0	30.0	10.0
Conductivity umhos/cm	400	970	460
Fluoride as F mg/l	.18	.31	.30
Iron as Fe mg/l	.010	.080	.290
Magnesium as Mg mg/l	19.68	48.00	27.36
Manganese as Mn mg/l	.008	.011	.027
Nitrate as NO3-N mg/l	.10	.12	.10
Phosphate as PO4-P (Total) mg	.030	<.010	<.010
Potassium as K mg/l	1.452	2.894	1.142
Selenium as Se mg/l	.001	.001	<.001
Silica as SiO2 mg/l	2.44	4.50	2.85
Sodium as Na mg/l	11.98	103.00	22.69



Ford Chemical
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40 WEST LOUISE AVENUE
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CERTIFICATE OF ANALYSIS

79-005384

	#105 001 EAST SPRING 7/4/79	#106 041 QUITC HPAH CRK AB NO FK 7/4/79	#107 042 NO. FK.QUITCH PAH 7/4/79
Sulfate as SO4 mg/l	21.0	260	78.0
Suspended Solids mg/l	9.0	5.0	45.0
Total Dissolved Solids mg/l	260	631	299
Total Kjeldahl Nitrogen mg/l	.22	.20	.30

FORD CHEMICAL LABORATORY, INC.

DRAINAGE FACILITIES
AND SEDIMENT CONTROL PLAN

SOUTHERN UTAH FUEL COMPANY
MINE NO. 1

September 17, 1979

Prepared for

Southern Utah Fuel Company
P. O. Box P
Salina, Utah 84654

Prepared by

MERRICK & COMPANY
Engineers and Architects
P. O. Box 22026
(10855 East Bethany Drive)
Denver, Colorado 80222

Reference: 197-2904

merrick
and company
engineers and
architects

10855 east bethany drive
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denver, colorado 80222
(303) 751-0741

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(303) 878-5058

crested butte, colorado
(303) 349-5313

September 17, 1979

Mr. Kerry Frame
Chief Engineer
Southern Utah Fuel Company
P. O. Box P
Salina, Utah 84654

Subject: Drainage Facilities and Sediment Control Plan for the Southern Utah Fuel Company, Mine No. 1

Dear Kerry:

Submitted herewith is a report describing our recommendations for drainage facilities at the Southern Utah Fuel Company, Mine No. 1.

We suggest collecting runoff, from the disturbed area, at the toe of the slope and piping it to a sedimentation pond. This pipe will be transitioned to an open channel in two areas to collect runoff from the two coal dumping areas.

We feel that these measures will minimize any adverse impact on East Spring Canyon resulting from operations of the Southern Utah Fuel Company, Mine No. 1.

REGISTERED PROFESSIONAL ENGINEER
No. 5016
DUANE M JOHNSON
STATE OF UTAH

Very truly yours,

MERRICK & COMPANY

Duane M. Johnson

Duane M. Johnson
Utah P.E. #5016

Mark W Glidden

Mark W. Glidden

MWG/kar

Site Location

The Southern Utah Fuel Company Mine Number 1 is located in Sevier County, Utah about 24 miles east of Salina. The mine lies in Section 12 of Township 22 South, Range 4 East, Utah Meridian.

Hydrology

The total upstream drainage basin contributing flows to the mine site is approximately 8 square miles in area. This basin consists of two major drainageways, Mud Spring Hollow and East Spring Canyon.

Mud Spring Hollow contributes flows from the west of the site. This drainage basin is approximately 3 square miles in area and nearly rectangular with a length of 3.3 miles and a width of 1 mile. A 10 year - 24 hour storm event for this basin results in a rainfall of 1.88 inches and a peak runoff of 147 cfs. 42"cmp

East Spring Canyon contributes flows from the east part of the total drainage basin. This sub basin is highly irregular in shape and has an area of 5 square miles. A 10 year-24 hour storm event results in a peak runoff of 247 cfs. 72"cmp

Rainfall data for this report was obtained using the NOAA Atlas for Utah (Ref. 1). The runoff for the various storms was determined by SCS procedures using rainfall and runoff curve numbers. These methods are described in References 2 and 3. The curve numbers for the various soil types used in this method were determined by talking to the soil scientist and hydrologist for the Fishlake National Forest. The Soils Map shows the various soil types and their locations. A composite curve number was obtained by taking a weighted average of the individual soil types. Reference 4 gives soils information for the basin.

Drainage Plan

Flows from the two tributary streams are diverted under the fill area by two large corrugated metal pipes. Mud Spring Hollow flows into a 42" diameter CMP. This pipe will require paving on the bottom 25% of the pipe and an addition of 4 feet to the headwall in order to pass the flow. These conclusions were arrived at using Manning's equation and nomographs to find required headwater, found in Chow's book, Reference 5, and Bureau of Public Roads publications, Reference 6.

The flows in East Spring Canyon are carried by a 72" diameter CMP. This pipe can handle the flows as well as the combined flows after the two pipes combine. This pipe will be extended to avoid having water run down the slope of the fill area.

A small interception ditch will be constructed in the maintenance road to the transformer. This ditch will divert flows from undisturbed areas to the east of the site and prevent them from passing through the disturbed area. These flows will be collected in a pipe and flow under the road and into a drainage way that will guide it to East Spring Canyon downstream of the fill area.

A water surface profile, Reference 7, has been performed to insure that no adverse effects are caused by the sedimentation pond or other work near the stream.

Sedimentation Control Plan

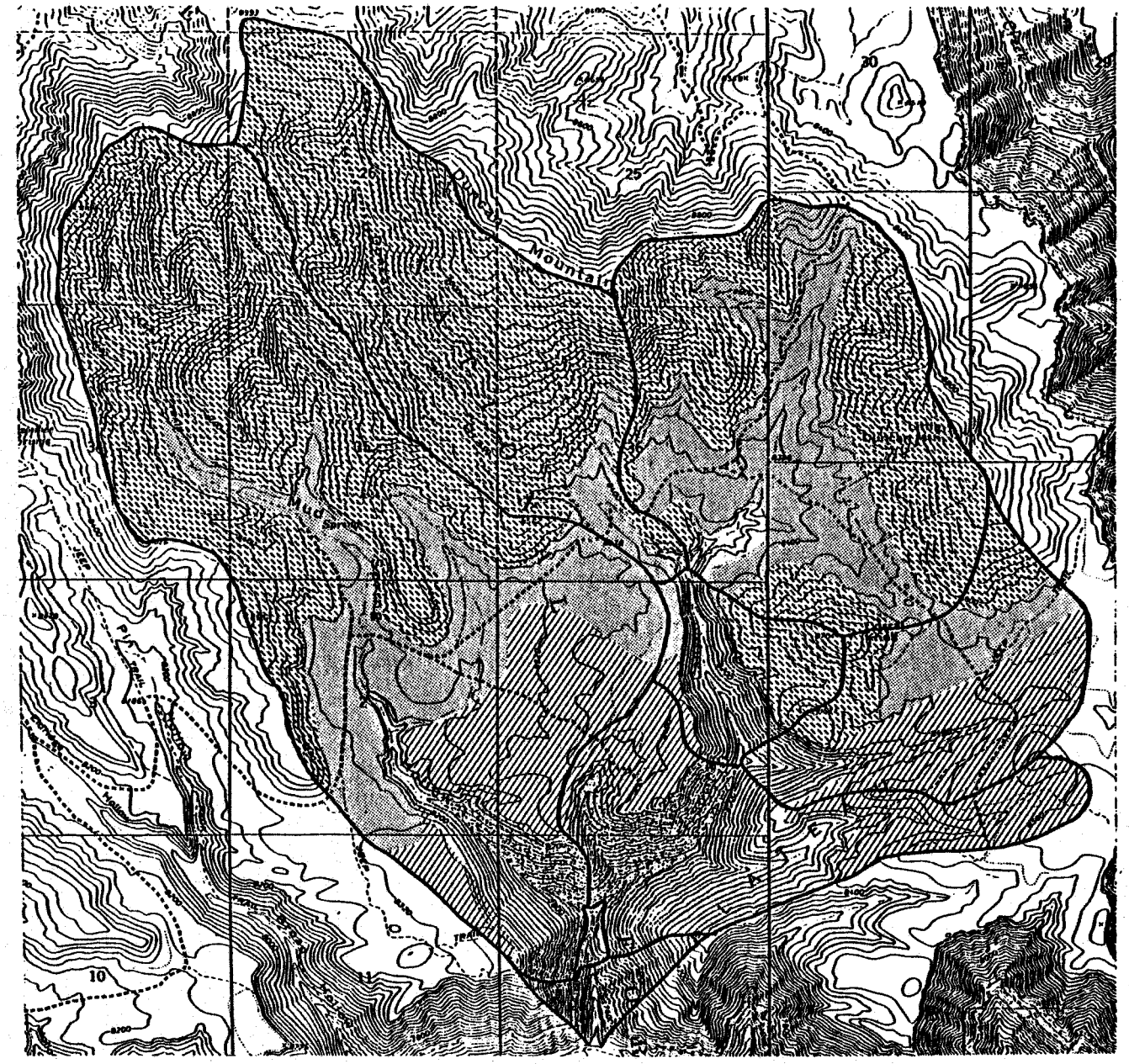
Sediment volume from the disturbed area was determined using the 0.1 Acre Feet/Acre criteria described in 30CFR715 and 717 as published in Federal Register, Vol. 43, No. 220 - Tuesday, November 14, 1978 and Part 817 - Permanent Program Performance Standards-Underground Mining Activities. All other designs in this plan and the drainage plan are also in accordance with these regulations.

The 0.1 Acre Feet/Acre criteria was used because no method of estimating actual sediment volume can be applied to basins as steep or long as the basins at the Southern Utah Fuel Company Mine Number 1.

Runoff from the fill area (disturbed area) as well as the tributary basin to the west is collected by an inlet structure on the fill and piped down the slope to an impact stilling basin (Reference 8) where energy is dissipated. This flow is combined with flow that runs off the slope area directly. This combination of flows is concentrated by a concrete wall and is forced into a pipe that carries it along the side of the canyon to a sedimentation pond. This pipe will be transitioned to an open channel at two locations to allow sediment and runoff from two coal slide areas to be collected and routed to the sedimentation pond. This pipe will be laid slightly below grade in an approximately 10 foot wide R.O.W. along the colluvium.

The sedimentation pond was sized to store the entire 10 year - 24 hour storm runoff and 0.1 Acre Feet/Acre of sediment from the disturbed area. The embankment will be a zoned embankment with an impervious core and rip-rap outer shell. The upstream and downstream embankment slopes are both 3 horizontal to 1 vertical. A spillway was sized to pass the 25 year - 24 hour storm with a freeboard of 1 foot above the water surface. A principle spillway was designed above the maximum volume of sediment to be expected. This is a gated outlet that will insure no runoff receives less than the required 24 hour detention time. A similar gate has been installed at the bottom of the pond to facilitate dewatering the pond after the sediment has been removed.

A complete plan set showing details and designs of all structures associated with the plan has been prepared. Hydrologic and hydraulic calculations are included in this report and follow.



SOILS MAP

LEGEND

- (11) SANDY LOAM SURFACE; GRAVELLY LOAMY SAND SUBSTRATUM OVERLYING SANDSTONE BEDROCK
- (15) SURFACE LOAMS; SANDY LOAM SUBSURFACE
- (20) SURFACE SILT LOAMS; SUBSOILS GRAVELLY LOAMS & CLAY LOAMS
- (21) THIN LOAMY SURFACE W/STONES & COBBLES; SILTY CLAY LOAM SUBSTRATUM
- (22) LOAMY SAND TO SANDY LOAM SURFACE; LOAMY SAND SUBSTRATUM

REFERENCE: LAND SYSTEMS INVENTORY, SALINA PLANNING UNIT, FISHLAKE NATIONAL FOREST, RICHFIELD, UTAH. A Basic Inventory for Planning and Management, 1975

REFERENCES

1. U.S. Department of Commerce, National Oceanic and Atmospheric Administration, Precipitation - Frequency Atlas of the Western United States; Volume VI - Utah; National Weather Service, Silver Springs, Maryland; 1973.

2. U.S. Department of Agriculture, Soil Conservation Service, SCS National Engineering Handbook, Section 4, Hydrology; SCS, August, 1972.

3. U.S. Department of Agriculture, Soil Conservation Service, Urban Hydrology for Small Watersheds, Technical Release No. 55; SCS, January, 1975.

4. Fishlake National Forest, Land Systems Inventory, Salina Planning Unit, Fishlake National Forest, Richfield, Utah, A Basic Inventory for Planning and Management; Fishlake National Forest, Richfield, Utah, 1975.

5. Chow, Ven Te, Open-Channel Hydraulics; McGraw-Hill Book Company; 1959.

6. U.S. Department of Commerce, Bureau of Public Roads, Hydraulic Engineering Circulars No.'s 5 and 10; Bureau of Public Roads; April, 1964.

7. U.S. Army, Corps of Engineers, HEC-2 Water Surface Profiles, Users Manual; Hydrologic Engineering Center; October, 1973.

8. U.S. Department of the Interior, Bureau of Reclamation, Design of Small Canal Structures; Bureau of Reclamation; 1974.

9. Environmental Protection Agency, Technology Transfer, Erosion and Sediment Control, Surface Mining in the Eastern U.S., Vol. 2; E.P.A.; October, 1976.

10. U.S. Department of the Interior, Bureau of Reclamation, Design of Small Dams, Bureau of Reclamation, 1974.

APPENDIX

HYDROLOGIC AND HYDRAULIC CALCULATIONS

DESCRIPTION OF TABLES

TABLE 1: BASIN TOPOGRAPHIC CHARACTERISTICS

This table gives various quantifiable values for each of the drainage sub-basins.

These values are used to determine factors used in SCS Technical Release No. 55, Table 5-3, specifically T_t and Time of Concentration.

Time of Concentration (T_c) is defined as the time it takes for rainfall hitting the farthest point in the basin to reach the bottom point in the sub-basin. This value is based on length, slope and type of flow.

Time of Travel (T_t) is defined as the time it takes flow to reach the design point from the bottom of the sub-basin. The design point is the upstream end of the mine site.

TABLE 2: HYDROGRAPH AT A GIVEN TIME (CSM/IN)

This table gives the hydrographs for each basin in cfs/sq. mi/in. These values are interpolated from Table 5-3 of TR55.

These values are then used in the equation $q=q_pAQ$ where q is the discharge at a given time, q_p is the interpolated value given in this table, A is the area of the sub-basin in square miles and Q is the runoff in inches based on the curve number and the rainfall event.

TABLES 3, 4 & 5:

These tables give peak flow hydrographs for each sub-basin in cfs for the 10, 25 and 100-year storm respectively. They also total the flows at both the upstream end of the site and the junction with Convulsion Canyon. A conservative value of flow at the mine site plus DWN 1 is used for the hydrograph at the junction.

TABLE 6:

This table gives summaries of the peak flows in CFS and volumes of sediment and runoff in Acre Feet for the 10, 25 and 100-year - 24 hours storm events.

HYDROLOGIC CALCULATIONS

The SCS Runoff Curve Number Method was used to determine the runoff for the 10, 25, and 100-year 24 hours storm events. This method is outlined in the SCS publications, Section 4, Hydrology and Technical Release 55. The rainfall was determined using the NOAA Atlas 2, Vol. VI Utah. Curve Numbers were determined after conversations with the staff Hydrologist and Soil Scientist at the Fishlake National Forest. The values for different soils types (outlined on Soils Map) were averaged to determine the composite Curve Number.

The drainage basins are shown on the enclosed Drainage Basin Map. The sediment producing areas are outlined on the Plan Views included in the plan set. Because of the steepness of the sediment producing areas, the Universal Soil Loss Equation was deemed unsatisfactory, and .1 Acre Feet/Acre of sediment from the disturbed area was used to calculate the sediment storage required.

DATA DERIVED FROM

NOAA Atlas 2
Precipitation-Frequency Atlas of the Western United States

Volume VI - Utah
U. S. Department of Commerce
NOAA 1973

AREA OF BASIN

8.1 square miles

POINT RAINFALL VALUES

2 yr. - 6 hr.	.875 in.
100 yr. - 6 hr.	1.94 in.
2 yr. - 24 hr.	1.18 in
100 yr. - 24 hr.	2.90 in.

CONVERSION FACTOR FOR AREAL CORRECTION FOR ENTIRE BASIN

.99

2 yr. - 24 hr.	1.17 in.
100 yr. - 24 hr.	2.87 in.

From Figure 6:

10 yr. - 24 hr.	1.88 in.
25 yr. - 24 hr.	2.25 in.
50 yr. - 24 hr.	2.60 in.

TABULAR RAINFALL - 24 HR. STORM

Event	Depth
2	1.17
10	1.88
25	2.25
50	2.60
100	2.87

LANDTYPE	AREA	1 PERCENTAGE	2 CN	1x2
11	1.00	.12	50	6.00
15	4.15	.51	75	38.25
20	1.75	.22	78	17.16
21	0.25	.03	70	2.10
22	0.86	.11	70	7.70
23	0.09	.01	85	0.85
CN				72.06

USE CN 72

TABLE 1

BASIN TOPOGRAPHIC CHARACTERISTICS

Basin	Area	Lolf	Solf	Volf	Tolf	Lch	Sch	Vch	Tch	T_c sec/hr	T_t Mine
MSH1	3.08	1600	.20	4.0	400	18900	.06	3.0	6300	6700/1.9	0
ESC1	1.39	4400	.07	2.4	1830	11400	.04	2.5	4750	6580/1.8	.68
ESC2	1.63	2200	.35	5.5	400	7300	.05	2.7	2700	3100/.86	.68
ESC3	0.30	2700	.25	4.5	600	4000	.07	3.3	1210	1810/.50	.34
ESC4	0.72	4200	.11	3.0	1400	6200	.09	3.7	1680	308/.86	.34
ESC5	0.80	1600	.22	4.3	370	9200	.11	4.1	2240	2610/.72	0
DWN1	0.12	2500	.41	5.8	430	1900	.15	4.8	400	830/.23	-
TOTAL	8.04										

Basin

MSH	Mud Spring Hollow
ESC	East Spring Canyon
DWN	Downstream Basin

Area

Drainage Sub Basin Area in Square Miles

Lolf

Length of Overland Flow to Channel (Ft)

Solf

Slope of Overland Flow to Channel (Ft/Ft)

Volt

Velocity of Overland Flow Based on Slope and Land Cover from SCS TR55 (Ft/Sec)

Tolf

Time of Overland Flow Travel Lolf/Volf (Sec)

Lch

Length of Flow in Channel to Bottom of Basin (Ft)

Sch

Slope of Channel from Beginning to Bottom of Basin (Ft/Ft)

Vch

Velocity of Flow in Channel Based on Slope and Channel Form (Ft/Sec)

Tch

Time of Travel in Channel. Lch/Vch (Sec)

T_c

Time of Concentration for Sub Basin. Tolf + Tch. Time for Rainfall Striking Furthest Point in Basin to Reach Bottom of Sub Basin. (Sec and Hr)

T_t Mine

Time of Travel of the Flood Wave from Bottom of Sub Basin to Top of Mine Site (Hr)

RUNOFF INFORMATION

CN Information based upon information obtained from Fishlake National Forest's Hydrologist and Soil Scientist as well as Engineer's Field Inspection.

CN = 72 (CN = 80 for Disturbed Area)

Event	Rainfall	Runoff	Disturbed Runoff
2 yr.	1.17	0.03	0.14
10 yr.	1.88	0.24	0.49
25 yr.	2.25	0.40	0.72
50 yr.	2.60	0.58	0.96
100 yr.	2.87	0.74	1.16

Runoff Determined from NEH Section 4

TABLE 2

HYDROGRAPH AT A GIVEN TIME (CSM/IN)

BASIN	11.8	11.9	12.0	12.1	12.2	12.3	12.4	12.5	12.6	12.7	12.8	12.9	13.0	13.2	13.5	14.0	14.5	15.0
MSH1	32	42	55	72	91	109	130	148	167	179	187	194	199	192	171	123	88	64
ESC1	12	14	17	22	28	38	49	63	80	98	117	135	151	175	194	169	123	86
ESC2	18	20	26	35	51	74	107	146	187	225	255	276	283	268	208	115	69	48
SEC3	44	74	131	214	299	363	389	380	347	305	260	219	183	129	84	53	41	34
ESC4	30	43	66	102	148	198	244	279	298	302	293	275	252	201	139	83	53	41
ESC5	103	174	263	342	383	388	364	318	269	226	190	161	138	104	74	50	39	33
DWN1	454	733	646	457	283	194	152	129	110	90	78	73	69	58	50	40	34	29

TABLE 3

10 YR. FLOW HYDROGRAPHS (CFS)

BASIN	11.8	11.9	12.0	12.1	12.2	12.3	12.4	12.5	12.6	12.7	12.8	12.9	13.0	13.2	13.5	14.0	14.5	15.0
MSH1	24	31	41	53	68	81	96	109	124	132	139	143	147	142	126	91	65	47
ESC1	4	4	5	7	10	12	16	21	27	33	39	45	51	59	65	56	41	28
ESC2	7	8	10	13	20	29	42	57	73	88	100	108	111	105	82	45	27	19
ESC3	4	5	10	15	21	26	28	28	25	22	19	16	13	9	6	4	3	3
ESC4	5	7	12	18	26	34	42	48	53	53	51	47	44	35	24	14	9	7
ESC5	20	34	51	66	74	75	70	61	52	44	36	31	27	20	14	10	7	6
ESC Peak												247						
Total to Mine	64	89	129	172	219	257	294	324	353	371	384	390	393	350	317	220	152	110
DWN1	13	21	19	13	8	6	4	4	4	3	3	2	2	2	1	1	1	1
Total to Junction	77	110	148	185	227	263	298	328	357	374	387	392	395	352	318	221	153	111

TABLE 4

25 YR. FLOW HYDROGRAPH (CFS)

BASIN	11.8	11.9	12.0	12.1	12.2	12.3	12.4	12.5	12.6	12.7	12.8	12.9	13.0	13.2	13.5	14.0	14.5	15.0
MSH1	39	52	68	89	112	135	169	183	205	221	230	239	245	236	211	152	108	79
ESC1	6	8	9	12	15	21	27	35	45	55	65	75	84	97	108	94	68	48
ESC2	12	13	17	23	34	48	70	95	122	146	166	180	185	175	135	75	45	31
ESC3	5	9	15	25	35	44	46	45	42	36	31	26	22	15	10	6	5	4
ESC4	9	13	19	29	43	57	70	73	85	87	85	79	73	58	40	24	15	12
ESC5	33	55	85	109	123	125	116	102	86	73	61	52	45	34	24	161	13	11
ESC Peak												412						
Total at Mine	104	150	213	287	362	430	489	533	585	618	638	651	654	615	528	367	254	185
DWN1	22	35	31	22	14	10	7	6	5	5	4	4	4	3	3	2	2	1
Total at Junction	126	185	244	309	376	440	496	539	590	623	642	655	658	618	531	369	256	186

TABLE 5

100 YR FLOW HYDROGRAPH (CFS)

BASIN	11.8	11.9	12.0	12.1	12.2	12.3	12.4	12.5	12.6	12.7	12.8	12.9	13.0	13.2	13.5	14.0	14.5	15.0
MSH1	73	96	125	164	208	249	296	338	380	408	426	442	453	437	390	280	200	146
ESC1	12	14	17	23	28	39	50	65	83	101	120	139	156	180	199	174	126	88
ESC2	22	24	31	42	62	89	129	176	226	271	307	333	342	324	250	139	83	58
ESC3	9	16	29	47	66	81	86	84	77	67	58	48	41	28	19	11	9	8
ESC4	16	23	35	54	79	105	130	149	158	161	157	146	135	107	74	45	28	22
ESC5	61	103	156	202	227	230	215	188	159	134	113	95	82	62	44	29	23	20
ESC Peak												761						
Total at Mine	193	276	393	532	670	793	906	1000	1083	1142	1181	1203	1209	1138	976	678	469	342
DWN1	40	64	58	41	26	17	13	11	10	8	7	7	6	6	5	4	4	3
Total at Junction	233	340	451	573	696	810	919	1011	1093	1150	1188	1210	1215	1144	981	682	473	345

RUNOFF

Area Top of Fill (ATOF)

L = 1095

S = 15%

Vel = 4 FPS

T_c = .1 Hr.

q_p = 991

Area = 12.0 Acres = .019 Sq. Mi.

Event	Volume Ac Ft	Peak Flow CFS
10	.49	9.2
25	.72	13.6
100	1.16	21.8

Area Slope of Fill (SOF)

L = 310

S = 60%

Vel = 6.2 FPS

T_c = .1 Hr.

q_p = 991

Area = 2.5 Acres = .004 Sq. Mi.

Event	Volume Ac Ft	Peak Flow CFS
10	.10	1.9
25	.15	2.8
100	.24	4.5

DIS = ATOF + SOF

Area Tributary to Disturbed Area

Contributing Basin East (CBE)

To be Diverted Around Site by Access Road - Ditch

No Contribution to Pond

L = 1300

S = 49%

Vel = 6.5 FPS

T_c = .1 Hr.

q_p = 991

Area = 14.9 AC = .023 Sq. Mi.

Event	Peak Flow (CFS)
10	5.5
25	9.3
100	17.1

Contributing Basin West (CBW)

L = 1200

S = 68%

Vel = 7.5 FPS

T_c = .1 Hr.

q_p = 991

Area = 25.4 AC = .04 Sq. Mi.

Event	Volume Ac Ft	Peak Flow CFS
10	.51	9.5
25	.85	15.8
100	1.57	29.3

Coal Slide Areas (CSA)

q_p = 991
Area = 2.57 AC = .004 Sq. Mi.

Event	Volume Ac Ft	Peak Flow CFS
10	.10	1.9
25	.15	2.9
100	.25	4.6

Area Tributary to Pond (ATTP)

q_p = 991
Area = 2.0 AC = .003 Sq. Mi.

Event	Volume Ac Ft	Peak Flow CFS
10	.04	.7
25	.07	1.2
100	.12	2.2

TABLE 6

PEAK FLOWS AND VOLUMES

Event	Basin	Peak Flow	Runoff Volume Ac Ft	Sediment Volume Ac Ft	Total Ac Ft
10	MSH	147			
	ESC	247			
	CBE	5.5			
	CBW	9.5	.51		
	ATOF	9.2	.49	1.20	
	SOF	1.9	.10	0.25	
	CSA	1.9	.10	0.26	
	ATTP	0.7	.04		
	Total to Pond	23.2	1.24	1.71	2.95
25	MSH	245			
	ESC	412			
	CBE	9.3			
	CBW	15.8	.85		
	ATOF	13.6	.72	1.20	
	SOF	2.8	.15	0.25	
	CSA	2.9	.15	0.26	
	ATTP	1.2	.07		
	Total to Pond	36.3	1.94	1.71	3.65
100	MSH	453			
	ESC	761			
	CBE	17.1			
	CBW	29.3	1.57		
	ATOF	21.8	1.16	1.20	
	SOF	4.5	.24	0.25	
	CSA	4.6	.25	0.26	
	ATTP	2.2	.12		
	Total to Pond	62.4	3.34	1.71	5.05

HYDRAULIC DESIGN

There are two large pipes located under the fill which carry the 10 year - 24 hour flow under the fill. The capacity of both the inlet and pipe were determined and some improvements are required.

An existing inlet from the fill area is in place and is currently connected to the large pipes. This pipe will be detached and plugged and a new 24" diameter pipe will replace it and will be extended down the slope to a stilling basin. These flows will combine with flows generated on the slope and be concentrated into a smaller pipe to carry it to the sedimentation pond.

A diversion ditch was sized to intercept flows from undisturbed areas on the west side of the disturbed area.

All hydraulic calculations were performed using Manning's equation, the Bureau of Public Roads Publications 5 and 10, and other commonly used hydraulic equations.

Q	=	Flow cubic feet per second
A	=	Area of flow feet squared
HW	=	Head water feet
D	=	Depth feet
R	=	Hydraulic radius feet
S	=	Slope feet per foot or percent
n	=	Manning's roughness coefficient
W	=	Width feet
H	=	Head over spillway
L	=	Length
Z	=	Slope feet horizontal per 1 foot verticle
L_s	=	Length of pipe within phreatic zone
V_b	=	Bottom velocity of channel
V	=	Average velocity
D_x	=	Stone size at which x% of sample by weight is less than

A 24 inch diameter corrugated steel pipe was sized to carry flows concentrated at the toe of the fill slope to the sedimentation pond. This pipe will be placed slightly below grade and covered. It was felt this would minimize any permanent damage to the environment.

In order to collect runoff from the two coal slide areas, the closed pipe will be transitioned into one half of a 36 inch diameter corrugated steel pipe. This pipe will be transitioned, back into the closed 24 inch pipe, with a small drop to maintain the energy grade line. All calculations for the design of these structures are included in the hydraulic calculations.

HYDRAULIC CALCULATIONS

Large Pipe Flows

72" Dia Q = 247 cfs
42" Dia Q = 147 cfs

72" Dia Inlet CMP
Q = 247 cfs
HW/D Req = 1.18
HW = 7.1 Ft
Available HW = 12 Ft

Capacity $Q = \frac{1.49}{n} AR^{2/3} S^{1/2}$
A = 28.3 Sq Ft R = 1.5 Ft S = 0.042 Ft/Ft n = 0.027
Q = 419 cfs
Q req. after Junction = 393 cfs Good

42" Dia Inlet CMP
Q = 147 cfs
HW/D req = 3.2
HW = 11.2 Ft
Available HW = 7.2 Ft, No Good
Add 4 Ft to headwall, continue steel and concrete

Capacity $Q = \frac{1.49}{n} AR^{2/3} S^{1/2}$
A = 9.62 Sq Ft R = 0.87 Ft S = 0.07 Ft/Ft n = 0.027
Q = 128 cfs, No Good
Pave bottom 25% n = 0.023
Q = 150 cfs, Good

Top of Slope Inlet

Existing inlet HW = 18" Pipe = 12" Dia
Q = 23.2 cfs, Not enough head available

Try new 24" Dia CMP

Orifice Control
HW req = 1.14 Ft = 14", Good
Inlet Control (at bend)
HW req = 2.8 Ft = 34", Good

Pipe Sizing Along Slope

Shallowest slope 0.05
Use unpaved CMP 2-2/3 x 1/2 Corrugations
n = .024
Q = 23.2 cfs
$Q = \frac{1.49}{n} AR^{2/3} S^{1/2}$

Size	A	R	Q		
18	1.77	0.375	15.5	No Good	
24	3.14	0.50	27.5	Good	V = 8.75 fps
21	2.41	0.44	19.3	No Good	
Q/Q Full = .84		V = 9.8 fps		D = 1.23 ft	

S	Q Cap	V Cap	Q/Q Cap	V	d
0.215	52.3	16.6	0.44	9.4	0.92
0.135	41.4	13.2	0.56	13.5	1.06
0.120	39.1	12.4	0:59	12.9	1.10

Open Channel Part - Collection of Coal Slide Areas

Try 1/2 - 36 inch diameter CMP @ 0.05
Q Cap = 81.0 cfs V Cap = 11.5 fps
Q/Q Cap = .29 V = 10.0 fps y = 1.11 ft

Find Drop Required at Transition from Open Channel

$E_1 = E_2\ th_L - \Delta Z$ Sta 3+79.68 to Sta 5+19.47

h_L = head loss in transition

ΔZ = drop required through transition

$$h_L = .2\left(\frac{V_2^2}{2} - \frac{V_1^2}{2g}\right)$$

$y_1 = 1.11$ ft $y_2 = 1.23$ ft

$V_1 = 10.0$ fps $V_2 = 9.8$ fps

$E_1 = 2.66$ ft $E_2 = 2.721$

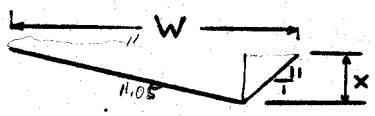
$h_L = 0.012$ ft

$\Delta Z = 0.07$ ft

Continue second pipe into pond with Class II rip-rap erosion layer

Interception Ditch (Access Road to Transformer)

Q = 6.2 cfs W = 12 ft
S = 1.1% Minimum
Design as triangular open channel



$$Q = \frac{1.49}{n} AR^{2/3} S^{1/2} \qquad n = 0.035$$

X	A	R	Q	
1	6	0.46	16	
0.7	4.2	0.34	9.2	
0.6	3.6	0.29	7.1	Good use this

Berm on Fill Area

Prevents flow from going down fill slope

Top Width = 4 ft
Side Slopes 3:1
Height = 1 ft

Spillway Sizing (Sedimentation pond)

Q = 36.3 cfs 25 yr - 24 hr flow

$Q = CLH^{3/2}$ C = 3.0 L = 30 ft

H = .55'

Anti-Seep Collars

L = 63 ft outlet pipe
S = 5%
y = 5 ft head above inlet to pipe
Z = 3 upstream embankment slope

$$L_s = y(Z + 4)\left[1 + \frac{S}{0.25 - S}\right] = 44'$$

Anti-Seep Collar size = 3'-4" x 3'-4" with 3 collars
space collars at 8'cc

Rip-Rap Sizing in East Spring Canyon

V_b = 9.81 (based on velocity and depth in natural stream)

D_{50} req = 15" Class II Rip-Rap

Filter Sizing

Existing Soil

d_{85} = 0.37 mm
d_{50} = 0.135 mm
d_{15} = 0.017 mm

Filter Layer 1

$DF_{1\,15} \leq 5d_{85}$	$DF_{1\,15} \leq 1.85$ mm	$DF_{1\,15} = 0.50$ mm
$DF_{1\,15} \geq 5d_{15}$	$DF_{1\,15} \geq 0.085$ mm	$DF_{1\,50} = 1.50$ mm
$DF_{1\,50} \leq 25d_{50}$	$DF_{1\,50} \leq 3.38$ mm	$DF_{1\,85} = 3.50$ mm
$DF_{1\,15} \leq 40d_{15}$	$DF_{1\,15} \leq 0.68$ mm	

Filter Layer 2

$DF_{2\ 15} \leq 17.50$ mm $DF_{2\ 15} = 7.0$ mm
$DF_{2\ 15} \geq 2.50$ mm $DF_{2\ 50} = 23.0$ mm
$DF_{2\ 50} \leq 37.50$ mm $DF_{2\ 85} = 55.0$ mm
$DF_{2\ 15} \leq 20.00$ mm

Rip-Rap Limits

$RR_{15} \leq 275$ mm
$RR_{15} \geq 35$ mm
$RR_{50} \leq 575$ mm
$RR_{15} \leq 280$ mm

Stilling Basin for Pipe from top of fill

Q = 23.2 cfs in 24" Dia CMP
S = 51% Down Face of Slope
S = 15% Final 30' into stilling basin

$Q\ Cap = \frac{1.49}{n} AR^{2/3} S^{1/2}$ n = 0.027 $A = 3.14\ Ft^2$ R = 0.5 Ft S = 0.15

Q Cap = 42.3 cfs V Cap = 13.5 fps
Q/Q Cap = .55 V = 13.9 fps y = 1.1 ft

Froude number = $V/\sqrt{gd}$

where $V = \sqrt{2gh}$

g = acceleration of gravity

h = head loss required

d = A

$V = \sqrt{2g\ (4.1)} = 16.2$

$\sqrt{gd} = \sqrt{g(1.77)} = 7.6$

F = 2.15

W/d = 4.4

W = 7.8 ft - use W = 8 ft

Use Type 5 baffled outlet 103-D-1344